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STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
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April 7, 2020

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R.J. Sherman
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Re: Ecology and Yakama Nation comments on the February 14, 2020 Draft Supplemental Remedial Investigation Work Plan for the Vancouver Port of, NuStar Cadet Swan, Vancouver, Agreed Order 15806, Ecology Facility Site Id: 1026

Dear Patty, Renee, and R.J.:

This letter presents the Department of Ecology (Ecology) and the Yakama Nation comments on the February 14, 2020, Draft Supplemental Remedial Investigation Work Plan (SRIWP). Preliminary comments prepared by Ecology are included in this cover letter and have already been submitted to you in Memorandum form on March 24, 2020.

These comments as well as those provided by Yakama Nation were discussed at the March 25, 2020, joint meeting. Additional language has been added to better explain the preliminary comments. The comments provided here take the place of the preliminary comments.

The comments from the Yakama Nation (attached) are included with this letter so all comments can be found in one document. Detailed comments on the work plan text are attached to this letter.

General Topics

It appears there could be metals and fertilizer contamination in groundwater to the north and west of MW-10 and MW-26. Ecology's preliminary comments requested groundwater characterization to the north and west of these wells. It was indicated during the March 25, 2020, joint meeting that characterization sampling would be part of the Phase 2 work.

Establish screening levels for all compounds and media in this document. The screening levels should be at least as low as the anticipated cleanup levels for the contaminants being evaluated at the site. Ecology will assist with preparation of these screening levels including those for sediment.

Obtaining sediment background levels for fertilizer products would be of great aid for establishing screening levels. Ecology is recommending 5 to 7 sediment samples be collected from areas not influenced by fertilizer operations. Prospective areas for that sample collection should be added to the sediment-sampling portion of the work plan.

Figure 2 presents "Project Area" and "Investigation Area." Ecology prefers the use of "Investigative Area," for the Work Plan. "Project Area," is vague. Also on this same figure, please indicate the dividing line between Terminals 2 and 3. Please include the location of the storm water pond outfall at Berth 9.

One nitrate concentration contour is provided on Figure 5. In addition to that contour, please provide additional concentration contours for 200 and 400 milligrams per liter.

It appears from nitrate concentrations at MW-8 and nitrate and ammonia concentrations at MW-21i that additional shallow groundwater characterization will be needed north of MW-8. It was indicated during the March 25, 2020, joint meeting that characterization sampling would be part of the Phase 2 work.

For surface water and groundwater samples, please collect and analyze for total and dissolved metals.

Figures 10 and 11

There is a disparity between what is described on page 46 for potential pathway for ingestion and direct contact for fishers and surface water and what is marked on Figures 10 and 11 under surface water (Columbia River).

- Wouldn't there be an "X" for occupational worker, i.e., fishers on Figures 10 and 11?
- Isn't there an exposure to occupational workers in the vicinity of the storm water pond?

Figure 17

In an effort to obtain the best results regarding metals source assessment, Ecology is recommending that the groundwater flow direction be determined or indicated prior to collection of grab groundwater samples in the vicinities of MW-9 and MW-10. The direction of groundwater flow may help determine the placement of the grab sample boring locations.

Figure 18

Is there a reason the soil sampling is only proposed for the south side of the railroad-unpaved area? It would seem that the north side of the unpaved area will need to be characterized anyway because of the air transport pathway, whether it is during Phase 1 or Phase 2.

Section 2.1.1.2, 2nd Paragraph

The location of product handling areas is an important part of the background information. The location of all truck loading/unloading racks and the rail tank car loading/unloading area(s) need to be included on a Figure.

Clarify the NuStar facility includes a “marine vessel dock and associated piping.”

- Is this at Berth 5?

Bullets at Top of Page 7: Please include locations of the truck loading facilities at the east end of buildings 2645 and 2655 on a figure if different from the truck racks mentioned above.

Section 2.1.1.3, 2nd Paragraph under Historical Fertilizer Operations (1968–2008)

Phosphorous and potassium should be investigated to determine if either is a contaminant of concern.

Two receiving stations are referenced and it is unclear if these are the same as the warehouse pits.

There were three pits; two remain operational – Is that correct?

- What is the construction of each pit?
- Are there any drains in the pit bottoms?

Fertilizer has been handled at Berths 3, 8, and 9.

- Have these berths and the areas upland of the berths to the offloading locations always been paved?
- Was any fertilizer handling done in these areas before they were paved?

Berths 3, 8, and 9 are paved docks that extend out over the water. Characterization of sediment beneath the docks is not discussed; please indicate if and how sediment beneath the docks is going to be characterized.

Last Bullet on Page 7: According to Port records, on rare occasions, the fertilizer was loaded to railcars for off-site distribution (Parametrix, 2019a).

- Loaded onto rail cars from which building(s)?
- How was that done?

Page 9: Handling of Chromated Copper Arsenate and Alkaline Copper Quaternary: Give more details on storage and handling locations of these compounds.

Section 4.2.1, Page 59

Ecology disagrees with well redeveloping before collecting grab groundwater samples from borings by MW-9 and 10. Redevelopment is going to change water quality in the formation surrounding the wells redeveloped and potentially allow collection of unrepresentative groundwater results. Grab sampling to determine the contaminant lateral extent should be done before well redevelopment.

Please feel free to contact us with any questions regarding items discussed above.

Sincerely,

Craig Rankine, RG, LHG
Cleanup Site Manager/Hydrogeologist
Toxics Cleanup Program
Vancouver Field Office
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Unit Supervisor Technical Support Unit
Toxics Cleanup Program
Southwest Regional Office
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andrew.smith@ecy.wa.gov

Attachments: Memorandum prepared by Ridolfi on Yakama Nation's behalf, *Comments on the Draft Supplemental Remedial Investigation Work Plan*, dated March 19, 2020.

Ecology comments on Draft Supplemental Remedial Investigation Work Plan Text

Ecology comments on Appendix F – Sampling and Analysis Plan

cc: Stephanie Salisbury, Cascadia Associates LLC (by email: sbsalisbury@cascadiaassociates.com)
Scott Heidegger, Kinder Morgan (by email: scott_heidegger@kindermorgan.com)
Nate Hemphill, Antea Group (by email: nate.hemphill@anteagroup.com)
Kevin McCarty, Antea Group (by email: kevin.mccarthy@anteagroup.com)
Richard Roche, Parametrix Inc., (by email: rroche@parametrix.com)
Jessica Saltzman, Ridolfi (by email: jessica@ridolfi.com)
Laura Shira, Yakama Nation (by email: shil@yakamafish-nsn.gov)
Amanda Spencer, Cascadia Associates LLC (by email: aspencer@cascadiaassociates.com)
Kevin Hancock, Ecology Water Quality Program (by email: kevin.hancock@ecy.wa.gov)
Joyce Mercuri, Ecology Toxics Cleanup Program (by email: joyce.mercuri@ecy.wa.gov)
Ecology Site File

RIDOLFI Environmental

M E M O R A N D U M

DATE: March 19, 2020

TO: Laura Shira and Rose Longoria
Yakama Nation

FROM: Jessica Winter-Stoltzman and Bill Beckley

SUBJECT: **Comments on the Draft Supplemental Remedial Investigation Work Plan NuStar Vancouver Main Terminal, Vancouver, Washington**

Background

Cascadia Associates, LLC (Cascadia), Antea Group, and Parametrix submitted a draft Supplemental Remedial Investigation Work Plan (SRIWP) for the NuStar Vancouver Main Terminal in Vancouver, Washington on February 14, 2020. The plan was submitted to the Washington State Department of Ecology (Ecology) on behalf of NuStar Terminals Services, Inc., Kinder Morgan, and Port of Vancouver. The plan discusses sampling and analysis to be conducted in 2020 to supplement previously collected data to characterize the project area for remedial design. This memorandum provides RIDOLFI, Inc.'s (Ridolfi) review of the SRIWP on behalf of Yakama Nation (YN).

Comments

1. Section 2.1.1 describes storage of fertilizer in pits. Please describe the pits. Were the pits lined?
2. Section 2.1.1 states the smaller warehouse is used to store material scraped from the ship bottom and/or floor bottom. Please clarify what is meant by floor bottom. Does this refer to the floor of the other warehouses?
3. Section 2.1.1.3 describes the dates of solvent handling inconsistently. It says "The records suggest that handling of chlorinated solvents may have ended as early as 1990, but the end date is uncertain." It also says "solvent handling ended almost 30 years ago," which gives an impression of greater certainty around the end date. Please clarify what information is available to support the end date.

4. Section 2.1.1.4 describes maintenance, cleaning, and handling practices at the NuStar Leasehold. Understanding that there may be variation among the multiple practices, is it possible to give a general date when these were initiated? For the purposes of evaluating potential releases and necessary sampling, it would be helpful to understand if these are relatively recent or long-standing practices.
5. The description of groundwater flow in the shallow unconsolidated sedimentary aquifer in Section 2.2.2.2 is confusing. "Prior to operation of the SMC groundwater pump and treat interim action (GPTIA), groundwater flow in the shallow USA zone at the SMC and Cadet sites was toward the southeast." "Groundwater flow in the shallow zone beneath the Cadet site is now to the southeast due to the operation of the GPTIA at the SMC site." If the flow is the same before and after the GPTIA, it is confusing to say it is due to the operation of the GPTIA. Please confirm if "southeast" is correct in both cases, or if this was intended to say that there has been a change in groundwater flow.
6. Section 2.3 states: "in the case of portions of the KMBT Operations Area, *wastewater* is managed by a wastewater treatment system" (emphasis added). Should this say stormwater?
7. Section 2.3.1 references the stormwater permits that applied from 2003 to 2012. Please add a similar description for earlier dates, if applicable.
8. Section 2.6 (potential receptors) fails to mention drinking water. Since the Columbia River in the vicinity of the site includes domestic water supply as a designated use, human exposure through surface water ingestion should be identified as a pathway.
9. Section 3.1.3 identifies "aquatic receptors - ingestion and/or direct contact with surface water and/or sediments that have been impacted by metals COPCs potentially transported to these media via stormwater, direct releases, or groundwater" as a potentially complete pathway, but lists as an incomplete pathway "Aquatic receptors via exposure (inhalation, contact, or ingestion) of outdoor air, on-site surface soil, or on-site groundwater containing copper concentrate COPCs." Please clarify how these groundwater pathways differ. What is meant by aquatic receptors exposure to on-site groundwater?
10. The bullets at the end of section 3.2.3 refer to copper concentrate, but should presumably refer to fertilizer. Please confirm and modify if necessary.
11. Section 3.3.2.1 summarizes historical data for soils. It would be useful to show the previous soil sampling on a map, as is done on Figure 17 for groundwater. In particular, it would be useful to see if there has been previous sampling in the area under the conveyor near where the gutter investigation found that copper was escaping the closed conveyor system. Please include the previous soil sampling locations on a map.

12. Section 3.3.2.3 references Sample Location 43. This did not appear to be included on Figure 18. Please confirm and add if needed.
13. Section 3.3.3.1 references two areas shown on Figure 19 that have not been historically sampled for copper or fertilizer. It's not clear from the figure or text what the two areas are. Does this mean west of berth 7 and east of berth 7? Please clarify.
14. Section 3.3.3.2 notes that the objectives for sediment investigation are to determine whether contaminants are present in sediment at potential concentrations of concern. Section 3.3.3.4 states that concentrations will be compared to applicable regulatory levels, and the PLPs will work with Ecology to identify the appropriate sediment screening levels to use. We are concerned that the freshwater sediment chemical criteria in the state Sediment Management Standards (SMS) may not reliably predict toxicity because of conditions that may be present where the VOC plume is co-mingled with metals contamination. Where such conditions exist alternative methods for characterizing benthic community toxicity may be required [WAC 173-204-263(2)]. We recommend toxicity testing through bioassays be considered to evaluate these areas.
15. Section 3.3.5 notes that stormwater sampling will not be conducted in this phase and regular stormwater monitoring occurs under National Priority Discharge Elimination System (NPDES) permits. Please reference the sampling plans. It would be useful to know where they sample and for what analytes.
16. Groundwater monitoring is planned to assess whether contaminant concentrations taper with distance from the well. However, samples 22, 23, and 24 are located in a line with some upgradient and some downgradient of MW10. Will the groundwater flow direction complicate interpretation of the results? What depths are proposed for the borings?
17. Section 4.5.1 should be expanded to identify the analytes and methods.

DRAFT Supplemental Remedial Investigation Work Plan

NuStar Vancouver Main Terminal
2565 NW Harborside Drive
Vancouver, Washington

Prepared for:

NuStar Terminals Services, Inc./Kinder Morgan/Port of Vancouver
February 14, 2020

Prepared by:

Cascadia Associates, LLC
5820 SW Kelly Avenue, Suite B
Portland, Oregon 97239

Antea Group
One World Trade Center
121 Southwest Salmon Street, 11th Floor
Portland, Oregon 97204

Parametrix
700 NE Multnomah Street, Suite 1000
Portland, Oregon 97232

DRAFT

Supplemental Remedial Investigation Work Plan

NuStar Vancouver Main Terminal

2565 NW Harborside Drive

Vancouver, Washington

Prepared for:

NuStar Terminals Services, Inc./Kinder Morgan/Port of Vancouver

November 2019

Prepared by:

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DRAFT

Stephanie Bosze Salisbury, R.G.

Sr. Associate Geologist, Cascadia Associates, LLC

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DRAFT

Kevin McCarthy, R.G.

Consultant, Antea Group

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Richard Roche, LHG

Senior Project Manager, Parametrix

DRAFT

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1.0 INTRODUCTION

On behalf of the Port of Vancouver, U.S.A. (Port), NuStar Terminals Services, Inc. (NuStar), and Kinder Morgan Bulk Terminals, LLC (KMBT), Antea Group, Parametrix, and Cascadia Associates LLC (Cascadia) have prepared this combined Supplemental Remedial Investigation Work Plan (SRIWP) to describe investigative activities to be conducted in support of a Supplemental Remedial Investigation (RI) at portions of the Port that include the NuStar Leasehold and the KMBT Operations Area (Location Map [Figure 1]).

This SRIWP was prepared in accordance with the Model Toxics Control Act (MTCA) as defined in Washington Administrative Code (WAC) 173-340-350 and pursuant to Agreed Order (AO) No. DE 15806 ("AO DE 15806") between the Washington State Department of Ecology (Ecology) and the Port, NuStar, and KMBT (the "Parties"). AO DE 15806 requires the Parties to conduct a Supplemental RI for certain hazardous substances which may include, but are not limited to, ammonia, nitrate, copper, and other metals.

AO DE 15806 identifies the Site as the "Vancouver Port of NuStar Cadet Swan," Facility Site Identification (FS-ID) 1026. As detailed in AO DE 15806, the Supplemental RI is required on a portion of the Site that is referred to herein as the Project Area. The Project Area includes, but is not limited to, the NuStar Leasehold and KMBT Operations Area. The boundary of the Project Area will encompass the geographic area needed to define the extent of the chemicals of potential concern (COPCs) being assessed in the Supplemental RI. The Supplemental RI will be conducted in phases, as discussed with Ecology in meetings held in July and October 2019. Figure 2 shows the Phase I Investigation Area and identifies the location of the KMBT Operations Area and the NuStar Leasehold.

1.1 OBJECTIVES

The primary objective of this SRIWP is to present the rationale, methods, and scope of work to be conducted to complete the Supplemental RI for portions of the Site, as described in WAC 173-340-350(7)~~8).~~). Per AO DE 15806, this investigation includes an evaluation of materials currently and historically used, handled, or stored at the NuStar Leasehold and KMBT Operations Area, including but not limited to copper and related metals, ammonia, and nitrate. The purpose of the Supplemental RI is to collect the data necessary to adequately characterize the Site for the purpose of developing and evaluating cleanup action alternatives.

While the primary objective of the RI activities proposed herein is to evaluate for the presence and/or extent of copper and related metals, ammonia, and nitrate in Project Area media, Ecology has also requested additional volatile organic compound (VOC) delineation to the west of NuStar monitoring well MW-26 as part of the Supplemental RI.

Commented [SA(1]: VOCs?

Commented [MJ(2]: Should this document be subtitled Phase I so it would be easier to keep track of which document is which in the future?

Commented [RC(3]: Fig 2 – Former Sand Shield should be Shed?
Include label for BERTH 6.
Has copper concentrate storage been in both Bldgs 2745 and 2725?
Please include the division between Terminals 2 and 3 on this figure.

Commented [MJ(4]: The work area should include the outfall at Berth 9

Commented [SA(5]: Project Area and Phase 1 Investigation Area, why two?

Commented [RC(6]: MTCA 350 (8) pertains to FS. (7) refers to RI.

Commented [SA(7]: Discuss all areas at the port where NuStar or KMBT materials are currently or historical handled.

1.2 REGULATORY FRAMEWORK

RIs have been conducted by the Port and NuStar to evaluate the nature and extent of VOCs in various media associated with the historical handling and storage of chlorinated solvents at the Swan Manufacturing/Cadet Manufacturing and NuStar facilities, respectively. Results of the RIs for each of the facilities were presented and summarized in the NuStar (Apex Companies, LLC [Apex], 2013a), Swan Manufacturing Company (SMC; Parametrix, 2009), and Cadet (Parametrix, 2010) RI reports. Ecology approved the SMC, Cadet, and NuStar RIs on May 8, 2009; May 26, 2010; and November 6, 2013, respectively. The Port and NuStar worked collaboratively on the Feasibility Study (FS) and submitted an initial draft in 2015 (Apex and Parametrix, 2015). This draft was revised in response to Ecology and other stakeholder comments and was re-submitted to Ecology in December 2016 (Apex and Parametrix, 2016). Ecology met with NuStar and the Port several times during 2017 to refine the FS before approving the document for public comment.

Commented [SA(8]: This is incorrect.

In December 2017, copper was detected in groundwater samples collected from the NuStar facility. While NuStar was not handling products with copper at the time of the groundwater sampling, KBMT was handling bulk dry materials in its operations area, including copper concentrate in powdered form. Ecology issued a Potentially Liable Persons (PLP) status letter to KBMT on May 2, 2018, and after receiving and responding to comments, issued a determination of KBMT as a PLP under RCW 70.105D.040 via letter on July 19, 2018.

In early 2018, Ecology announced that they would also be requiring additional investigation at the NuStar Leasehold to evaluate two additional COPCs, ammonia and nitrate, associated with the historical and current handling of fertilizer at the NuStar facility. Ecology rescinded approval of the NuStar RI in a letter dated January 25, 2018.

Preliminary data indicated that ammonia, nitrate, and copper (and other related metals) have commingled with the solvent plume at the Site. In accordance with MTCA, Ecology prepared AO DE 15806 requiring the Parties to prepare an SRIWP, Supplemental RI report, and FS for hazardous substances, including but not limited to ammonia, nitrate, and copper and related metals. The proposed work scope described herein will be performed pursuant to AO DE 15806 and in accordance with MTCA.

Commented [RC(9]: Instead of Site how about assessing solvent plume portion at areas where NuStar and KMBT have handled materials under investigation.

Technical consultants for each PLP have worked collaboratively to develop this SRIWP and will oversee completion of the Supplemental RI. The consultant leads include:

NuStar
Consultant: Cascadia Associates LLC
Technical Leads: Stephanie Bosze Salisbury, R.G.; Amanda Spencer, R.G., P.E.

KMBT
Consultant: Antea Group
Technical Leads: Kevin McCarthy, R.G.; Nate Hemphill

Port of Vancouver
Consultant: Parametrix
Technical Leads: Richard Roché, LHG; Rick Malin, LHG

Each PLP is responsible for overseeing the implementation of AO DE 15806. To the maximum extent possible, communications between Ecology and the Subject PLPs, and documents, including reports, approvals, and other correspondence concerning the activities performed pursuant this SRIWP shall be directed through the PLPs.

1.3 SRIWP ORGANIZATION

This report is organized as follows:

Section 1: Introduction – provides the regulatory context, defines the Project Area, and describes the general content of the report.

Section 2: Site Background – includes a site description as well as summary of the Site geology and hydrogeology determined from previous investigations as well as literature review. The background section also describes the fertilizer and bulk materials handling in the Project Area, summarizes previous investigations and relevant data collected to date, evaluates the potential receptors in the Project Area, and defines the COPCs for the Supplemental RI.

Section 3: Preliminary Conceptual Site Model (CSM) – summarizes the preliminary conceptual site models for copper and fertilizer constituents which will be evaluated using the data collection proposed in this SRIWP.

Section 4: Scope of Work for Supplemental Remedial Investigation – describes the approach and procedures for investigation of copper/metals, nitrate, nitrite, and ammonia at the Project Area.

Commented [SA(10]: And VOCs?

Sections 5: Summary of Phase I Investigation Report – summarizes the general contents of the Phase I Investigation report and provides recommendation for additional investigation, as necessary.

Section 6: References – lists the references cited in this report.

Appendices are included that provide technical and supporting information.

2.0 BACKGROUND

Commented [MJ(11]: It would be helpful to have a description of the nearshore river environment somewhere in the document – is there a bathymetry map available? Is it muddy, sandy? Steep/flat? How deep?

Commented [MJ(12]: Include a descripton of the dredging history of this area.

Section 2.1 provides site description information for the NuStar Leasehold and the KMBT Operations Area, both of which are leased from the Port. The locations of these two areas are shown on Figure 2. For both the NuStar and KMBT facilities, this SRIWP includes a summary of current and historical materials handling activities.

Section 2.2 provides a synopsis of the geology/hydrogeology in the Project Area as well as the regional geology and hydrogeology.

Section 2.3 describes the stormwater management system in the Project Area, and Section 2.4 summarizes relevant analytical data collected to-date.

In Section 2.5, the list of COPCs for the Supplemental RI is developed based on the information presented in Sections 2.1 through 2.4.

2.1 DESCRIPTION OF NUSTAR LEASEHOLD AND KMBT OPERATIONS AREA

This section provides a description of the KMBT and NuStar facilities, including location, physical features, and historical and current operations.

2.1.1 NuStar Facility

The facility was owned/operated by GATX from the early 1960s through 1998, and was acquired in 1998 by Support Terminals (ST) Services, a subsidiary of Kaneb Pipeline Partners L.P. (Kaneb). Kaneb was acquired in 2005 by Valero L.P., and Valero L.P. changed its name to NuStar Energy L.P. in 2007 and changed the name of ST Services to NuStar Terminals Services, Inc. The terminal property is currently leased by NuStar Terminal Operations Partnership, L.P. and operated by NuStar Terminals Services, Inc.

The NuStar facility was developed to receive, store, and handle bulk fuel and chemicals. Typically, these chemicals were not owned by the facility operator. Rather, the operator entered into agreements as a wholesale distributor to handle chemicals for owners.

2.1.1.1 Location

The NuStar facility is located at the Port Terminal No. 2 in Vancouver, Washington, on property owned by the Port and leased by NuStar. The extent of the NuStar Leasehold is shown on Figure 2. The NuStar facility address is 2565 NW Harborside Drive, Port of Vancouver, Vancouver, Washington 98660 (Latitude: N45º 38.26’; Longitude: W122º 42.20’).

The NuStar facility is located on Clark County Tax Lot (TL) Nos.: 151979-000, 502010-002, 502010-000, and a portion of 502020-000, as well as a portion of the Washington Department of Natural Resources tideland area managed by the Port. A Site Plan of the NuStar leasehold is provided as Figure 3.

2.1.1.2 Physical Features

The NuStar Leasehold is approximately 19 acres located on the north shore of the Columbia River. Land adjacent to the NuStar Leasehold is industrial property also owned by the Port.

The NuStar facility includes five buildings (Port Warehouses Nos. 2645, 2655, 2625, 2585, and 2565), a loading dock at Berth 5, three aboveground storage tank (AST) farms, two tank truck loading/unloading racks, a rail tank car loading/unloading area, marine vessel dock (Berth 5?) with ~~and~~ piping~~,~~ (also Berth 5), and an office (in Warehouse 2565). The ground surface is nearly flat at an elevation typically between 32 and 34 feet above mean sea level (msl).

Commented [RC(13]: The locations for these facilities need to be included on a Figure.

The NuStar facility includes extensive underground utilities. Utilities are within about 12 feet of the ground surface, above the groundwater table.

The ground surface coverage consists of the following (with approximate aerial extent):

- Buildings (35 percent);
- Paved areas (45 percent);
- Tanks (5 percent); and
- Gravel/bare ground (15 percent). The unpaved areas are primarily located along portions of the rail corridor~~.~~ (see Figure 3 for rail locations).

2.1.1.3 Historical and Current Operations

Dry and liquid bulk products are received, stored, and exported from the facility. Previously, dry fertilizer products were also packaged at the facility.

Dry bulk products consist of fertilizers which are received, stored, and handled in the western and central portion of the NuStar Leasehold. Liquid products consist of Jet Fuel A, sodium hydroxide, and calcium chloride, and are handled at the tank farm in the eastern portion of the NuStar Leasehold, in a separate area from where dry bulk products are handled.

Liquid wood preservatives, methanol, and chlorinated solvents were previously stored and handled at the facility.

Historical and current chemical handling is described below.

Summary of Dry Bulk (Fertilizer) Storage and Handling

The Port and NuStar have each prepared memoranda summarizing fertilizer handling activities in the Investigation Area. The Port's memorandum, entitled *Summary of Port Records Related to Historical Fertilizer Operations*, focuses on the fertilizer operations that occur outside of the NuStar Leasehold and summarizes the receipt of fertilizer products via cargo vessels at Port Berths 8 and 9 (and occasionally Berth 3), the offloading by longshoremen, and the transportation of fertilizer products to the NuStar Leasehold (Parametrix, 2019a).

Once the fertilizer product reaches the NuStar Leasehold, NuStar assumes control of handling and management. NuStar's memorandum, entitled *Transmittal of NuStar Fertilizer Handling Memorandum and Clarification Items on Port of Vancouver Technical Memorandum – "Summary of Port Records Related to Historical Fertilizer Operations"*, summarizes the current and historical fertilizer products handled on the NuStar Leasehold, offloading of fertilizer products into terminal warehouses for storage, and loading of trucks for distribution (Cascadia, 2020a). The complete fertilizer handling process, from cargo vessel to departing the NuStar Leasehold, is synthesized from the two memoranda in the section below.

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Historical records indicate that fertilizer handling was conducted over two time periods on the NuStar Leasehold. The first being from 1968 to 2008, and the second between 2014 and the present.

Historical Fertilizer Operations (1968–2008)

Fertilizer Products. The fertilizer products handled at the NuStar Leasehold prior to 2009 consisted of calcium nitrate and Triple 16 (a commercial fertilizer formulation comprised of equal parts phosphorous, nitrogen, and potassium).

Commented [MJ(14]: Have phosphorous or potassium been found in gw? Please investigated to see if should be a COC.

Receipt of Product by Vessel and Transport to NuStar Leasehold. The shipment of dry bulk fertilizers, in prill and crystal form, began in approximately 1968 (Parametrix, 2019a). Fertilizer was transported using the ship's cranes and grab buckets to unload the cargo into hoppers at Terminal 2, Berth 3, and, since 1979, Terminal 3, and Berths 8 and 9. Stevedores hired by the product importer/ship owner/charterer then loaded the product to dump trucks for transport to the NuStar Leasehold at one of two receiving stations in the A-frame warehouses (buildings 2645 and 2655). The material was also offloaded into pits located inside the warehouses. that are still present today. A third pit located on the outside exterior of building 2655 was sealed off at least 16 years ago (the cessation of use/sealing date is unknown, but operations staff recall the pit was no longer in use by 2004). The locations of the warehouses and associated pits are shown on Figure 1 of *Memorandum: Port Summary of Records Related to Historical Fertilizer Operations* (Parametrix, 2019a).

Commented [RC(15]: The extent of fertilizer product in sediment at Berths 3, 8 and 9 requires investigation in one of the two project phases proposed in this Work Plan.

Commented [MJ(16]: Did they completely stop using Berth 3 in 1979?

Commented [RC(17]: Explain receiving stations, what are they and where are they located?

Commented [RC(18]: Are receiving stations different than dump pits?

Commented [RC(19]: How many pits where there and how many are there now and which are still in use?

Commented [RC(20]: Please reference the location for this dump pit.

Product Handling and Packaging and Transport Off-Property. After the bulk fertilizer was delivered to buildings 2645 or 2655, the product was placed into hoppers and relocated into bulk storage piles using a conveyor belt. A shaker sieve, located in the northeast corner of Warehouse 2645, was used to remove oversized material from the bulk fertilizer prior to further handling. Oversized materials were then reworked to a consistent size as the sieved material and added back to the product pile. Conveying and sieving of materials was performed indoors.

Commented [RC(21]: What creates oversize material? Oversize material from 2655 was transported to building 2645 to be sieved and then transported back to 2655? Seems like oversize material could be generated in any storage location.

Commented [RC(22]: This was done in both 2645 and 2655 or just one. Which one?

Handling of the fertilizer products from the bulk warehouses varied depending upon the packaging of the product to be delivered:

- Some of the products were transferred from bulk storage piles in buildings 2645 or 2655 to trucks for bulk delivery (via truck loading facilities at the east end of buildings 2645 and 2655); and
- Some of the products were bagged into end-user sized sacks (which involved the loading of products in warehouses 2645 and 2655 into a dump truck for transport to the bagging area in building 2585), placed on pallets, and stored pending shipment. The palletized bags of fertilizer and the tote sacks were subsequently loaded onto flatbed trucks for off-site transport.
- According to Port records, on rare occasions, the fertilizer was loaded to railcars for off-site distribution (Parametrix, 2019a).

In 2008, fertilizer operations were discontinued on the NuStar Leasehold until 2014.

Current Fertilizer Operations (2014 to Present)

Fertilizer operations were reinstated on the NuStar Leasehold in 2014 and have continued to the present.

Fertilizer Products. Since 2014, the NuStar facility has handled three fertilizer products:

- Granulated Urea
- Mono-ammonium phosphate
- Ammonium sulfate

There is not a dedicated building for the individual fertilizer products, but rather the five warehouses are filled based on availability at the time the cargo is received. Buildings 2645, 2585, 2655, and 2565 are used to store undisturbed product. The smaller warehouse (2625) is generally used to store material scraped from the ship bottom and/or floor bottom. This “bottom” material is also sold and distributed. Building 2695 is used a few times per year to store excess fertilizer.

Receipt of Fertilizer Product by Vessel and Transport to NuStar Leasehold. Two Rivers (a fertilizer importer, formulator, and distributor) hires stevedores to unload the fertilizer from vessels docked primarily at Terminal 3, Berth 8 and/or Berth 9 using buckets. According to NuStar shipment records, 25 fertilizer ships have arrived at Berth 8/9 since the NuStar fertilizer operations resumed in 2014. No fertilizer ships have docked at Berth 3 during this time. The stevedores are responsible for hiring the labor (longshoremen) to perform the work. Once the vessel arrives, the stevedores install steel/wood ramps to cover the gap between the bull rail of the dock and vessel to prevent fertilizer from entering into the river. A tarp is attached from the vessel to the terminal, covering the entire ramp. Spilled fertilizer either falls back into the vessel (from the tarp) or onto the dock. Fertilizer is transferred from the buckets into hoppers, then into dump trucks for transfer to the NuStar facility warehouses. During the unloading operations, the stevedores are responsible for product management including cleanup of spillage. A regenerative

Commented [RC(23]: Indicate truck loading locations on Fig if different from loading locations already requested.

Commented [SA(24]: East or West end?

Commented [RC(25]: Loaded onto rail cars from what building(s)?
How was this done?

Commented [RC(26]: ?, see comment below.

Commented [SA(27]: What are buckets (crane operated clamshell)? Please explain the unloading process more thoroughly.

air street sweeper is used to clean the pavement. Fertilizer unloading is generally not completed during rain or high wind events.

The Port does not have direct involvement with the unloading or management of the fertilizer. However, in 2015, the Port implemented specific Best Management Practices (BMPs) for Terminal 3 Fertilizer Operations. The BMPs focus on the protection of stormwater and compliance with air permits. Prior to vessel arrival, the Port maintenance crew plugs the stormwater catch basins on Berths 8 and 9, as well as along the haul route used by trucks on Port property (not on the NuStar Leasehold). Upon completion of the unloading operations, the Port inspects Berths 8 and 9 and along the route used by trucks on Port property (not on the NuStar Leasehold) with the stevedore. Longshore sweepers perform sweeping along truck routes during the cargo operation. An environmental contractor hired by the Port (currently West Coast Marine Cleaning) pumps stormwater, if any, that has accumulated during the fertilizer unloading. The Port then removes the plugs from the catch basins on Berths 8 and 9 and along the haul route. Water from the trench drain goes to the Port's decant treatment facility at Terminal 3 which uses an oil/water separator and Contech Filter Cartridges with a three-filter cartridge vault. Solids are disposed at Columbia Resource Company. Treated water is discharged to the City of Vancouver (City) wastewater system in accordance with an approval letter from the City.

Fertilizer Product Handling. Dry bulk materials are stored in five warehouse buildings at the NuStar terminal: buildings 2645, 2585, 2655, 2625, and 2565, and intermittently in building 2695 (see Figure 2 for building locations). In both of the A-Frame buildings (2645 and 2655) fertilizers are either off-loaded into pits or placed directly onto the warehouse floor via the transport truck. From the pits, the material is moved by a conveyor system (within the building) into large piles. When the material is placed directly on the floor inside the building, the fertilizer is pushed into the main ("high") pile with a backhoe or front loader. Off-loading of the fertilizer product is always done inside the warehouse buildings, and movement of the fertilizer is done under the building cover.

There are no pits at buildings 2585, 2625, and 2565. The trucks place the fertilizer products directly on the floor and the product is pushed into high piles with a big wheel loader.

Granulated urea will solidify if exposed to significant moisture. Thus, this material is not offloaded while it is raining. Typically, the weather forecast will be checked the day before the offloading event and if rain is predicted, the offloading event will be postponed. When urea has been exposed to water or moisture, mechanical grinders located in the warehouses are used to grind the urea into the small pellets used for industrial distribution.

Packaging and Transport Off-Property. Each of the five fertilizer storage buildings has an attached covered loading station located adjacent to, but outside of, the warehouse. Distribution trucks are driven into the loading areas, and bulk fertilizer is conveyed from the warehouse into a loading chute that pours fertilizer directly into the storage compartment of the truck. The loading chute and trucks are strategically positioned to limit spillage and fugitive dust. The trucks are then covered for transport off the NuStar Leasehold property. Each of the five drive-through loading

Commented [SA(28]: But there haven't been any fertilizer offloaded since 2014, correct?

Commented [SA(29]: Where does this water go?

Commented [RC(30]: There is a storm water routing system that goes to Terminal 4 pond and routing system for process water that goes to the port's treatment system/City. These systems need to be explained better and the points of separation made clear as to what goes where.

Commented [SA(31]: Where is the trench drain?

Commented [RC(32]: Please reference diagram of catch basins and trench drain locations and storm water routing.

Commented [RC(33]: How are pits constructed and are there low point drains and potential for any liquid discharge?

Commented [SA(34]: Dumping?

areas is covered and surrounded by a concrete berm to limit the migration of fertilizer material from the loading area .

Summary of Liquid Materials Storage and Handling

Interviews with NuStar terminal staff and reviews of historical product inventories were used to determine what products were handled on the NuStar Leasehold, either historically or currently. Liquid products currently or previously handled by NuStar have included wood preservative, sodium hydroxide, potassium hydroxide, calcium chloride, phenol, ethanol glycol, sodium chlorate, mineral spirits, cyclohexane, methanol, and chlorinated solvents.

Currently Handled Liquid Materials

Liquid products currently handled include:

- Liquid sodium hydroxide - Liquid sodium hydroxide is received via ship and transported out by rail and truck.
- Calcium chloride - Calcium chloride is received via rail and transported out via truck.
- Jet A fuel - Jet A fuel is received via ship and transported out via truck and barge.

Previously Handled Liquid Materials

Two wood preservative products were handled and stored in the liquid phase between February 2000 and March 2010: alkaline copper quaternary (ACQ 2102) and chromated copper arsenate (CCA). In addition, methanol and chlorinated solvents were historically handled and stored, although chlorinated solvents have not been handled/stored at the terminal for almost 30 years.

Historical Handling and Storage of CCA. CCA is a wood preservative that has been used in the timber industry to treat timber for microbes and insects since the 1930s. Historically, CCA was transported to the NuStar Leasehold, via rail tank cars and was offloaded into storage tanks at the facility.

Historical Handling and Storage of ACQ 2102. ACQ 2102 is a water-based wood preservative formulation made of soluble copper and a quaternary compound[1]. Like CCA, the product is used to treat wood to make it resistant to fungi and bacteria. ACQ 2102 was transported to the NuStar Leasehold via rail tank cars and was offloaded into storage tanks at the facility.

Historical Handling of Methanol. Methanol was received via rail and transported out via truck and rail.

Historical Handling of Chlorinated Solvents. Historical company records identified the following with respect to chlorinated solvent handling at the NuStar facility.

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[1] In chemistry, a quaternary compound is a cation consisting of a central positively charged atom with four substituents.

Commented [SA(35]: How long ago were these practices implemented?

Commented [RC(36]: List any other BMPs used like sweeping after loading event, etc

Commented [SA(37]: What type of wood preservative?

Commented [SA(38]: Ethylene glycol?

Commented [SA(39]: Have these compounds been tested for?

Commented [MJ(40]: Has there ever been any sign of fuel in groundwater near the shore?

Commented [SA(41]: Check for Jet A and methanol

Commented [RC(42]: Are these the only wood preservative products handled. If so please indicate.

Commented [SA(43]: Check for chromium and arsenic.

Commented [SA(44]: Check this area.

Commented [RC(45]: How and where did CCA leave the facility?

Commented [SA(46]: Check this area for copper.

Commented [RC(47]: How and where did this product leave the facility?

Commented [RC(48]: How and where did this product leave the facility?

Commented [RC(49]: How and where did this product leave the facility?

- Tetrachloroethylene (PCE), trichloroethylene (TCE), methylene chloride (MC), and 1,1,1-trichloroethane (1,1,1-TCA) were handled for several companies beginning prior to 1976, but the start date is uncertain. The records suggest that handling of chlorinated solvents may have ended as early as 1990, but the end date is uncertain.

- Direct loading (direct transfer from rail tank cars to tank trucks) was the initial method used for transfer of chlorinated solvents. Direct loading occurred near Warehouse 2625. Direct loading ended in 1982. Interviews with long-time employees support the records review.

- Indirect transfer (transfer from rail to ASTs, transfer from ASTs to tank trucks) began in 1981 and continued throughout the remainder of chlorinated solvent handling. Indirect transfer occurred in and around the AST farms located east of Warehouse 2565 (rail car loading racks to the north, truck loading rack to the south).

Commented [RC(50]: Locate racks on a Figure.

Solvent handling ended almost 30 years ago.

2.1.1.4 Best Management Practices at NuStar Leasehold

NuStar implements BMPs to minimize releases of handled materials at its leasehold. NuStar has filed a NuStar Fertilizer Handling Best Management Practices memorandum with the Port, documenting BMPs utilized by NuStar for handling bulk fertilizer. A copy of the memorandum is provided in Attachment A of NuStar's fertilizer memorandum (Cascadia, 2020a).

In addition to these BMPs, NuStar has implemented the following maintenance, cleaning, and handling practices to further reduce the migration of fertilizer products from the handling areas at the NuStar Leasehold:

- NuStar sweeps the Leasehold property at least daily during shipments to keep the asphalt pavement free of fertilizers. In addition to operating its own street sweeper, NuStar will also hire a contractor to assist in street sweeping during shipments or other busy transportation times. Distribution trucks and/or hopper trucks do not travel on unpaved areas at (or off) the terminal.

- Twice daily inspections are conducted to visually monitor for the presence of fertilizer material outside of the handling areas, and sweeping is conducted if these inspections identify spilled fertilizer on the NuStar Leasehold; the Port is contacted if spilled fertilizer is identified off the NuStar Leasehold.

- The storm drain manholes in the vicinity of the fertilizer handling areas are sealed during shipment receipt to keep fertilizer out of the stormwater system.

- Berms are located around each of the five truck loading areas to minimize fertilizer from migrating outside of the loading areas.

- Engineered heavy-duty covers have been added to the loading areas for each of the five buildings.

Commented [RC(51]: What is done if fertilizer gets into these manholes?

Commented [SA(52]: What type of berms? Asphalt, concrete or something else.

Commented [RC(53]: What is the significance of the heavy-duty covers, for instance, they were added because they can withstand the heavy load and frequent traffic in these areas?

- Berms have been added to the vehicle entrances of each building to help keep product inside while operations equipment is being moved in and out of the buildings.
- Drop down industrial flaps were installed at each of the five loading areas. These flaps hang down from the roof and are designed to prevent fugitive dust from leaving the bermed areas.
- During loading of the distribution trucks at each of the warehouses, care is taken to position the truck relative to the loading chute to minimize spillage; product that is spilled is immediately swept up and returned to the storage pile within the building.
- At the large A-Frame (building 2645) a diversion system has been installed to aid in the cleaning/maintenance of dust on the roof near the elevator (conveyor system). Dust on the roof periodically needs to be rinsed clean. When rinsing is occurring, the system diverts liquid into a storage tank. When no rinsing is occurring, the system diverts any incidental water to a downspout feeding into a Port Grattix box (a large treatment planter used as a filtration system for roof runoff). Liquid fertilizer from the storage tank is periodically pumped out and sold as a separate product.
- Inside building 2645, sumps have been installed underneath the large permanent loading equipment and near the equipment pad (which has been paved with asphalt and bermed). The loading equipment and equipment pad are routinely cleaned and the rinsate water is collected and pumped into a large horizontal tank. The product-rich water from the tank is periodically pumped out and sold separately as liquid fertilizer.

Longshoremen sweep the roads that the trucks use to transport the fertilizer from the off-loading area to the NuStar Leasehold. The paved areas between the berths and the NuStar Leasehold, that are not on Port roadways, are cleaned/swept by longshoremen.

Commented [RC(54]: What areas are bermed and how are the berms constructed? How is product and/or storm water addressed that is captured in the bermed areas?

Commented [SA(55]: Is this new? How often. How do Grattix boxes work?

Commented [RC(56]: How are the sumps constructed that they can contain liquid?

Commented [RC(57]: On and from Berths 8 and 9? How often is sweeping done during ship off-loading and with what equipment?

2.1.2 KMBT Operations Area

The Port constructed the Bulk Terminal facility in 1981 to support import of copper concentrate via rail and export via ship. The Port operated the terminal from 1982 to 1995. In May 1995, the Port entered into a Terminal Management Agreement with Hall-Buck Marine, Inc., for the operation of the Bulk Terminal. Hall-Buck Marine, Inc., was acquired by KMBT in July 1998 and, since that time, has operated the terminal as KMBT.

The following provides a summary of the location, description, and history of the KMBT facility.

2.1.2.1 Location

The KMBT facility is located at the Port of Vancouver Terminal in Vancouver, Washington, on property owned by the Port and leased by KMBT. The extent of the KMBT Operations Area is shown on Figure 2. The KMBT facility address is 2735 NW Harborside Drive, Port of Vancouver, Vancouver, Washington 98660 (Latitude: N45º 38.26'; Longitude: W122º 42.20').

2.1.2.2 Physical Features

Operations at the KMBT facility consist of transportation, storage, maintenance, fueling, and operating pollution-control equipment. Structures at the site consist of a bulk material warehouse (building 2725), a Coverall Building (building 2745), a pier and loading dock (Port Berth 7), a belt conveyor system a railroad control station, and 2,400 feet of railroad track. Air emission control systems include seven baghouse dust collectors working in conjunction with enclosed building structures, fully and partially enclosed conveyors, and the ship loader spout. Structures are shown on Figure 2. Another building called the Sand Shed (former building 2705; located immediately south of building 2745 and west of building 2695) was also used for bulk materials storage prior to demolition in 2013. The former location of the Sand Shed is depicted on Figure 2.

Important upgrades to the facility completed since KMBT took over the operations in 1998 include the following,

- In 1997, as part of Hall-Buck Marine operations, the Port built a new ore storage building located at the north end of current building 2745.
- In 2006, the Port constructed the Coverall Building in support of KMBT operations (see building 2745 on Figure 2). The Coverall Building was constructed over the footprint of the storage building built in 1997.
- In September 2017, the Port completed upgrades to the Bulk Terminal, including replacement of the rail unloading facility, enclosing both the bulk offloading point and conveyors inside a negative pressure structure, and adding baghouses to control dust emissions. The upgrades were completed to support the Port's West Vancouver Freight Access process and as a level 3 corrective action to comply with the Port's Industrial Stormwater General Permit. The new rail unloading facility, identified as building 2877, includes two options for rail car unloading: belly dumping of rail cars or the use of an excavator to remove bulk materials from open top rail cars. The unloading operations are operated within a bermed area where releases are manually cleaned up by KMBT and placed in the product pile or washed into an onsite wastewater treatment system.

Commented [RC(58]: What comprises the negative pressure structure?

Commented [RC(59]: What areas are bermed and how are the berms constructed? How is product and/or storm water addressed that is captured in the bermed areas?

Bulk mineral concentrates are shipped to the facility primarily via rail. The facility is equipped to manage both bottom-dump and top-unloading railcars. Railcars are unloaded by an excavator-type machine onto a covered system for transport into the bulk material warehouse. Heavy mobile equipment, including front-end loaders working inside the warehouse, transfers the ores onto a covered ship-loading conveyor. The conveyor connects directly to the ship loader and loads ore cargo into the ship's storage compartment.

The KMBT facility includes extensive underground utilities. Utilities are within about 12 feet of the ground surface, above the groundwater table.

The ground surface coverage consists of the following (with approximate aerial extent):

- Buildings (24 percent);
- Paved areas (50 percent); and
- Gravel/bare ground (26 percent).

The bare ground is generally limited to the rail corridors.

2.1.2.3 Historical and Current Operations

Operations have stayed fairly consistent since initiating in 1982, consisting of the import of bulk materials via rail or truck, storage at the facility, and export via ship.

Historical Operations and Materials

In 1981, the Port received permits to construct a copper concentrate shipping facility. The facility was designed to receive copper concentrate from Anaconda Minerals Company from Butte, Montana, via rail, store, and export by vessel. Shortly after construction of the facility was completed, market prices for copper dropped and operations ceased. For several years there were limited shipments of copper through the facility. The Bulk Terminal was renovated in early 1986 to handle a variety of other bulk products. Between 1982 and 1994, the following products were handled at Terminal 2, Berth 7 (Parametrix, 2019e):

- Bentonite clay
- Talc (in bags)
- Beet pulp pellets
- Alfalfa pellets
- Hay pellets
- Copper concentrate
- Silica concentrate
- Manganese concentrate
- Zinc concentrate
- Bauxite
- Hydrated alumina
- Ferrophosphorus

Commented [SA(60]: Probably should screen for some of these.

Current Operations and Materials

Most of the products currently handled are mineral concentrates (primarily copper concentrate; see Appendix A for the Safety Data Sheet on copper concentrate for more information). At the time of the Hall-Buck purchase in 1998, KMBT was also permitted to handle bentonite clay, talc, fish meal, quartz silica, zircon sand, coal, chalk, agricultural pellets (e.g., beet, alfalfa, hay), and other miscellaneous bulk materials.

Bulk mineral concentrate (primarily copper) and bentonite clay arrive by rail and are offloaded at the rail unloading facility, transferred by a system of conveyor belts to storage buildings, then into oceangoing vessels at Berth 7. Recently, KMBT started exporting tire chips which arrive at the terminal by truck, are stockpiled, then loaded by enclosed conveyor belts into ships at Berth 7. Tire chips, bentonite, and copper concentrate are the only products that KMBT has handled in recent years.

Commented [RC(61]: Same conveyors are used for bentonite and ore concentrate?

Airborne dust is generated during the offloading, conveyance, and onloading of copper concentrate and bentonite. Operators of the KMBT Operations Area have maintained air discharge permits with regulatory permitting agencies, including the Southwest Air Pollution Control Authority (SWAPCA) which was re-named Southwest Clean Air Agency (SWCAA) in the year 2000. Discharge limits for the following contaminants are included in air discharge permits: arsenic, cadmium, chlorine, chromium, copper, lead, manganese, molybdenum, and silver.

Commented [SA(62]: Probably should screen for these metals.

2.1.2.4 Best Management Practices at KMBT Operations Area

KMBT implements BMPs to minimize releases of handled materials at its management area. These management practices are selected to reduce the release of cargo and ensure that spilled cargo is cleaned up appropriately. The BMPs were last revised on January 31, 2019, and are split into four categories (operational, structural, cleaning, and inspection) as detailed below:

1. Operational BMPs are a set of work practices that maintain a clean facility and ensure that cargo reaches its final destination in good condition without loss:
    - Rail Unload Building (Building 2877 on Figure 2): Excavator door is to be closed during unloading operations. Coupled with the "Freezer curtain" style flap closures, wind through the building is limited.
    - Baghouses and air emissions controls are operated during bulk cargo handling: these control devices are maintained to achieve the control efficiency required by the air permit. Air pollution control equipment includes seven baghouse dust collectors, enclosed building structures, fully and partially enclosed conveyors, and the ship loader spout. Routine maintenance and regular operation of the air pollution control equipment is a key part of KMBT's BMPs.
    - Storage buildings: Doors are to remain closed when reclaiming cargo from the storage buildings to the vessel. This practice keeps airborne cargo inside the structures.
    - Limiting copper storage time: KMBT has notified customers that the length of time copper concentrate may be stored at the facility is limited. The copper concentrate (cargo) is shipped in damp form and must be kept damp; as dry copper concentrate potentially forms a dustier cargo. If dry cargo is noted, customers are notified, and effort is made to mix the new and old cargo to moisten the dry cargo to limit dusting.
2. Structural BMPs are constructed to control or contain cargo:
    - Mesh wind screen is attached around the ship loader to prevent material from becoming airborne. Screens are inspected and repaired or replaced as needed. These screens limit

air movement around the shiploader spout and reduce the chance of cargo from being blown from the ship.

- Stormwater containment and segregation: The KMBT Operations Area is bermed and graded to divert stormwater to the wastewater treatment system that is operated and maintained by the Port. The wastewater treatment system discharges to the City sanitary sewer under permit. The area of the newly developed rail unloading facility is bermed and the drains within the berms are directed to the wastewater treatment system.
- Contained conveyor system: Conveyor hoods and bottom pans are designed to reduce dust and the release of cargo. Hoods are inspected monthly and pans are cleaned as needed.
- "Freezer curtain" style flap closures have been installed at east and west ends of the unload building. These flap barriers limit wind through the structure when rail cars are being unloaded and limit fugitive dust from leaving the building.

3. Cleaning activities are performed regularly to collect and reclaim cargo at the facility. Recovered copper concentrate is screened and returned to the storage buildings for later shipment.
   - Pavement sweeping and cleaning: Sweeping is done across the KMBT Operations Area as needed. All site cleaning efforts will be logged. Spilled cargo within the KMBT Operations Area is cleaned up as needed by sweeping, or washdown to the wastewater treatment system.
   - Shiploader area cleaning: The shiploader and adjacent paved areas are washed down every 1 to 2 months or when needed as determined during inspections. Wash water flow is directed to the wastewater treatment system that is managed and maintained by the Port. These washdowns limit the quantity of copper concentrate that can be tracked outside the wastewater capture area.
   - Drain cleaning: Drains located behind the ship loader are cleaned out on an annual basis. These drains also feed to the wastewater collection and treatment system operated by the Port.
   - Conveyor cleaning: Terminal conveyors are scheduled for cleanings as determined by inspections. The shiploader transfer points are cleaned 2 to 3 times per shift when loading vessels.
4. KMBT ensures compliance with these BMPs by conducting inspections:
   - Periodic inspections of the general KMBT management area are completed to ensure that correct practices are being followed and equipment is operating correctly.

Commented [SA(63]: Curious how this works

Commented [RC(64]: Are the process water and storm water streams handled the same? Please provide explanation of this system and the differences between the process and storm water handling and treatment.

Commented [RC(65]: What areas are bermed and how are the berms constructed? How is product and/or storm water addressed that is captured in the bermed areas?

Commented [SA(66]: When are pans inspected? I remember being in the field with everyone and seeing the big hole in the pan.

Commented [SA(67]: For future reference. It seems like this is not frequent enough.

Inspections of the shiploader and dock areas are completed during ship loading operations in order to ensure compliance with the above BMPs.

- Monthly spill prevention, control, and countermeasure (SPCC) inspections include inspection of storage and containment areas. Inspection of the operating area is performed monthly to confirm stormwater BMPs are in place. Emphasis is placed on locations outside the capture area of the wastewater treatment system.
- The crossover conveyor between the storage buildings (buildings 2725 and 2745 on Figure 2) are inspected monthly to note the condition of the tarps enclosing the crossover conveyors between the storage buildings.
- Opacity readings are taken at least twice per vessel with special attention given to the first pour and topping off hatches.
- When loading vessels, KMBT management walks the length of the main overhead conveyor (Figure 2) between the storage buildings and shiploader at least once per shift as part of operational rounds.

2.2 GEOLOGY AND HYDROGEOLOGY

The following sections summarize the geology and hydrogeology of the Investigation Area and are obtained from the Draft FS (Apex and Parametrix, 2016). Geologic and hydrogeologic conditions in the areas of the SMC, Cadet, and NuStar sites are detailed in their respective RI Reports (Parametrix, 2009 and 2010; Apex, 2013). Approximately 48 monitoring wells have been installed by NuStar (or the Port) in or near the KMBT Operations Area and NuStar Leasehold and are used to interpret the geology of the Project Area (see Figure 3). A detailed description of regional geologic and hydrogeologic conditions is also presented in the Vancouver Lake Lowlands Groundwater Model Summary Report (Parametrix, 2008).

2.2.1 Geologic Units

The regional geologic framework and associated groundwater system detailed in the Swan/Cadet and NuStar RI Reports are based on the geologic setting described and the nomenclature used in the United States Geological Survey (USGS) water resources investigation report, *A Description of Hydrogeological Units in the Portland Basin, Oregon and Washington* (Swanson et al., 1993). The *Vancouver Lake Lowlands Groundwater Model Summary Report* (Parametrix, 2008) presents a regional conceptual model and detailed discussion of geologic and hydrogeologic units in the region and their presence in the Project Area. The groundwater model was developed using site-specific geologic and hydrogeologic data collected throughout the Vancouver Lake Lowlands.

There are three regional geologic units (Quaternary alluvium, catastrophic flood deposits, Troutdale formation) in the Project Area. Groundwater in the Quaternary alluvium and catastrophic flood deposits is associated with the Unconsolidated Sedimentary Aquifer (USA), while groundwater in the upper section of the Troutdale formation is associated with the Troutdale gravel aquifer (TGA).

The three geologic units are described in the following sections.

2.2.1.1 Alluvial Deposits

The Quaternary alluvial deposits in the Project Area primarily consist of two main subunits: a lower sand and an upper silt. In the area adjacent to the Columbia River, two localized subunits have been identified; these represent overbank flood deposits and dredge fill. The variability in fines present in the Quaternary alluvial deposits can notably influence the rate at which groundwater passes through the material. Three alluvial subunits are present in the Project Area and are described below.

Dredge Fill (Sand 2) – Dredge fill deposits are present in the southern portion of the Project Area and generally within 1,500 feet of the Columbia River. Dredge fill consists predominantly of sand but can include lenses of silt and gravel. Extensive dredge filling has occurred in the southern portion of the NuStar Leasehold particularly adjacent to the river where the thickness of the fill can reach up to 50 feet. Depending upon location, dredge fill can be saturated or situated above the water table.

Overbank Deposits (Silt 2) – This alluvial subunit is present along the Columbia River and is associated with the historical riverbank. The overbank deposits represent the historical riverbank and seasonal overbank flood deposits, consist of silt and clay material, and are thickest adjacent to the historical river channel. The overbank deposits are thicker and contain more clayey material than the lowland area silt subunit (Silt 1). The water table is generally found within the basal portion of the overbank deposits. Consequently, its lower section is usually saturated and its upper section is within the vadose zone. Beginning in the mid-1930s, filling was completed along the historical riverbank in the Project Area as part of the Port's terminal developments that resulted in the river being displaced approximately 500 feet south of its historical river channel.

Lowland Area Sand (Sand 1) – The lowland area sand is present throughout the project area. The lowland area sand contains variable amounts of fines and is described in places as silty sand. This subunit overlies the catastrophic flood deposits and, in the area of the Swan site, appears to be contemporaneous with lowland area silt deposits. The lowland area sand can be differentiated from catastrophic flood deposits by its lack of gravel. The lowland area sand is present under the overbank deposits on the north side of the historical riverbank. The water table is usually situated within the lowland area sand and silt subunit where overbank deposits are not present. Under these conditions its lower section is saturated, and its upper section is in the vadose zone.

2.2.1.2 Catastrophic Flood Deposits

This unit consists predominantly of medium- to coarse-grained sand with gravel. The gravel can be coarse, ranging up to cobbles 6 inches or greater in diameter. These deposits are associated with the Late Pleistocene catastrophic floods of the Columbia River. This material was deposited throughout the Site and underlies the Quaternary alluvium. Due to the generally coarse nature of these deposits and the general lack of fines, these deposits are highly transmissive.

2.2.1.3 Troutdale Formation

The Troutdale formation encountered at the Site consists of well-graded, cemented to semi-consolidated sandy gravel with varying amounts of sand, silt, and clay. The gravel clasts range up to 8 inches (i.e., cobble) in diameter and generally consist of basalt and quartzite. The matrix usually consists of brown to green fine-grained silty sand with varying amounts of silt and clay and is usually abundant with mica. The Troutdale formation underlies the catastrophic flood deposits throughout the Project Area. It is distinguished from the catastrophic flood deposits by the presence of cementation, consolidation, quartzite clasts, and a silty matrix containing mica. In certain places, it can be difficult to distinguish the Troutdale formation from the reworked Troutdale formation material subunit. A noticeable reduction in water production is another characteristic that can be used to distinguish the Troutdale formation from the overlying catastrophic flood deposits.

2.2.2 Hydrogeologic Units

Consistent with the USGS Portland Basin (Swanson et al., 1993) nomenclature, there are two regional hydrogeologic units at the Site; the USA and the underlying TGA. The USA occurs in the Quaternary alluvium and catastrophic flood deposits, while the TGA occurs in the Pleistocene-aged Troutdale formation.

The distinction between the USA and the TGA is based on differences in the geologic units and resulting hydrogeologic conditions. The overall permeability of the USA is at least one order of magnitude greater than the permeability of the TGA (McFarland and Morgan, 1996). Consequently, primarily due to pumping, groundwater flow conditions in the USA differ from conditions in the TGA. In addition, groundwater flow conditions within the three zones of the USA differ due to permeability contrasts between the alluvium and the catastrophic flood deposits.

The following sections describe the hydrogeologic conditions of the three USA groundwater zones and the TGA at the Site.

2.2.2.1 Unconsolidated Sedimentary Aquifer

Regionally, the USA receives recharge primarily from precipitation. Within the Site, the USA also receives recharge from the Columbia River or discharges to the river, depending upon relative river stage conditions and pumping stresses. The flow of groundwater in the USA has historically been dominated by pumping at the Great Western Malting (GWM) site. Water levels in the USA respond quickly to changes in the Columbia River stage, indicating that the river is in direct hydraulic connection with the USA. This rapid response is attributed to the proximity of the river and the high hydraulic conductivity of the USA. These dynamic conditions make it difficult to define groundwater flow direction based on water level measurements collected during short periods of time. Water level measurements indicate very low hydraulic gradients with small-scale and local variations in apparent groundwater flow direction due in part to river stage changes. Groundwater flow model results indicate that the operation of high volume continuous-rate pumping of production wells in the USA is possible and sustainable due to high hydraulic conductivity and relative thickness (i.e., high transmissivity) and the presence of a substantial recharge source (i.e., the Columbia River). Groundwater recharge from the Columbia River due to high volume production well pumping primarily occurs in the intermediate zone.

Three groundwater zones have been established for the USA based on observed geologic and hydrogeologic conditions. Groundwater zones were adopted during the course of the SMC, NuStar, and Cadet RI efforts to evaluate and describe groundwater quality and groundwater flow trends. These zones are used to facilitate understanding of the hydrogeologic system and were originally defined by groundwater quality conditions observed during early phases of the SMC RI. Based on the presence and distribution of the alluvial and catastrophic flood deposits in the Project Area, the groundwater zone classification system has been retained, but has been modified and is now applied only to the USA. The zones for the USA are as follows:

- Shallow USA groundwater zone: This zone extends from the ground surface to -10 feet msl (approximately 40 feet below the ground surface [bgs]). The shallow groundwater zone of the USA primarily corresponds to the alluvial deposits. At the NuStar Leasehold, the bottom of the shallow zone is about -10 to -25 feet msl and is located in the fill deposit, historical river channel deposits, and overbank deposits.
- Intermediate USA groundwater zone: This zone extends from the bottom of the shallow zone (-10 feet msl to -25 msl, depending upon location within the Project Area) to -100 feet msl (approximately 130 feet bgs). The intermediate groundwater zone of the USA primarily corresponds with the catastrophic flood sand and gravel deposits. This zone can also include a portion of the channel fill deposits and reworked Troutdale formation material. At the NuStar Leasehold, the intermediate zone lies between approximately -15 and -100 feet msl and is located under the historical river channel deposits and the overbank deposits.
- Deep USA groundwater zone: This zone extends below -100 feet msl. The deep groundwater zone of the USA primarily corresponds with the channel fill deposits and reworked Troutdale formation material. The deep zone generally corresponds to those portions of the aquifer that are less influenced by groundwater pumping. At the NuStar Leasehold, the deep zone is not present and the hydrogeologic units grade from intermediate groundwater to the TGA.

The elevations of these zones continue to serve as general guidelines and have been adjusted slightly in certain areas based on encountered geologic conditions or other hydrogeologic observations. Characteristics of the three groundwater flow zones within the USA are described

Commented [SA(68]: This implies there is GW at the ground surface.

below. Cross sections depicting the lithological units and groundwater zones in the Project Area are provided in Appendix B.

2.2.2.2 Shallow USA Zone

The shallow USA zone consists primarily of the alluvial deposits. Depending on the thickness of the alluvial deposits, the shallow USA zone can extend into the upper part of the sand and gravel subunit of the catastrophic flood deposits. The alluvial deposits contain greater amounts of finer material than the underlying catastrophic flood deposits. Consequently, the transmissivity of the alluvial deposits is notably lower than the underlying sand and gravel deposits. Due to the overall presence of finer material with notably lower permeability, the distribution of contaminants in the shallow USA zone can differ from the distribution of contaminants in the underlying catastrophic flood deposits.

Prior to operation of the SMC groundwater pump and treat interim action (GPTIA), groundwater flow in the shallow USA zone at the SMC and Cadet sites was toward the southeast. This flow direction was reflected by contaminant distribution where high concentrations of solvents in groundwater at the two source areas decreased with distance southeast of the source area. Before groundwater pumping at SMC, potentiometric contour maps based on water level measurements from shallow monitoring wells also suggested a southeastern flow direction in the shallow USA zone in the SMC and Cadet areas. Groundwater flow model results indicated that, prior to starting the Port's GPTIA, flow in the shallow USA zone was primarily influenced by pumping occurring at the GWM site but also appeared to be influenced by City water station pumping. The flow direction at the Cadet site was similar, based on the distribution of contaminants, potentiometric contour maps, and modeling. Groundwater flow in the shallow zone beneath the Cadet site is now to the southeast due to the operation of the GPTIA at the SMC site.

The direction of shallow zone groundwater flow beneath the NuStar ~~site~~ leasehold has not been affected by the GPTIA due to the presence of a silty layer in ~~between~~ the shallow zone that extends to the north of the leasehold ~~and intermediate zones beneath the site~~, and the presence of a "silt ridge" in the shallow zone beneath the northern 2006 leasehold boundary (see Figure 2-6 in Appendix B). Groundwater flow in the shallow USA zone in the area of the NuStar Leasehold has been observed to fluctuate toward or away from the river in response to river stage changes. A groundwater divide in the shallow zone is present in the central portion of the NuStar ~~site~~ leasehold generally corresponding to the southern edge of the "silt ridge" along the northern side of the NuStar Leasehold (see cross section 2-6 in Appendix B). The presence of the silt layer associated with the pre-fill Columbia River channel (former natural riverbank) results in a low-permeability zone in the shallow zone along the northern boundary of the NuStar facility. The pre-fill river channel silty gravel layer beneath the NuStar Leasehold also greatly impedes hydrogeologic communication between the shallow and intermediate zones (Apex, 2013). These pre-fill river channel features also serve to isolate the shallow zone at the NuStar site from the shallow zone north of the site.

Commented [RC(69)]: Only a cross section, not cross sections is provided. A vertical datum of where the 0 MSL elevation is would be useful for gauging formation elevations. The cross section is incomplete in that it does not show complete depth of all units referenced in the text, like where is the bottom of the Intermediate zone/top of TGA?

Commented [RC(70)]: Reference the data supporting this statement.

Commented [RC(71)]: Text has been added about the location of the silts as they are not marked on Ap B Fig 2-6.

Commented [RC(72)]: The "silt ridge" – correct?

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Based on stable oxygen isotope data, recharge of the shallow USA zone appears to be primarily from precipitation along with indications of some recharge from the river. Oxygen isotope data indicate that the shallow USA zone at the NuStar Leasehold is recharged from precipitation. Due to the presence of overbank deposits (former natural riverbank) just north of the NuStar Leasehold, northerly flow in the shallow USA tends to be restricted.

2.2.2.3 Intermediate USA Zone

The intermediate USA zone corresponds to the catastrophic flood deposits. The catastrophic flood deposits are more permeable than the overlying alluvial deposits or the underlying TGA. Based on well log descriptions, the sand and gravel subunit is the most permeable sedimentary unit in the USA (Mundorff, 1964). Consequently, the rate of groundwater movement is highest in the intermediate USA zone where it is greatly influenced by pumping at high-volume production wells located in the lower terrace and Vancouver Lake Lowlands area, including wells operated by the City, Clark Public Utilities (CPU), GWM, and the Port. In response to high-volume pumping, recharge of the intermediate USA zone is primarily from the river.

Commented [SA(73]: Really? What about Vancouver Lake?

Prior to operation of the GPTIA, groundwater flow in the intermediate zone near the SMC, Cadet, and NuStar sites was to the north/northeast (from the river) and curving to the east, and then toward the GWM production wells, which have been in operation since the 1940s. These flow patterns are supported by the distribution of contaminants from the SMC, Cadet, and NuStar sites, isotope data, and groundwater flow model results. After startup of the GPTIA, overall flow in the intermediate zone is towards the GPTIA. The gradient in the area between the SMC/Cadet and NuStar properties (former Carborundum pond area) is typically flat, although it does vary during periods of rapid river stage change.

2.2.2.4 Deep USA Zone

This zone of the USA includes the deeper area of the USA where the rate of groundwater flow is lower, less influenced by groundwater pumping, and more regionally influenced. Groundwater flow in the deep USA zone has not substantially changed due to operation of the GPTIA. At the NuStar Leasehold, the deep USA appears to contain re-worked Troutdale formation material that is situated on top of the Troutdale formation. The channel fill deposit and the reworked Troutdale formation material are permeable, but not as permeable as the sand and gravel subunit of the intermediate USA zone. Both the channel fill deposits and the reworked Troutdale formation material are more permeable than the underlying consolidated to semi-consolidated Troutdale formation that makes up the TGA.

Commented [RC(74]: Reference data to support this statement.

2.2.2.5 Troutdale Gravel Aquifer

The TGA is associated with the Troutdale formation, which underlies the catastrophic flood deposits and alluvial deposits that make up the USA at the Project Area. The top of the Troutdale formation varies noticeably, and the presence of an erosional trough has been identified. The permeability of the TGA is at least one order of magnitude lower than the USA (McFarland and

Morgan, 1996). This is due to the presence of more fines in the Troutdale formation and the extent of its lithification/cementation, which ranges from consolidated to semi-consolidated. The combination of lower permeability and lack of groundwater extraction from the TGA at the Project Area produces much lower flow rates in the aquifer than in the overlying USA. There is hydraulic connection with the USA due to a lack of a confining layer. It is anticipated that the TGA would exhibit similar river response behavior as the USA, but would be more attenuated due to its lower permeability and the fact that it appears not to be in direct contact with the river (i.e., the USA is situated between the river and the TGA).

2.3 STORMWATER/WASTEWATER MANAGEMENT

Commented [MJ(75]: Describe historical discharges directly to river – when they stopped and approx.. where they were.

The majority of the stormwater in the Project Area is either conveyed to a Port stormwater pond, or in the case of portions of the KMBT Operations Area, wastewater is managed by a wastewater treatment system. The details of stormwater management in the Project Area are provided in the subsections below.

2.3.1 Port of Vancouver Stormwater System

Stormwater in the Project Area enters storm drains that flow into the Port's stormwater conveyance system and ultimately into a settling pond (Terminal 4 pond) before discharging into the Columbia River under the Port's Industrial Stormwater General Permit (ISGP) WAR000424. A figure depicting the extent of the Permit area as well as catch basin, manholes, outfalls in the investigation area is provided in Appendix C.

Commented [MJ(76]: State where the discharge is.

Commented [RC(77]: This figure is very difficult to interpret. Suggest more than one figure be used. For starters separate figures would be useful in showing where water is collected and treated by the port before being discharged to the City and the area of capture for water that goes to Terminal 4 pond.

From 2003 to 2012, NuStar operated under two Industrial Stormwater General permits (ISGP S03002510 and WAR002510) to discharge stormwater from the NuStar Leasehold into the Port's stormwater system discussed above. Under NuStar's ISGP, NuStar was required to sample quarterly at select storm drains for pH, turbidity, zinc, copper, and nitrate and report the results to Ecology. Historical records indicate that the samples were collected from three locations: the northwest end of building 2585, the southwest end of building 2655, and the southwest end of building 2565. The buildings are labeled on Figure 2. NuStar's records were queried along with Ecology's Permitting and Reporting Information System (PARIS) database for historical stormwater data from that time period. A summary of the available stormwater analytical data and a comparison to permit action levels are provided in Table 1.

Commented [SA(78]: Compounds to consider.

Commented [RC(79]: Sample points locations and consist of what and explanation of how samples are collected is needed.

Commented [RC(80]: Sample locations listed on the Table need to be included on a figure.

NuStar discontinued the storage of fertilizer products at the facility in 2009 and applied for a Conditional No Exposure (CNE) Exemption with the Ecology Water Quality program on June 7, 2013. On December 19, 2013, NuStar received a letter from the Ecology Water Quality program granting the exemption from the ISGP.

2.3.2 Wastewater Treatment Facility

Stormwater in the rail area of the KMBT Operations Area infiltrates; the stormwater in the remaining areas is directed to an onsite wastewater treatment plant located in building 2715 (see

Commented [RC(81]: It should be noted that stormwater can infiltrate because this area is unpaved.

Commented [RC(82]: Are these remaining areas paved or unpaved?

Figure 2). The wastewater treatment plant is owned and operated by the Port. The KMBT Operations Area includes four drainage basins and encompasses approximately 8.8 acres of bermed impervious area. Wastewater (i.e., runoff) generated in the drainage basins is contained and conveyed via sumps that include lift stations to the onsite wastewater treatment plant (building 2715), which was upgraded in 2010 and provides pretreatment prior to discharging to the City wastewater treatment facility. The onsite treatment system includes detention tanks and two coagulation treatment trains with a total capacity of 100 gallons per minute. The drainage basins and locations of the sumps/lift stations, conveyance piping, and treatment plant are shown on Figures 1 and 2 of the Port's memorandum *Kinder Morgan Operating Area - Wastewater Line Inspection and Testing* (Parametrix, 2018a). The discharge permit for the City wastewater treatment facility includes limits for the following metals: arsenic, cadmium, copper, lead, silver, nickel, and zinc.

Commented [RC(83]: Define and explain bermed area as commented on earlier in these comments.

Commented [SA(84]: Metals of concern.

2.3.3 Recent Inspection of Stormwater and Wastewater Systems

Two recent studies were completed by the Port to evaluate the conditions and to assess the potential of the storm system as a potential contaminant pathway. Both show that the stormwater systems and wastewater conveyance systems are not a potential contaminant pathway to the subsurface.

1. In August and September 2018, the Port managed the cleaning and video inspection of the Terminal 2 stormwater system. Details can be found in a March 18, 2019 Parametrix memorandum (Parametrix, 2019b). Stormwater system cleaning included Terminal 2 pipelines, catch basins, manholes, and other associated infrastructure. The cleaning was completed using a jet pressure washer to remove sediment, oil, grease, and other debris. Wash water, sediment, and debris were vacuum extracted and disposed of at the Port decant facility located at Terminal 3.

   After the stormwater system was cleaned, a video inspection of accessible stormwater lines was conducted. Several short sections of small diameter piping had blockages and could not be video inspected. The small pipes with blockages were on the opposite end of the terminal near United Grain and no discharge from NuStar or KMBT went to these pipes. The video was used to inspect the integrity of the stormwater lines, looking for evidence of breaks, leaks, separated joints, or other damage that could result in releasing stormwater to the subsurface. The results from the Terminal 2 stormwater system cleaning and video inspection show that the system is intact and is operating as designed. No evidence of the system as a source of contaminants to the subsurface was identified (Parametrix, 2019b).

2. In late September 2018, the Port managed a cleaning, inspection, and pressure testing of the wastewater conveyance system associated with the KMBT Operations Area. Details can be found in a December 17, 2018 Parametrix memorandum (Parametrix, 2018a). The portions of the conveyance system included in the cleaning are shown on Figure 2 of the December 2018 memorandum (Parametrix, 2018a). Conveyance facilities, including catch basins,

sumps, and lift stations, were cleaned using a vacuum truck and pressure washer. Lift stations operate in Sumps 1, 2, 3, 5, 7, and 8. Sumps 7 and 8 are located inside buildings 2875 and 2877, respectively. These two sumps were tested during construction of these buildings in 2017; therefore, they were not included in the Port's 2018 work.

After cleaning, the conveyance facilities were visually inspected. Based on a review of inspection forms completed by Port staff, other than a few minor cracks in catch basins and sumps, no damage, breaks, or leaks were observed. As part of the inspection process, a static water test was conducted in each sump. The tests included filling the sumps with water and measuring the water level over a 24-hour period. None of the sumps showed evidence of water loss or leakage (Parametrix, 2018a).

Pressure testing was completed on the primary treatment system conveyance piping to evaluate potential leaks, breaks or other evidence of damage. The following three main lines were pressure tested: Sump 1 to Old Sump 2, Sump 5 to Water Treatment Facility, and Sump 3 to Water Treatment Facility. The main line from Sumps 7 and 8 to Sump 3 was tested during construction of buildings 2875 and 2877 in 2017; therefore, it was not included in the current testing. These features are shown on Figure 2 of the above-referenced memo. Pressure testing found no loss of pressure in the tested lines, and, as such, no evidence of leaks or breaks in the lines were identified (Parametrix, 2018a).

Overall, results show that other than a few cracks in the catch basins and sumps, no damage, breaks, or leaks were observed. None of the sumps showed evidence of water loss or leakage. Pressure testing did not identify any loss of pressure or evidence of leaks or breaks. There was no evidence that the wastewater treatment sumps and piping are a potential pathway for contaminants to the subsurface (Parametrix, 2018a).

2.4 PRELIMINARY INVESTIGATION ACTIVITIES

Several investigations of copper (and other related metals) and/or nitrates/ammonia in various media in the Project Area have been conducted. A description of the preliminary investigation activities and results are provided in the subsections below.

2.4.1 Blue Water in SVE System

Interim remedial activities are ongoing on the NuStar Leasehold to address chlorinated solvents in the vadose-zone soil and groundwater. A soil vapor extraction (SVE) system is currently operating at the Facility. The extent of the SVE system is shown on Figure 13 in Appendix D.

During the November 2017 monthly SVE monitoring event, approximately 16 gallons of water were observed in the condensate knock-out drum, and the water was bright blue rather than colorless, as is typical when water is present. The knockout drum is designed to separate liquid from vapors that have been removed from the SVE wells, by allowing the liquid to precipitate into a drum before the vapors are drawn into the vacuum system (blower). A sample of the "condensate" was collected and shipped to a local laboratory for analysis of constituents that were known to be historically or currently handled at or in the vicinity of the NuStar Leasehold and the KMBT Operations Area, including chlorinated VOCs, fertilizer compounds (sulfate, nitrate, nitrite, and phosphorous), and metals (copper). The analytical results are provided in Table 1 of the *Summary of Additional Field Activities at the NuStar Facility – March through June 2018* report (Cascadia, 2018a). As reported in the additional investigation report, the results indicated that the knockout tank sample had elevated concentrations of copper, iron, ammonia, and nitrate, while the chlorinated VOC concentrations were at or below method reporting limits (Cascadia, 2018a).

After the blue water was discovered, the SVE system blower, knockout drum, piping manifold, and immediate area were inspected for obvious sources of surface water infiltration. However, nothing was observed. SVE system operating parameters remained consistent with historical results, suggesting that the piping remained intact and that there were no significant leaks in the system. During a site visit in April 2018, a gurgling sound was noted outside of SVE well vault VE-1-2, located between NuStar warehouses 2625 and 2655. When the vault to well VE-1-2 was opened, horizontal piping inside the vault was observed to have separated at a coupling. The inspection indicated that surface water was accessing the vault through a small pryhole located on the surface of the vault, at which point, water would accumulate in the vault until reaching the separating coupling, which could then allow stormwater to enter the SVE system and end up in the condensate drum.

The well coupling was repaired and the well was returned to service in September 2018. After repairing the well, blue water was still observed in the knockout drum. From June through November 2018, water was not observed in the knockout drum, which is consistent with the dry season in Vancouver, Washington.

To date, the source of the blue water in the SVE system has not been confirmed. During the 2018 rainy season, all SVE wells were closed, except those under building 2625, and blue water still collected in the knockout drum. As of the December 2019, NuStar is currently isolating (opening) small groups of wells, in an attempt to identify the location in which ground surface water (stormwater) is entering the SVE system.

2.4.2 Initial Groundwater Sampling for Copper – November 2017

To better assess the source of metals in the SVE knockout drum water, total copper analysis was ordered on groundwater samples collected during the fourth quarter 2017 groundwater monitoring event for the NuStar Leasehold. The copper analytical results from the fourth quarter 2017 groundwater monitoring event are shown on Figure 2 of the NuStar *Summary of Additional Field Activities at the NuStar Facility – March through June 2018* (Cascadia, 2018a). Copper concentrations

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Commented [RC(86]: The dry season is which months?

Commented [SA(87]: What do these sentences mean?

Commented [RC(88]: The rainy season is which months?

Commented [RC(89]: Meaning these wells are not drawing a vacuum because the valves to each SVE has been turned to the closed position?

Commented [RC(90]: Not finding metals results lab report for Nov 2017 event for MW-12, -13 and -15.

were detected in 25 of the 41 samples, with the highest concentrations located closer to the copper handling areas at the KMBT Operations Area (Cascadia, 2018a).

2.4.3 Wellhead Assessment

During fieldwork in November 2017, three groundwater monitoring wells (monitoring wells S-1, S-2, and MW-13) were identified as needing repair and redevelopment which was completed in 2018.

To further evaluate potential sources and pathways for metals in groundwater, Ecology requested a monitoring well monument assessment be conducted on the NuStar monitoring well network. The results of the monitoring well repair and redevelopment, and the monitoring wellhead assessment work is documented in the *Summary of Additional Field Activities at the NuStar Facility – March through June 2018* report (Cascadia, 2018a). The following paragraphs provide a summary of the scope and results of the wellhead assessment work.

On March 27, 2018, a representative from Ecology assessed 19 monitoring wells owned by NuStar. These wells consisted of wells EW-1, EX-1, MW-1, MW-6, MW-7, MW-8, MW-10, MW-12, MW-13, MW-14, MW-17, MW-23i, MW-2, MW-3, MW-9, MW-16, MW-19, MW-25i, and MW-26. Field representatives from Apex (on behalf of NuStar) and Parametrix (on behalf of the Port) were also onsite for the assessment.

Commented [SA(91]: Which wells were developed and what date were they developed? Were wells developed more than once? What dates?

During the wellhead assessment, Ecology took photos of monitoring wells and recorded information about the presence or absence of sediment in the well monuments above the well surface seal and around the upper portion of the well casing. Of the 19 wells assessed, 12 well monuments contained sufficient sediment volume for sample collection and analysis, including monitoring wells EW-1, EX-1, MW-1, MW-6, MW-7, MW-8, MW-10, MW-12, MW-13, MW-14, MW-17, and MW-23i. Ecology collected sediment samples from each of these well monuments. The well monuments for monitoring wells MW-2, MW-3, MW-9, MW-16, MW-19, MW-25i, and MW-26 did not contain enough sediment in the monument for sample collection.

A weighted tape was used to probe the bottom of the 19 wells to determine if sediment had accumulated. Sediment in wells S-1 and S-2 was assessed and sampled by Apex prior to Ecology's visit as summarized in the following paragraph. The only well with a notable amount of bottom sediment during the March 27, 2018 assessment conducted by Ecology was well MW-13. The sediment was present as murky or grainy dark water rather than a distinctly separate solid material. Ecology collected a sample of the murky water for laboratory analysis.

During a field event conducted a week earlier in conjunction with well monument repair work, Apex collected sediment from the monuments of wells S-1 and S-2 (on March 22, 2018) and sediment-containing water samples from the bottom of wells S-1 and S-2 (on March 26, 2018).

At the request of Ecology, well monument and sediment-containing well bottom samples that were collected by Ecology on March 27, 2018, and by Apex on March 22 and 26, 2018, were combined under one chain-of-custody for laboratory analysis of metals aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, molybdenum, selenium, silver, and zinc. Analytical results are provided are included in Table 3 of *Summary of Additional Field Activities at the NuStar Facility – March through June 2018* (Cascadia, 2018a). Copper concentrations in the well bottom "sediment" samples ranged from 612 milligrams per kilogram (mg/kg) in well S-2 to 20,300 mg/kg in well MW-13. Copper concentrations in sediment samples collected from the well monuments ranged from 2,060 mg/kg in well MW-1 to 23,800 mg/kg in well S-1.

Commented [SA(92]: What are results?

Commented [RC(93]: Only wells MW-13, S-1 and S-2 were redeveloped?

2.4.4 Surface Sediment and Gutter Sampling on NuStar Leasehold

On March 29, 2018, Apex collected a ground surface sample for analysis of copper. The sample was collected on the pavement surface where a layer of mud had accumulated adjacent to the seawall. NuStar terminal operations staff had collected a similar surface sediment sample from near the seawall in 2010 and copper concentrations in the 2010 sample were approximately 35,000 mg/kg.

The 2018 sample result for copper was 10,400 mg/kg. The location of the 2010 and 2018 surface sediment samples are shown on Figure 6 of *Summary of Additional Field Activities at the NuStar Facility – March through June 2018* (Cascadia, 2018a), along with photos of the surface sediment locations.

NuStar staff have documented red-brown staining on the roof of the northwestern corner of warehouse building 2655. The staining was located above a portion of the building gutter that looked to be heavily corroded and filled with 2 to 3 inches of sediment. The stained roof and corroded gutter are located directly beneath the KMBT conveyor system, where copper concentrate and bentonite material are transported from storage buildings to vessels at the Port Berth 7, located on the Columbia River. Cascadia field staff collected a sample of the gutter sediment from two locations as shown on Figure 6 of *Summary of Additional Field Activities at the NuStar Facility – March through June 2018* (Cascadia, 2018a). Samples were submitted to Apex Laboratories (Apex Labs) of Tigard, Oregon, for analysis of arsenic, barium, cadmium, chromium, copper, lead, mercury, molybdenum, selenium, silver, zinc, aluminum, and iron by EPA Method 6020A. Analytical results for the metals are provided in Table 4 of *Summary of Additional Field Activities at the NuStar Facility – March through June 2018* (Cascadia, 2018a), and copper results are presented on Figure 6 of *Summary of Additional Field Activities at the NuStar Facility – March through June 2018* (Cascadia, 2018a).

Copper concentrations in the two gutter samples were 174,000 mg/kg and 88,200 mg/kg, respectively. Photos of the gutter sediments and surrounding area are also provided in Attachment G.

2.4.4.1 Routine Groundwater Sampling and Analysis for Copper, Nitrates, and Ammonia

Commented [MJ(94]: It's not clear to me why 2.4.4.1 through 2.4.4.6 are subheadings of 2.4.4

Groundwater monitoring has been conducted at the Site to monitor the progress of remediation of chlorinated solvents in groundwater. Selected wells have also been analyzed for copper, nitrates, and/or ammonia as described below.

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Copper. Routine groundwater monitoring for copper was initiated by KMBT following the November 2017 groundwater sampling which indicated the presence of copper concentrations above typical background levels in groundwater in the Project Area (see Section 2.4.2).

Groundwater sampling for copper has been conducted in conjunction with NuStar's semi-annual groundwater monitoring program for VOCs. Since the initial sampling conducted in November 2017, an additional four groundwater sampling events have been completed from select monitoring wells with the most recent occurring in September 2019 (see Table 2).

Groundwater samples have been analyzed for the following constituents:

- General water quality parameters (alkalinity, bicarbonate, carbonate, calcium);
- Total dissolved solids;
- Total and dissolved copper;
- Chloride; and
- Sulfate.

Table 2 presents results of groundwater samples analyzed for total and dissolved copper. There has been a general reduction in copper concentrations in most wells since 2017. In September 2019, the highest concentration measured in groundwater was from monitoring well S-2 (211 micrograms per liter [µg/L]) located west of the bulk terminal conveyor belt (see Figure 4). Groundwater from several monitoring wells located a significant distance from KMBT operations contains copper greater than detection limits. For example, in September 2019, groundwater from well MW-2, located approximately 1,000 feet east of the ore conveyor contained 75.1 µg/L copper (Figure 4).

Nitrates and Ammonia. Groundwater samples collected from select NuStar monitoring wells between 2007 and 2016 were analyzed for ammonia and nitrates to evaluate natural attenuation processes in Project Area groundwater and to aid in the design of enhanced bioremediation interim actions for remediation of VOCs in groundwater. These data were reported in the NuStar RI (Apex, 2013) and are summarized in Table 3 herein.

Additionally, quarterly groundwater monitoring for ammonia, nitrate, and nitrite was initiated in November 2017 and has continued through the present. The analytical results are reported in each semi-annual groundwater monitoring report (Apex, 2017 and Cascadia, 2018b, 2019a, 2019b) and have been summarized in Table 3 for reference. Figures 5 through 8 illustrate the map view and extent of ammonia, nitrate, and nitrite in groundwater based on June 2019 results. In general, the concentrations of both nitrate and ammonia have been variable during the monitoring history at each well, with no discernible trend.

As shown on Figures 5 through 9, elevated ammonia and nitrate concentrations are generally limited to Shallow Zone groundwater beneath the part of the NuStar Leasehold where fertilizer is handled. With the exception of ammonia in well MW-2, fertilizer constituents are not present in groundwater on the eastern side of the NuStar Leasehold in the small and large tank farm areas.

2.4.4.2 Soil Investigation at KMBT Operations Area

As part of the West Vancouver Freight Access Project (WVFA), three soil investigations were completed near the north end of KMBT Operations Area. The WVFA project included expansion and relocation of rail facilities and associated utilities at the Port. Parametrix prepared a memorandum summarizing the results of these investigations (Parametrix, 2019c). A brief summary of the three investigations is provided below.

- In April 2010, the Port completed a soil investigation that included 16 direct-push borings (labelled PT1 to PT16) to collect soil samples and to assess soil conditions in the Project Area (Parametrix, 2019c). The borings were generally located to the north and west of buildings 2725 and 2745 in the area where bulk copper concentrate material is unloaded (Parametrix, 2019c). A total of 53 soil samples were submitted for petroleum hydrocarbons and metals (including copper) analysis. Except for soil from one boring (PT-10), detected constituent concentrations were below Ecology cleanup levels and the Port's fill acceptance criteria (Parametrix, 2019c). Copper was detected at a concentration of 3,800 mg/kg in a soil sample collected from 1 to 2 feet bgs in boring PT10 (see Table 1 in Parametrix, 2019c). This boring was located directly north of building 2745. The Method B cleanup level for copper in 2010 was 3,000 mg/kg.

- In April 2016, a limited Phase II Environmental Site Assessment (ESA) was conducted as part of the Grain Track Unit Train Improvements & South Lead project. The intent of the investigation was to evaluate soil conditions around the KMBT Dumper Pit and to characterize the soil for disposal. A total of 17 borings (labelled B1 to B17) were completed to a depth of approximately 5 feet bgs (see Figure 1 of Attachment B in Parametrix, 2019c). The boring locations were close to borings completed during the 2010 investigation but extended to the west and east.

  One composite soil sample was collected from each boring and submitted for petroleum hydrocarbons, priority pollutant metals, and follow-up Toxicity Characteristic Leaching Procedure (TCLP) analysis, if necessary. Copper was detected at concentrations ranging from 7.83 to 1,120 mg/kg. The Phase II report text, tables, and figures are included as Attachment B of the Parametrix 2019c memorandum.

- In July 2017, the Port conducted a soil investigation along the former railroad tracks in the Project Area. The tracks were removed as part of the WVFA project. The intent of the investigation was to characterize the material beneath the former railroad line. A total of 12 test pits (labelled 001 to 012) were completed along the former tracks (see Exhibit A of Attachment C in Parametrix, 2019c).

  Two samples were collected from each test pit, one from the near-surface ballast material and one from the underlying sand. The ballast samples were from the fine-grained material within the ballast. The samples were analyzed for petroleum hydrocarbons, priority

Commented [RC(95]: Please detail what constitutes the project area.

Commented [RC(96]: What was done to delineate the extent of this contamination and has it been cleaned up? Where can that information be found?

Commented [RC(97]: What does composite mean, what depths? Is that from the same or multiple borings?

Commented [RC(98]: Please detail what constitutes the project area.

Commented [RC(99]: What were the sample depths/intervals?

pollutant metals, polychlorinated biphenyls (PCBs), and polynuclear aromatic hydrocarbons (PAHs). The analytical results are summarized in Table 1 of Attachment C in Parametrix, 2019c. The ballast samples contained elevated concentrations of petroleum-related compounds and metals. Copper was detected in the ballast samples at concentrations ranging from 1,200 to 12,000 mg/kg. The concentrations of copper detected in the sand underlying the ballast material ranged from 6.8 to 600 mg/kg (one to two orders of magnitude lower than ballast samples).

The data indicated petroleum hydrocarbons and elevated metals concentrations were limited to the shallow ballast material located directly below the copper-ore loading area and railroad line (Parametrix, 2019a). Based on the findings, the Port retained a contractor to excavate the ballast material to a depth of approximately 5 feet bgs.

Commented [RC(100]: Supposed to be 2019c? Not summary of fert?

Commented [RC(101]: Reference excavation area.

2.4.4.3 November 2015 Sediment Sampling and Chemical Analysis

The Port completed an investigation of sediment in November 2015 as part of maintenance dredging at Ports berths 2, 3, 4, 5, 7, 8, and 9 (Floyd Snider, 2016). Because the focus was on dredge material quality, sampling was conducted in the shipping berths; samples were not collected from the area between the shoreline and the berths.

Details of the field November 2015 activities and sediment characterization results are presented in a January 27, 2016 Memorandum by Floyd Snider (Floyd Snider, 2016).

Commented [RC(102]: The Floyd Snider memos need to be included in the SharePoint site.

As described in the 2016 memorandum, the sediment sampling was intended to accomplish the following four objectives:

1. Characterize sediments (dredged material sampling) in support of a Portland Sediment Evaluation Team (PSET) anti-degradation evaluation.
2. Characterize post-dredge surface sediments via sediment grab sampling to assess the chemical quality of the new sediment surface and support the PSET anti-degradation evaluation by comparing post-dredge data to the Sediment Management Standards (SMS) Freshwater Sediment Cleanup Objective (SCO) and Cleanup Screening Level (CSL) criteria.
3. Characterize surface sediments via sediment grab sampling in berths that were not dredged to provide chemical characterization of all berths at the same time.
4. Characterize sediment vertically in Berths 8 and 9 via sediment core sampling to obtain a better understanding of both the vertical extent of previous contamination found in Berths 8 and 9 and to inform future maintenance dredging efforts.

To assess the chemical quality of the new sediment surface and to conduct the PSET anti-degradation evaluation, post-dredge sediment grab samples were collected from the berths that were dredged during the 2015 maintenance dredging (i.e., Berths 2, 3, 4, 5, 7, 8, and 9, and the United Grain Terminal [Grain Terminal]). Samples were generally collected in accordance with a July 2015

Sampling and Analysis Plan (SAP) memorandum (Floyd Snyder, 2015a) and an October 2015 SAP addendum (Floyd Snyder, 2015b). The post-dredge sediment grab sample locations are depicted in blue on Figure 2 of the January 27, 2016 Memorandum by Floyd Snider (Floyd Snider, 2016).

Sediment samples were analyzed for the following constituents

- Total petroleum hydrocarbons
- Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc)
- Butyltin
- Semi volatile organic compound (SVOCs)
- Pesticides
- PCBs as Aroclors
- Total organic carbon
- Total sulfides
- Ammonia
- Total solids

Tables 2, 3, and 4 of the January 27, 2016 Memorandum by Floyd Snider (Floyd Snider, 2016) provide a summary of the analytical results.

Both post-dredge and non-dredged sample data were compared to SMS Freshwater SCOs and CSLs. Results indicated that no detected analytes exceeded either their respective freshwater SCO or SCL criteria. Only tri-butyltin (TBT) exceeded the TBT SCO from core sampling in Berths 8 and 9. The TBT surface results of the core analytical data for Berths 8 and 9 are consistent with previous TBT concentrations detected in 2007 in composite sediment samples collected from Berths 8 and 9.

Ammonia concentrations ranged from <0.11 to 1.36 mg/kg in the post-dredge and non-dredged samples, well below the SCO (per the SMS Freshwater Criteria) for ammonia of 230 mg/kg. Sediment cores extending to depths of 5 feet below the mudline were advanced at Berths 8 and 9. Ammonia concentrations in the core samples ranged between 10 and 19 mg/kg, more than an order of magnitude below the SCO.

Commented [RC(103]: The SCO level was/is?

As previously discussed, fertilizer has been offloaded from ships at Berths 8 and 9 since 2014, but it has not been offloaded at Berths 2, 4, 5, or 7. Therefore, it would be anticipated that sediment adjacent to Berths 8 and 9 would have the highest potential for the presence of ammonia. However, the sediment sampling conducted at all of the berths had similar ammonia concentrations and all were well below the ammonia SCO.

Commented [RC(104]: Overall general summary of the sampling would be nice.

2.4.4.4 2018 Airborne Dust Assessment

Commented [SA(105]: This assessment could be more comprehensive.

In March 2018, the Port assessed the potential that dust generated during KMBT copper concentrate or NuStar fertilizer operations was migrating via air and depositing in the Project Area. Details can be found in the July 26, 2018 *Updated Roof Gutter Sampling Results* memorandum

(Parametrix, 2018b). Prior to replacing gutters on specific buildings located on and near copper handling operations, gutter sediment was sampled in March 2018 and tested for seven metals and nitrates (see Figure 1 in Parametrix, 2018c). One additional sample was also collected from a gutter on a small bathroom located directly beneath the conveyor system. Roof gutters on the NuStar Leasehold were not included in the gutter evaluation performed by the Port.

Commented [RC(106]: Bathroom building?

The gutter sediment analytical results are provided in Table 2 of the July 26, 2018 *Updated Roof Gutter Sampling Results* memorandum (Parametrix, 2018b). The results in Table 2 are compared to Clark County soil background levels (Ecology, 1994) as well as MTCA screening levels. Arsenic and cadmium concentrations also consistently exceeded Cleanup Levels and Risk Calculation (CLARC) levels. Results show the highest concentrations were from gutters located closest to the KMBT Operations Area and attenuating with distance (Parametrix, 2018c).

Commented [MJ(107]: Also? In addition to what other metal? Looks like something was left out here

Commented [SA(108]: COCs?

Of the 21 gutter samples analyzed for nitrates, 20 did not contain nitrate at concentrations above method reporting limits. One sample collected from the northeast side of Port building 2835 contained nitrate at a concentration of 12.3 mg/kg.

2.4.4.5 2018 Pavement Evaluation Project

The Port initiated a pavement rehabilitation project in May 2018 at Terminals 2 and 3 southeast of the KMBT facility. Part of the project consisted of assessing the asphalt and subsurface conditions to determine the thickness, condition, and remaining life of the pavements and sub-grade. Parametrix prepared a memorandum documenting the results of sampling conducted in support of the project (Parametrix, 2018c) A brief summary is provided herein.

As part of the investigation, six borings (B-1 through B-6; see Attachment A of Parametrix, 2018c for boring locations) were advanced to a depth of approximately 4 feet. Soil samples were collected at two depths from each location for chemical analysis to evaluate road base conditions. The samples were analyzed for nitrate-nitrogen, ammonia, total Kjeldahl nitrogen (TKN), aluminum, calcium, copper, iron, lead, selenium, and zinc. The sample collected from boring B-5 at 2 feet bgs, which had the highest copper concentration (133 mg/kg), was further analyzed for antimony, arsenic, beryllium, cadmium, chromium, nickel, silver, and thallium. Tables summarizing the analytical results are included in Parametrix, 2018c.

Commented [RC(109]: Which two depths?

Samples from borings B-6, B-5, and B-4, located closest to the KMBT Operations Area, contained copper above the Clark County soil background level of 34 mg/kg (Parametrix, 2018c). However, the results were below the MTCA Method B Non-Cancer cleanup level for copper of 3,200 mg/kg and Vadose Zone Soil - Protective of Groundwater cleanup level of 284 mg/kg (Parametrix, 2018c).

Commented [RC(110]: For soil?

Commented [SA(111]: This was 3000 above.

Commented [RC(112]: Table on page 37 indicates a copper cleanup level of 3,000 mg/kg?

Nitrate concentrations ranged from non-detect (i.e., <2.7 mg/kg) in five of the twelve soil samples to a maximum of 137 mg/kg at location B-5 at 3 feet bgs. Ammonia ranged from 0.224 mg/kg at boring B-1 at 4 feet bgs to 1,070 mg/kg at boring B-4 (1 foot bgs). Total Kjeldahl nitrogen (TKN) concentrations ranged from below reporting limits (i.e., <42 mg/kg) in two of the twelve samples up to 2,400 mg/kg in boring B-4 at 1 foot bgs. There are no MTCA regulatory standards available for screening nitrate or ammonia concentrations in soil.

The Port repaved the asphalt around buildings 2655 and 2625 in September/October 2019. Representatives for NuStar noted an ammonia odor emanating from the subsurface after the old pavement had been removed (and prior to laying the new asphalt). Surface soil samples were collected from three areas with discernable ammonia odors, and the samples were analyzed for ammonia by Method SM 4500-NH3 and nitrate/nitrite by EPA Method 9056A. The sample locations and analytical results for ammonia and nitrate are shown on Figure 9. The ammonia concentration in the three samples ranged from 40 to 122 mg/kg and the nitrate concentrations ranged from non-detect (<2.59 mg/kg) to 37.8 mg/kg.

In general, the ammonia, nitrates, and metals results support the conclusion that the pavement is limiting migration of copper concentrate and fertilizer into the underlying soil. The presence of the higher copper, nitrates, and/or ammonia concentrations in soil in borings B-4 through B-6 can be explained by the more intensive operations in these areas; the area around sample locations B-6, B-5, and B-4 are subject to tracking by vehicles, and the area around B-6 is subject to washdown activities when mineral handling equipment is cleaned after transfer operations.

Commented [MJ(113]: Can these be added to Figure 9 so future readers don't have to track down the other document?

2.4.4.6 2019 Storm Pond Outfall

On July 30, 2019, the Port and Ecology each collected samples from the Terminal 4 storm pond outfall for analysis of total nitrate/nitrite as nitrogen by EPA Method 353.2. The Port sampled the outfall for total nitrate and nitrite again on October 3, 16, and 22, 2019, and Ecology sampled for total nitrate and nitrite on October 16, and 22, 2019. The October 3 and 16, 2019 outfall sampling events were conducted concurrently with a fertilizer offloading event at Berths 8 and 9 that lasted from September 11, 2019 through October 18, 2019. The October 22, 2019 sampling was conducted following completion of the unloading event. The results from the outfall sampling events are provided in Table 4. The concentration of total nitrate/nitrite ranged from 0.342 to 0.895 mg/L during the sampling events. Water from the storm pond is ultimately discharged to the Columbia River under an NPDES permit held by the Port. The permit benchmark for nitrates is 0.68 mg/L.

On November 6, 2019, Jones Stevedoring Company and Two Rivers Terminal, LLC received a Notice of Violation (NOV) from Ecology, identifying that bulk fertilizer was visible on the ship's rail and in scuppers, allowing fertilizer to enter the Columbia River via the Port's stormwater system. The NOV requires improved BMPs to be implemented by the longshoreman and stevedore companies to mitigate fertilizer from entering the river. In addition, Ecology transmitted a Water Compliance Inspection Report (Report) to the Port on December 30, 2019, which listed the results of the Ecology sampling of stormwater discharge in July and October 2019. The Report noted that the benchmark was exceeded during the offloading event but not before or after the offloading event. Ecology concluded in the Report that the sweeping and BMPs implemented by Jones Stevedoring are not sufficient to prevent nitrate concentrations above benchmark values from entering the river via stormwater discharge. The Report references the NOV issued to Jones Stevedoring and Two Rivers requiring they file a report describing how they will improve cargo handling to prevent nitrates from entering the Port's stormwater system during unloading activities. Ecology has decided to defer enforcement until after Jones Stevedoring implements their proposed improved BMPs.

2.5 COPPER-RELATED RELEASES AND REMEDIAL ACTION

Four separate remedial activities associated with releases of copper have been performed in the Project Area:

1. Copper concentrate release to sediments near the Port's bulk loading facility (Port Berth 7 in 1987),
2. Copper concentrate release to soil south of the former sand shed (West Marine Coast, 2006).
3. CCA wood treatment preservative concentrate release near storage tank 132 at ST Services Facility in 2006 (Valero, 2006)
4. ACQ wood treatment preservative release within the ST Services Facility in 2007 (Ash Creek, 2007a/b).

Commented [RC(114]: Include on reference page and make available on SharePoint site.

Commented [SP115]: Should this be 2007a/b/c?

The first two releases were associated with copper concentrate in the KMBT Operations Area, and the second two were associated with copper-containing wood preservative in the eastern portion of the NuStar Leasehold. A summary of each release and remedial efforts to address the release are provided below.

2.5.1.1 Copper Concentrate Release to Columbia River Sediments and Remedial Action

Below is a summary of a Parametrix memorandum (Parametrix, 2019d) that describes the copper concentrate release investigation and remedial response.

Discovery and Initial Investigation. In August 1987, Ecology discovered a release of copper concentrate to the Columbia River from the Port loading facility at Berth 7. Ecology issued the Port a Compliance Order (DE 87-S225) in November 1987 that required a site investigation to determine the nature and extent of copper-contaminated sediment. Ecology approved a Work Plan submitted by the Port in January 1988. The findings of the investigation were documented in a report submitted to Ecology in October 1988. Sediment samples were collected near Berth 7 to define the extent of copper contamination in sediment. Concentrations of copper detected in sediment are summarized on Figure 3 of the Parametrix memorandum (Parametrix, 2019d). The investigation found the highest concentrations of metals were in the immediate vicinity of the bulk loading facility. For the most part, concentrations decreased downstream. Copper and arsenic concentrations were greater than background in the study area (Parametrix, 2019c). Zinc, chromium, lead, and mercury concentrations were within the range of background levels.

Commented [MJ(116]: So that a reader does not have to track down this document, please say how many samples were taken and range of concentrations, and any gradients noted. It would actually be helpful to include the figure from the memo too.

Additional Sampling and Required Remediation. Based on the findings of the initial investigation, a Phase II Columbia River Impact Investigation was completed, which included additional sediment sampling and acute static bioassay testing. The findings of the Phase II investigation indicated the highest concentrations of copper in sediment were located immediately adjacent to the bulk loading facility (see Figure 4 of Parametrix, 2019d). In addition, the bioassays indicated the sediments were not acutely toxic to fish and not classified as Extremely Dangerous Waste. However, sediment with higher concentrations of copper was determined to be a potentially Dangerous Waste. In December 1989, the Port submitted a Draft Dredging and Disposal Feasibility Evaluation, which included a recommended action of hydraulic dredging. In July 1990, Ecology issued an enforcement order (DE 90-S189) that required the cleanup of copper-impacted sediments from the Columbia River using hydraulic dredging. In addition, remedial activities included the design and construction of a water pollution control facility for the Bulk Facility Operation Area, including the construction of a concrete curb near the loading facility to eliminate surface stormwater flow to the river.

Remediation Activities. In July 1990, dredging of the copper-contaminated sediment was initiated. A cleanup level of 1,300 mg/kg was determined to be protective of freshwater organisms. The area of sediment containing copper at concentrations exceeding the cleanup level was limited to the area around the Berth 7 dock. The Port removed approximately 5,000 cubic yards of sediment with copper concentrations exceeding 1,300 mg/kg. The dredge area was divided into 35 cells that were 40 by 40 feet in size. The dredged volume was approximately 34,700 cubic feet and the average depth of the dredge was 1.5 feet.

Cleanup Verification Sampling and Closure. Cleanup verification sampling of sediment in the grid cells was completed in June and August 1990, and April 1991. Based on the sampling, sediment with copper concentrations exceeding 1,300 mg/kg was identified in the area directly under the dock (grid cells 10 and 11) and the area of grid cells 25 and 26 (Century West, 1990). In August 1992, approximately 400 cubic yards (yd^3) of additional sediment were removed from grid cells 25 and 26 using clamshell dredging in accordance with an Ecology-approved supplemental remedial alternatives plan. The dredged material was placed on a barge for dewatering prior to transport by truck to the Port's upland disposal site. Verification sampling in grid cells 25 and 26 indicated copper concentrations in sediment were below the 1,300 mg/kg cleanup level. The sediment with copper exceeding the cleanup level in grid cells 10 and 11 (beneath the dock) was left in place due to safety concerns for divers. As approved by Ecology, natural sedimentation was relied upon to reduce copper concentrations over time in the area beneath the dock.

Commented [SP117]: We need to track down this reference at some point.

In 1993, Ecology notified the Port that all required actions of the Enforcement Order had been fulfilled, and the site was removed from the Hazardous Sites List.

2.5.1.2 2006 Copper Concentrate Release to Soil at KMBT

Release. In early 2006, during the drying process to reduce moisture in copper concentrate, the drying system failed, resulting of a release of copper concentrate to the ground surface. The release was localized in the area immediately south of the former sand shed footprint.

Cleanup and Cleanup Verification Sampling. Cleanup began on January 29, 2006, and final cleanup verification samples were collected in April 2006. Information and analytical results are presented in a copper concentrate clean up report prepared by West Coast Marine (2006). West Coast Marine did not prepare a figure showing the final cleanup sampling locations and the actual soil sample locations are unknown. However, a sketch found in the Ecology Report Tracking System file (ERTS# 553779) shows the general area of the release.

The area is generally an arc wrapping around and within 120 feet of the east end of the former sand shed and the area between the sand shed and the A-frame building (building 2725). It is assumed that the verification soil samples were collected in this area. Cleanup began on January 29, 2006. Details of the remedial actions are unknown but as reported in Ecology ERTS# 553779, included excavating approximately 2-inch depth of paved area. Project details, the sketch, and the reference to the "no further action" needed are presented in the ERTS File 553779, 2006 KMBT Copper Cleanup.

Ten verification soil samples were analyzed of both copper and lead concentrations. Results show copper concentrations ranged from 16,200 to 37 mg/kg and lead concentrations ranged from 138 to 3 mg/kg.

Commented [SA(118]: Do these exceed cleanup levels?

2.5.1.3 2006 Release of Chromated Copper Arsenate and Remedial Action at NuStar Leasehold

Based on a review of NuStar records, two historical releases of liquid wood preservatives products containing copper occurred on the NuStar Leasehold. This included a release of CCA in 2006 and a release of ACQ 2102 in 2007. A summary of the two releases and subsequent remediation activities are provided in the sections below and were also provided to Ecology in a memorandum entitled *Historical Handling of Historical Products Containing Copper and Historical Management of Copper Dust from Nearby Operations – NuStar Vancouver Facility* (Cascadia, 2020b).

Release and Initial Response. On March 10, 2006, 15 gallons of CCA were spilled on the ground at the NuStar Leasehold during a product transfer from a rail car to a storage tank due to a leaking valve. The National Response Center (NRC), Ecology, and the EPA were notified within an hour after the spill was identified.

Spill Clean Up and Stockpile Characterization Activities. The spill cleanup operations were initiated within an hour after the release was discovered and the leaking valve was addressed and contained. Cleanup activities included cleaning the side of the railcar (to minimize additional spill material) and excavation of stained soil. The impacted soil was easy to identify and remove because the CCA left a distinct greenish color where it had contacted the soil. The soil was excavated vertically until the stained soil was removed; the sidewalls of the excavation were then extended an additional 2 feet laterally from the stained/unstained interface. The lateral extent and depth(s) of the historical excavation are depicted on Figure 3 of Cascadia, 2020b.

The excavation activities were completed on March 15, 2006. Water from the railcar cleanup and soil from the excavation were containerized pending sampling and profiling for subsequent disposal. Composite samples of the excavated soil and cleanup water were submitted for laboratory analysis of total metals and TCLP metals, including arsenic, chromium, and copper. The TCLP soil and water results were below state dangerous waste criteria, so the waste was classified as unregulated waste.

Soil Confirmation Sampling. On March 16, 2016, a work plan memorandum was submitted to Ecology, proposing methods and procedures for collecting soil confirmation samples from the excavation area (Ash Creek, 2006a). Locations of the confirmation sampling are shown on Figure 3 of Cascadia, 2020b.

Commented [RC(119]: 2006?

Soil samples CS-1 through CS-4 were collected on April 5, 2006, and were submitted to a laboratory for analysis of total arsenic, chromium, and copper. The analytical results from the soil samples are tabulated below.

Sample	**Total Concentration in mg/kg**		
	Arsenic	**Copper**	**Chromium**
CS-1	35.7	29.8	54.4
CS-2	1.20	5.97	50.6
CS-3	3.31	15.9	41.2
CS-4	2.86	14.3	94.5
CS-5	26.1	not analyzed as detailed below	not analyzed as detailed below
CS-6	5.85	not analyzed as detailed below	not analyzed as detailed below
Model Toxics Control Act (MTCA) Cleanup Level	20	3,000	2,000

Commented [RC(120]: Soil Total Concentration…

Note: Cleanup Levels: MTCA Method A, Copper Method B; CLARC database.

With the exception of arsenic in sample CS-1, the soil confirmation samples were below MTCA cleanup levels. On April 12, 2006, an additional 6 inches of soil were removed from the area around sample CS-1, and a second confirmation sample (CS-5) was collected and analyzed for arsenic. The analytical result for arsenic in confirmation sample CS-5 was 26.1 mg/kg, which still exceeded the MTCA Method A cleanup level of 20 mg/kg.

On April 17, 2006, an additional 6 inches of soil were excavated in the vicinity of confirmation samples CS-1 and CS-5, in the deepest part of the excavation. The maximum size of the “deep” part of the excavation was approximately 36 inches across and 30 inches deep. After the excavation was completed, sample CS-6 was collected from the base of the excavation and was analyzed for arsenic. The resulting concentration was 5.85 mg/kg, which was below the MTCA Method A cleanup level of 20 mg/kg. NuStar submitted a letter to Ecology on April 24, 2006, documenting the completion of the CCA excavation and soil sampling activities.

2.5.1.4 2007 Release of Alkaline Copper Quaternary and Remedial Action at NuStar Leasehold

A description of the release, initial response, remedial activities and confirmation sampling results is provided below.

Release and Initial Response. On May 26, 2007, a release of ACQ 2102 occurred at the NuStar Leasehold during off-loading of a rail tanker car. A loaded tanker car containing preservative was being prepared for off-loading following standard operating procedures (SOPs). Due to an incorrectly installed valve on the rail car, the valve was physically open when set in the position marked as being "closed." When the cap was removed from beneath the valve prior to connecting the transfer hose, the open valve allowed a total of 5,000 gallons of wood preservative to be released. Product was released to both paved and unpaved areas.

The following activities were conducted immediately in response to the release:

- The release was reported to the City emergency services (fire department), Ecology, NRC, US Coast Guard, the Port, and the Washington State Department of Transportation (DOT). The notifications were made within two hours of the release.
- An emergency response contractor mobilized to the facility within 15 minutes and immediately initiated the following activities:
    - Soil containment berms were created to contain product;
    - Liquid product was collected and placed in a temporary storage tank;
    - Surface soil with visible product (blue staining) was excavated and placed in roll-off boxes;
    - Paved areas were pressure washed and the water was collected in the storage tank; and
    - Plastic was placed over the excavated area pending further action.

A total of 5,000 gallons of liquid were recovered (estimated as 4,200 gallons of ACQ 2102 and 800 gallons of water) and approximately 60 yards of soil with visible staining were excavated. The approximate location and lateral extent of the excavation is shown on Figure 4 of Cascadia, 2020b.

Soil Confirmation Sampling. On June 1, 2007, NuStar submitted an ACQ Cleanup Sampling Work Plan to Ecology with a proposed soil confirmation sampling plan for the excavated area (Ash Creek, 2007a). The samples were collected and analyzed for copper by EPA Method 6020. The sampling methodologies and analytical results were summarized in the July 6, 2007 ACQ Cleanup Sampling Results report (Ash Creek, 2007b). The excavated surface samples from the two areas with remaining visible staining had copper concentrations that exceeded the excavation cleanup goal of 3,000 mg/kg copper, at concentrations of 6,110 mg/kg in sample ACQSS-4 and 5,550 mg/kg in sample ACQSS-9, respectively.

Push probe samples were collected from two borings (ACQ-B-1 and ACQ-B-2) at depths up to 5 feet bgs in the areas of locations ACQSS-4 and ACQSS-9 to define the extent of additional excavation that was needed. A detailed description of the sampling and analytical results was provided in the July 6, 2007 ACQ Cleanup Sampling Report (Ash Creek, 2007b). The push-probe results demonstrated that the vertical extent of the soil to be excavated was limited to a depth of about 2 feet bgs near boring ACQ-B-1 and about 3 feet bgs near boring ACQ-B-2.

Additional Excavation. Additional excavation was completed on August 7, 2007, in the areas where the push probe data identified slightly deeper impacts. The extent of the excavation is shown on Figure 4 of Cascadia, 2020b. Approximately 0.8 cubic yard of soil was removed from the northern excavation area (near location ACQSS-4 and boring ACQ-B-1) to a final depth of approximately 5.5 feet, and approximately 2 cubic yards of soil were removed from the southern excavation area (near location ACQSS-9 and boring ACQ-B-2 and the rail piping manifold) to a total depth of about 3.5 feet. After the additional excavation, the exposed soil at both locations was free of visible staining. Because unstained soil was correlated with concentrations one to two orders of magnitude below the cleanup goal, the remedial effort was considered complete. After excavation activities were completed, the excavation was backfilled with crushed gravel.

2.6 POTENTIAL RECEPTORS

There is the potential for both human and ecological receptors in the Project Area.

Human Receptors. The Project Area is located adjacent to the Columbia River and includes industrial land which is owned by the Port and leased by various industrial operators. Human receptors will include occupational workers of the industrial operations as well as construction or excavation workers contracted for shorter term projects. Because the leased land is highly secured, there is little opportunity for human trespassers onto the uplands portion of the Project Area.

The Project Area includes the Columbia River adjacent to the KMBT Operations Area and the NuStar Leasehold. The Columbia River has many uses, including as a navigational channel for commerce and recreational boaters and fisher persons. Therefore, human consumers of fish from the Columbia River are a potential receptor, as well as recreational users exposed to the water of the river via ingestion or direct contact.

Ecological Receptors. Ecological receptors are both terrestrial and aquatic. As discussed in Section 2.1, the NuStar and KMBT facilities and surrounding areas are predominantly covered with impermeable surfaces and provide no terrestrial habitat. Aquatic organisms, including anadromous and resident fish species, some of which are threatened or endangered, use parts of the river during various stages in their life cycles.

Commented [SA(121]: Benthic receptors?

2.7 CHEMICALS OF POTENTIAL CONCERN

COPCs for the Supplemental RI for the bulk mineral and fertilizer operations at KMBT ~~BT~~ and NuStar, respectively, are developed in the following subsections.

2.7.1 Bulk Mineral Operations

Based on a review of the historical and current site use information, bulk materials including copper, silica, zinc, and manganese concentrates, bauxite, hydrated alumina, and ferrophosphorus have been imported, stored, and exported from the bulk minerals operations area. Previous investigations indicate the presence of some metals in media in the bulk mineral operations area at concentrations above regional background levels. Therefore, the COPCs associated with the bulk mineral operations are focused on metals.

Commented [MJ(122]: Remind the reader where this is exactly

Metal COPCs associated with bulk handing operations were identified using information from the following sources:

1. Analytical results of a copper concentrate sample collected by Ecology in 2015;
2. Information of metal compounds associated with the concentrate found in Safety Data Sheets (SDS) supplied to KMBT by both Montana Resources and KGHM (Appendix A);
3. Gutter sediment analytical results collected in 2018 by the Port near the bulk mineral operations (Parametrix, 2018b); and
4. Method A Soil Cleanup Levels for Industrial Properties – Table 745-1 (Ecology, 2007).

Commented [MJ(123]: Also the other gutter results from Cascadia 2018a?

On December 16, 2015, Ecology collected and analyzed a copper concentrate sample from Montana Resources as part of a rail-car release response approximately 0.75 mile west of the KMBT rail unload facility. The release was assigned ERTS number 661538. The copper concentrate sample was analyzed at the Ecology Manchester Environmental Laboratory in Port Orchard, Washington. The sample was tested for copper and Resource Recovery and Conservation Act (RCRA) eight heavy metals (RCRA-8 metals). The SDS listed expected metal compounds (other than copper) and their associated percentages in the copper concentrate. The analytical results were compared with soil background concentrations published by Ecology in 1994 (Ecology, 1994) and summarized in the table below along with the SDS metal compound percentages.

Metal	Department of Ecology Copper Concentrate Sample – 12/16/15 (mg/kg)	Copper Concentrate Safety Data Sheets (Presence of metal or metal compounds listed in product) (Yes/No)	Washington Background Concentration for Clark County (Ecology 1994) (mg/kg)	Method A Cleanup Levels for Industrial Properties (mg/kg)
Copper	226,000	Yes (25 – 80%)	34	None
Zinc	Not Analyzed	Yes (0.1 – 15%)	96	None
		RCRA-8 Metals		
Arsenic	1,590	Yes (trace)	6	20
Cadmium	80.7	No	1	2
Chromium	4.26	No	27	2,000 (Cr^3)*
Lead	4,950	Yes (<1%)	17	1,000
Mercury	0.82	No	0.04	2
Silver	147	No	Not Available	None
Barium	1.50	No	Not Available	None
Selenium	55.9	No	Not Available	None

*Total Chromium

The tabulated results show the copper concentrate sample contained copper and four other RCRA-8 metals (arsenic, cadmium, lead, and mercury) greater than available Clark County 90th percentile background values. Chromium, while detected in the copper concentrate sample, was less than the background. In addition, the SDS did not identify the presence of chromium compounds in the concentrate.

Results from the gutter sediment data collected in February and March 2018 by the Port are consistent with the copper concentrate data collected by Ecology. The gutter data show elevated (above background) concentrations of copper, arsenic, cadmium, lead, and mercury (Parametrix, 2018b) near the KMBT facility. Zinc was not analyzed by Ecology in the concentrate samples. However, gutter sediment results show zinc concentrations above background. Chromium concentrations detected in the gutter samples were near the regional background of 27 mg/kg. Most of the chromium concentrations near the bulk terminal operations were less than background and all were below 50 mg/kg (Parametrix, 2018b). Concentrations of silver, barium, and selenium were also detected in the gutter data typically within one order of magnitude relative to the copper concentrate results.

Commented [SA(124]: We took a copper concentrate sample and tested but it is not on MSDS? Why aren't the gutter results on this table?

Commented [MJ(125]: Not sure of significance of this statement. Were the absolute values above background as is discussed for the other metals?

In summary, based on the available lines of evidence discussed above, the metal COPCs associated with bulk operations are as follows:

- Copper – Present above the background concentration in both the copper concentrate sample and gutter samples. Copper compounds are also a component of the concentrate as listed in the available SDS.
- Arsenic – Present above the background concentration in both the copper concentrate sample and gutter samples and present above the referenced Method A cleanup level. Arsenic compounds are also a component of the concentrate as listed in SDS.
- Cadmium – Present above the background concentration in both the copper concentrate sample and gutter samples. Also present above the referenced Method A cleanup level.
- Lead – Present above the background concentration in both copper concentrate sample and gutter samples. Lead was present above the referenced Method A cleanup level. Lead is also a component of the concentrate as listed in SDS.
- Mercury – Present above the background concentration in both the copper concentrate sample and gutter samples.
- Zinc – Zinc was not tested by Ecology in the copper concentrate sample. However, zinc was detected above background in the gutter samples and, according to the available SDS, zinc compounds can be expected to be present in the concentrate.

Chromium is not considered to be a COPC based on: (1) SDS information showing chromium is not significantly present in the copper concentrate, (2) the concentration of chromium detected in the copper concentrate sample collected by Ecology was below background, and (3) chromium was detected at concentrations below or slightly above background in gutter samples. Also, all chromium concentrations are below the Method A cleanup level for industrial properties. Barium, selenium, and silver are not considered COPCs because they are not expected to be significantly present in the copper concentrate.

2.7.2 Fertilizer Operations

Fertilizers, consisting predominantly of phosphorous, nitrogen, potassium, and ammonium sulfate products, have been imported, handled, and exported from the NuStar Leasehold. Previous investigations indicate the presence of nitrate, nitrite, and ammonia in media at or near the NuStar Leasehold. Therefore, the COPCs associated with the fertilizer operations are nitrate, nitrite, and ammonia.

Commented [MJ(126]: Need to compare Ecology values, or any other samples that were tested for these, to background concentrations. If above, should be included as preliminary COCs.

Commented [MJ(127]: Because manganese and alumina were transloaded we should also screen sediments for those chemicals in the shipping areas.

Commented [MJ(128]: Why aren't potassium and phosphorus included?

Commented [SA(129]: Phosphorous? Other metals?

3.0 PRELIMINARY SITE CONCEPTUAL MODEL

For exposure to chemicals and potential risks to occur, a complete exposure pathway from release to receptor must exist. That pathway requires a source, release mechanism, transport mechanism, environmental exposure point and receptors. Two CSMs have been constructed to assess the potential for complete exposure pathways to exist based on the historical site use information and previous investigation data described in Section 2. Section 3.1 presents the CSM for copper concentrate operations at the KMBT Operations Area, a potential source of metals. Section 3.2 presents the CSM for fertilizer operations at the NuStar Leasehold, a potential source of ammonia and nitrate/nitrites. In each section, the potential release mechanisms from the product operations are summarized, the transport mechanisms are then developed and potentially complete pathways between the releases and possible receptors are identified.

3.1 COPPER/METALS

3.1.1 Summary of Bulk Mineral (e.g., Copper Concentrate) Operations

The copper/metals CSM depicting potential contaminant release mechanisms, transport, and exposure pathways is presented on Figure 10. As detailed in Section 2, historical operations at the KMBT facility consist of the import, handling, and export of bulk minerals and other bulk dry products. Bulk mineral concentrates are shipped to the facility primarily via rail. Railcars are unloaded by an excavator-type machine onto a covered conveyor system for transport into the bulk material warehouse. Heavy mobile equipment, including front-end loaders working inside the warehouse, transfer the ores onto a covered ship-loading conveyor. The conveyor connects directly to the ship loader and loads ore cargo into the ship's storage compartment. The bulk minerals are a potential source of metals, the COPCs for the KMBT.

3.1.2 Potential Release Mechanisms and Pathways

3.1.2.1 Site Activities as Primary Release Mechanisms

Based on the historical and current site operations at the KMBT, primary release mechanisms include:

- Untarping and unloading of railcars and transport of ore to Storage Building;
- Loading of ore from Storage Building onto the conveyor belt;
- Transit on the conveyor; and
- Loading on to ships at Berth 7.

3.1.2.2 Secondary Sources and Transport Mechanisms

COPCs from the primary release mechanisms can impact media in the Project Area, which can then act as secondary sources and transport mechanisms, as described below.

Bulk Materials, Including Copper Concentrate, as Fugitive Dust. Dust has been documented during the loading, handling, and unloading operations at the KMBT Operations Area. Fugitive dust particles can be transported in outdoor air to potential receptors; they can also be transported and settle into storm water and onto the surface water of the Columbia River.

Based on fugitive dust as a secondary source and the transport mechanisms described above, the following potentially affected media have been identified:

- Air
- Surface water
- Sediment

Bulk Materials, Including Copper Concentrate, on Paved Ground Surfaces. Bulk materials have the potential for falling onto paved surfaces both during transport and handling. From the paved surfaces, the ore concentrates have the potential for reaching potential receptors when rainfall creates stormwater that enters the stormwater conveyance or management system, or via overland flows to surface water and/or sediment, or to groundwater via monitoring wells.

Based on paved ground surfaces as a secondary source and overland flow as a transport mechanism, the following potentially affected media have been identified:

- Stormwater
- Groundwater
- Surface water
- Sediment

Bulk Materials, Including Copper Concentrate, on Unpaved Ground Surface. Approximately 26 percent of the KMBT Operations Area is currently unpaved, including the area along the rail corridors. Additionally, the area east of building 2745 was historically unpaved. Ore concentrates that are deposited on unpaved soil, either from airborne dust or from direct releases during bulk materials operations, are potentially accessible to receptors on the ground surface. Additionally, the ore can be secondarily transported to groundwater via leaching through the soil to groundwater.

Based on unpaved ground surfaces as a secondary source and leaching through soil to groundwater as a transport mechanism, the following potentially affected media have been identified:

- Shallow soil
- Groundwater
- Sediment
- Surface water

Commented [MJ(130]: Not explicit below, but contaminated groundwater discharging to surface water is a source to surface water and potentially sediments

Commented [RC(131]: Clarify as upland or aquatic sediment.
Dust would also get into stormwater.

Commented [RC(132]: Transported in storm water runoff and to groundwater…

DRAFT

Bulk Materials, Including Copper Concentrate, in Stormwater. Stormwater in the majority of the KMBT Operations Area is contained and pumped to the industrial water treatment plant and ultimately discharged to the City sanitary sewer. Stormwater in the area of the rail corridors infiltrates. Stormwater in the remainder of the Project Area flows to catch basins that discharge into the Port's underground stormwater conveyance system and ultimately to the Port's stormwater pond. Water from the stormwater pond ultimately is discharged to the Columbia River, thus there is a potential exposure pathway for metals COPCs to reach potential receptors in the river.

Based on stormwater as a secondary source and the flow pathway to the Port stormwater pond as a transport mechanism to the Columbia River or the infiltration flow pathway as a transport mechanism to groundwater, the following potentially affected media have been identified:

Commented [MJ(133]: This should recognize historic stormwater configurations where sw could discharge directly to river. (also on Figure 10)

- Surface water (Columbia River)
- Groundwater
- Sediment

Bulk Materials, Including Copper Concentrate, Direct Release to Sediment. Copper ore could be inadvertently released to Columbia River sediments during loading of concentrate onto ships at Berth 7.

3.1.3 Potentially Complete and Incomplete Pathways to Receptors

In summary, the CSM identified the following media that could have been impacted by metals from bulk minerals operations:

- Groundwater
- Soil
- Sediment
- Surface water
- Stormwater
- Outdoor air

Possible receptors were then evaluated to assess whether receptors could potentially be exposed to one or more of the identified media and the potential exposure route. As detailed in Section 2.6, there is the potential for both human and ecological receptors in the Project Area. Ecological receptors are both terrestrial and aquatic. Human receptors could be occupational or construction/excavation workers in the Project Area or human consumers of fish in the Columbia River.

The copper concentrate CSM on Figure 10 illustrates the potentially complete exposure routes to ecological and human receptors. A list of the potentially complete exposure pathways to receptors are:

- Human receptors (occupational workers) via inhalation or direct contact with fugitive dust containing metals COPCs.

- Human receptors (construction/excavation workers) via direct contact with shallow groundwater containing metals COPCs.
- Human receptors (recreational users of Columbia River) via ingestion or direct contact with Columbia River (surface water) containing metals COPCs.
- Human receptors (occupational or construction/excavation workers) – ingestion and/or direct contact with unpaved soil containing metals COPCs.
- Human receptors (tribal fishers of Columbia River) via ingestion or direct contact with Columbia River (surface water) containing metals COPCs.
- Aquatic receptors – ingestion and/or direct contact with surface water and/or sediments that have been impacted by metals COPCs potentially transported to these media via stormwater, direct releases, or groundwater.
- Aquatic receptors – ingestion and/or direct contact with stormwater from the current Port Storm Pond Outfall.
- Aquatic receptors – ingestion and/or direct contact with stormwater from historic Port outfalls.
- Human consumption of fish exposed to metals COPCs.

Other potential pathways were evaluated and considered incomplete, as follows:

- Human receptors (occupational and construction/excavation) via ingestion or direct contact of surface water, groundwater (occupational only), and sediments containing copper concentrate. Occupational and construction workers are not expected to be exposed to copper concentrate COPCs through these exposure routes during a typical work day.
- Aquatic receptors via exposure (inhalation, contact, or ingestion) of outdoor air, on-site surface soil, or on-site groundwater containing copper concentrate COPCs.
- Terrestrial receptors are considered insignificant because the site is industrial and provides insufficient habitat for terrestrial receptors.

3.2 AMMONIA/NITRATE

3.2.1 Summary of Project History in Support of CSM

As discussed in Section 2.5.1, fertilizer has been received at the Port and handled on the NuStar Leasehold since the late 1960s. Historically, fertilizer products were received via vessel at Berth 3, and in recent years (2014 to present), fertilizer has been received almost exclusively at Port Berths 8 and 9. As previously described, the stevedores are hired by the product distributer to offload the product, using a clam shell, into temporary storage facilities at the berths. The longshoremen (hired by the stevedores) load the fertilizer into trucks that are then transported to the NuStar Leasehold.

Commented [SA(134]: Figure 10 does not seem to show all cases where SW is being impacted by metals, i.e., leaching to groundwater and flowing into river or as SW into river.

Commented [SA(135]: Occupational workers around SW pond?

Commented [SA(136]: Where do fishers come into play?

NuStar assumes possession of the fertilizer when it reaches the Leasehold. As discussed in Section 2.5.1, the Port has many BMPs in place during vessel offloading activities to prevent the fertilizer from entering the river and stormwater. As also summarized in Section 2.5.1, NuStar has BMPs in place on their Leasehold to prevent the fertilizer from impacting stormwater, surface water/ sediment, and groundwater. Once the fertilizer reaches the NuStar Leasehold, the products were stored primarily in buildings 2645 and 2655 prior to 2008 and since 2014, have been stored in all five warehouses on the NuStar Leasehold (2645, 2585, 2655, 2625, and 2565). Loading docks have been installed at each of the five warehouses on the NuStar Leasehold. Trucks are loaded with fertilizer at one of the five locations, covered, and then driven off the site for distribution to customers.

3.2.2 Potential Release Mechanisms and Pathways

A CSM describing the fertilizer handling practices that might act as primary release mechanisms, secondary sources, transport mechanisms, pathways, and exposure routes to potential receptors was prepared and is shown on Figure 11. A narrative of the CSM for fertilizer, from site product handling activities through potential receptors, is summarized below.

3.2.2.1 Site Activities as Primary Release Mechanisms

Based on our understanding of the historical handling of fertilizer products at the Port and on the NuStar Leasehold, the following site activities or mechanisms have been identified as having the potential for release of fertilizer to media:

- Unloading ships at Berth 3 (historically) and Berths 8 and 9 (currently).
- Transportation of trucks containing fertilizer from the Berths to the NuStar Leasehold.
- Dumping fertilizer into dump pits on the NuStar Leasehold.
- Handling of fertilizer at the NuStar Leasehold
- Transport of fertilizer from the NuStar Leasehold by truck.

Commented [SA(137]: Check to see if there is any investigation in this area.

3.2.2.2 Secondary Sources and Transport Mechanisms

Fertilizer as Fugitive Dust. As discussed in Section 2.5.1, fertilizer is offloaded from ships using a clam shell and dropped into temporary storage containers. There is a potential for airborne dust to be generated during this process. In addition, fugitive dust may be generated during transport of trucks to the NuStar Leasehold and while loading fertilizer onto trucks for distribution from the facility. Fugitive dust has the ability to reach potential receptors through pathways such as particles in outdoor air and particles ~~setting~~ settling directly into the Columbia River surface water and sediments.

Based on fugitive dust as a secondary source and the transport mechanisms described above, the following potentially affected media have been identified:

- Air
- Surface water
- Sediment

Commented [SA(138]: Soil?

Fertilizer on Paved Ground Surfaces. Fertilizer has the potential to fall onto paved surfaces both during transport and handling of fertilizer products. From the paved surfaces, fertilizer has the potential to reach potential receptors through pathways such as overland flow of precipitation directly to surface water and/or sediment, overland flow to groundwater via unsecured monitoring wells, or overland flow to stormwater.

Commented [SA(139]: Cracks in pavement?

Based on paved ground surfaces as a secondary source and overland flow as a transport mechanism, the following potentially affected media have been identified:

- Stormwater
- Groundwater
- Surface water
- Sediment

Commented [SA(140]: Soil?

Fertilizer on Unpaved Ground Surface. There is currently no unpaved ground surface at the Berths 3, 8, and 9. There is a limited portion of the NuStar Leasehold in the railroad corridor that is not paved, as shown on Figure 3. The paved versus unpaved portions of the NuStar Leasehold have generally remained unchanged since fertilizer was first handled in the late 1960s. Additionally, there are 11 SVE system well vaults which are not paved at the bottom and have a small access point for stormwater in the vault cover. Fertilizer that is deposited on unpaved soil, either from airborne dust or (more likely) falling off trucks or from truck tires, has the potential for leaching through the soil to groundwater.

Commented [SA(141]: There is still dust that carries onto the unpaved surfaces outside of the leasehold areas.

Based on unpaved ground surfaces as a secondary source and leaching through soil to groundwater as a transport mechanism, the following potentially affected media have been identified:

- Shallow soil
- Groundwater
- Sediment
- Surface water

Fertilizer in Stormwater. Ground surface water at the Port is captured into catch basins that discharge into the Port's underground stormwater conveyance system and ultimately to a stormwater pond located at Terminal 4 (see Figure 2). Water from the stormwater pond ultimately is discharged to the Columbia River; thus there is a potential exposure pathway for fertilizer constituents to reach potential receptors in the river.

Prior to the Port's construction of the existing stormwater conveyance system, water at the Port flowed into catch basins that discharged directly to the river. The approximate location of stormwater outfalls in the subject area are shown on Figure 19. There is the potential that precipitation could mobilize fertilizer on the ground~~water~~ surface, that would flow into the storm drains and ultimately discharge into the Columbia River.

Based on stormwater as a secondary source and the flow pathway to the Port stormwater pond as a transport mechanism to the Columbia River, the following potentially affected media have been identified:

- Surface water (Columbia River)
- Sediment

Surface water and sediments have also been identified as potentially affected media based on historical stormwater flows to outfalls at the NuStar Leasehold.

3.2.3 Potentially Complete Pathways to Receptors

In summary, the CSM identified the following media that could have been impacted by fertilizer operations:

- Groundwater
- Soil
- Sediment
- Surface water
- Stormwater
- Outdoor air

Possible receptors include ecological (terrestrial and aquatic) and human (occupational or construction/excavation workers, recreational users of the Columbia River, or human consumers of fish in the Columbia River). The fertilizer CSM on Figure 11 illustrates the potentially complete exposure routes to ecological and human receptors. A list of the potentially complete exposure pathways to receptors are:

- Human receptors (occupational workers) – inhalation or direct contact with fugitive dust containing fertilizer COPCs.
- Human receptors (recreational users of Columbia River) – ingestion or direct contact with Columbia River (surface water) containing fertilizer COPCs.
- Human receptors (tribal fishers of Columbia River) via ingestion or direct contact with Columbia River (surface water) containing fertilizer COPCs.
- Human receptors (occupational or construction/excavation workers) – ingestion and/or direct contact with unpaved soil containing fertilizer COPCs.
- Aquatic receptors – ingestion and/or direct contact with surface water and/or sediments that have been impacted by metals COPCs potentially transported to these media via stormwater, direct releases, or groundwater.

Commented [SA(142]: Figure 11 doesn't show this.

- Aquatic receptors – ingestion and/or direct contact with stormwater from the current Port Storm Pond Outfall.

Commented [SA(143]: Occupational contact ingestion?

- Aquatic receptors – ingestion and/or direct contact with stormwater from historic Port outfalls in the Project Area.
- Aquatic receptors – ingestion and/or direct contact with sediments near historical outfalls.

Other potential pathways were evaluated and considered incomplete, as follows:

- Human consumption of fish exposed to surface water or sediments containing fertilizer; the fertilizer constituents—ammonia, nitrates/nitrites—are not bioaccumulative in fish tissue; therefore, fish exposed to these constituents in surface water or sediment will not uptake the constituents into tissue, and this pathway is incomplete.
- Human receptors (occupational and construction/excavation) via ingestion or direct contact of surface water, groundwater~~groundwater~~ (occupational only) and sediments containing copper concentrate. Occupational and construction workers and not expected to be exposed to copper concentrate COPCs through these exposure routes during a typical work day.

Commented [SA(144]: Fishers?

- Aquatic receptors via exposure (inhalation, contact, or ingestion) of outdoor air, on-site surface soil, or on-site groundwater containing copper concentrate COPCs.

Commented [RC(145]: Discussion here is about fertilizer?

- Terrestrial receptors are considered insignificant because the site is industrial and provides insufficient habitat for terrestrial receptors.

3.3 MEDIA PATHWAY EVALUATION

While the CSMs were prepared to identify potential pathways to receptors, there are infrastructure and BMPs in place in the Project Area which limit or prevent actual exposure to receptors. These are discussed further by media in this section.

For each media, a summary of relevant historical information is provided. This may include a description of facility upgrades or engineering or administrative controls that are in-place to reduce or eliminate impacts from COPCs, a summary of relevant data collected to-date, and a description of BMPs that have been implemented to reduce or eliminate risk from COPCs.

Taking into account the relevant historical data and background information, objectives have been established for investigating each media in the RI work plan. These are considered "Phase I" objectives as the Parties understand that the results of this initial investigation may solicit additional questions and/or the need for further investigation.

From the Phase I objectives, Phase I Investigative actions have been established, which in most cases, involve the physical collection of data. The detailed scope used to carry out those investigations is proposed in Section 4.0.

After implementation of the scope proposed in this SRIWP, the data will be evaluated and reported to Ecology. At that time, additional investigation will likely be proposed to answer additional questions/meet other objectives and to expand on existing datasets (i.e., further delineate, fill in data gaps, etc.). Those "Phase 2" objectives will be identified in a future work plan.

3.3.1 Groundwater

3.3.1.1 Summary of Relevant Historical Information

Selected wells in the Project Area have been monitored quarterly for nitrate, nitrite, and ammonia since November 2017 and monitored quarterly for copper since September 2018. Tables 2 and 3 summarize the analytical results from the quarterly groundwater monitoring.

Copper

Figure 4 summarizes copper analytical results for groundwater in selected wells in the Project Area. Monitoring wells were sampled before and after redevelopment in 2018, as identified in Section 2.4.3. A decrease in copper concentrations was observed following the redevelopment of selected monitoring wells and suggests that copper concentrate entrained in overland flow may have entered compromised well monuments/surface completions and accumulated as sediment in the wells.

Nitrate, Nitrite, and Ammonia

Fertilizer COPC data include historical groundwater data dating back to 2007 collected from select monitoring wells in support of enhanced bioremediation interim action and quarterly monitoring data from up to 43 monitoring wells collected from November 2017 through September 2019. As can be seen in Table 3, the results of the nitrates and ammonia are variable but appear to be generally decreasing since 2017. Figures 5 through 9 illustrate the current extent and distribution of nitrates and ammonia in Project Area wells.

3.3.1.2 Phase I Objectives

Based on the analytical data available to-date as well as the information gathered from the inspection of the SVE system, the wellhead assessment, and well redevelopment and subsequent resampling, two objectives were identified for evaluation in the first phase of the SRI.

1. Collect additional data to better assess whether groundwater is impacted via sediment in monitoring (or other) wells.
2. Collect additional data to assess whether groundwater is impacted via leaching of COPCs at the ground surface.

These two objectives apply to evaluation under both the fertilizer and copper CSM. It should be noted that the source of impacts to groundwater, which are being evaluated in this investigation, may be different for the various COPCs.

3.3.1.3 Phase I Investigative Actions

The following lists the proposed actions to be conducted to address the Phase I objectives for groundwater.

Objective 1 (Groundwater Impacted via Sediments Entering Wells) – Select monitoring wells will be sampled, redeveloped, and then resampled to evaluate whether the removal of potential sediment accumulation in the well or well filter screen has an effect on COPC concentrations in groundwater.

In addition, a grab groundwater investigation will be conducted to collect groundwater samples adjacent to monitoring wells located in copper concentrate and/or fertilizer operations areas. Three grab groundwater samples will be collected adjacent to each selected well in a line of increasing distance from the well. The results from well sampling and grab groundwater sample analyses will be evaluated to assess whether the concentrations in the well are consistent with the grab groundwater results or whether the concentrations decrease with distance from the well. If the concentrations of COPCs are higher in the well samples and decrease after the redevelopment/ resampling and/or decrease with distance from the well, the data would suggest that sediment accumulation in the well might be impacting groundwater quality local to the well but not distal. If COPC concentrations post redevelopment are generally consistent with grab groundwater samples radiating from the well location, then the primary source to groundwater may not be from sediment accumulation in the wells. These data will help to identify the presence and extent of metals, nitrate, and/or ammonia in groundwater in the Project Area, and to develop objectives for a Phase II investigation of groundwater.

Commented [RC(146]: Being collected at the same time as the grab samples?

Objective 2 (Leaching through Soil to Groundwater) - Grab groundwater sampling identified under Objective 1 will be conducted in both paved and unpaved areas to assess whether and to what extent COPCs that may be present in surface soil are leaching to groundwater. If the distribution and extent of COPCs in groundwater in paved areas differ from those in unpaved areas (e.g., concentrations decrease with distance from wells in paved areas but not in unpaved areas), these results might suggest leaching from surface soil may be occurring.

Commented [SA(147]: Where is this done in the unpaved areas?

3.3.1.4 Phase I Evaluation and Potential Phase II Work

The first phase of groundwater investigation is intended to identify the potential pathway or pathways for copper, ammonia, and nitrate at the ground surface to reach Project Area groundwater. The results of the investigation will be tabulated and figures will be prepared depicting the concentration of each COPC in both shallow and intermediate zone groundwater. The Phase I Data Evaluation will consider the following three questions (in italics):

1. *Are data sufficient to identify source/mechanisms?* If the source/mechanisms for metals, nitrates, and/or ammonia reaching groundwater are not clearly identified from the Phase I and other existing data, additional exploration may be needed and/or other sources or mechanisms may be evaluated in a Phase II investigation. If the source and mechanisms are

sufficiently understood following the Phase I data evaluation, no additional investigation will be needed to address this question.

2. *Is the extent of COPCs in groundwater defined?* If the data collected during the Phase I investigation identify that the extent of one or more COPC is not defined, additional data collection may be needed under a Phase II investigation. If the extent of copper, nitrates, and ammonia is sufficiently defined, no further investigation will be needed to address this question.

3. *Is there the potential for groundwater containing COPCs at concentrations of potential concern to discharge to the Columbia River?* If the Phase I and existing data support that metals, nitrates, and ammonia are not present in groundwater at concentrations of potential concern to the river at the southern NuStar Leasehold boundary, surface water assessment for these constituents will not be needed. If, however, the southern extent has not been sufficiently defined and/or metals, ammonia, and/or nitrate concentrations are above applicable surface water criteria in sampling locations located at the top of bank adjacent to the Columbia River, further groundwater and/or surface water assessment may be needed during a Phase II investigation. Further discussion of sediment and surface water data evaluation is included in Section 3.3.3.

3.3.2 Soil

3.3.2.1 Summary of Relevant Historical Information

As discussed in Sections 2.4 and 2.5 above, existing metals and/or nitrate/ammonia soil data are available from three general areas:

1. Soil data consisting of metals and petroleum hydrocarbon analyses collected along the northern portion of KMBT Operations Area along the railroad tracks. The data associated with the WVFA project soil investigations indicated that metals were limited to the shallow soil in this area (e.g., railroad ballast material) and decreased with depth. Based on these findings, the Port excavated the ballast material to a depth of approximately 5 feet.

2. Soil data (metals, nitrates, and ammonia) collected in the central and southern part of the Project Area as a part of the Port's Pavement Rehabilitation Project, Asphalt Assessment Soil Investigation. These data support that pavement is limiting downward migration of metals and fertilizer COPCs into underlying soil.

3. Copper data from soil sampling following the cleanup of a copper concentrate release to the ground south of the former sand shed.

In addition, two cleanups of copper-containing wood preservatives were completed in 2006 and 2007, as detailed in Section 2.5. Soil containing the spilled wood preservatives was immediately removed, and confirmation sampling demonstrated copper (and other applicable wood preservative compounds) were below applicable regulatory criteria following the removal actions.

Therefore, no further soil sampling and analysis for copper near these former release areas is necessary.

Commented [RC(148]: These analysis were not used to determine the impact to groundwater or difference in shallow soil in paved and unpaved areas. Summary explanation is needed on how these area should be exempt from further investigation. Data from these areas needs to be correlated with gw contaminant levels before these areas can be ruled out for contaminant contribution.

3.3.2.2 Phase I Objectives

The objective of the Phase I soil investigation is to assess for the presence of metals and fertilizer COPCs in shallow soil in areas not previously sampled. Areas to be evaluated include areas that are currently unpaved or, in the past, were unpaved during the periods of ore concentrate or fertilizer handling.

3.3.2.3 Phase I Investigative Actions

To meet the Phase I objective, soil samples will be collected from shallow soil in currently or historically unpaved areas. Proposed Phase I soil sampling locations are presented on Figure 18. Locations 25 through 38 and locations 41 and 42 are currently unpaved areas. Locations 39, 40, and 15 are in operations areas that were unpaved in the past. Location 43 was added at the request of Ecology to assess soil beneath the SVE vault from which blue water was noted.

Commented [SA(149]: 43 not labelled.

Two soil samples will be collected at each location to assess for the presence of the COPCs in surface soil and whether the concentrations decrease with depth. The surficial sample will be collected at 0 to 1 foot bgs and a deeper sample will be collected at 2 to 3 feet bgs. Chemical analyses for the samples are detailed in Section 4.

3.3.2.4 Phase I Evaluation and Potential Phase II Work

Phase I baseline soil data will be validated and summarized in tables. The tables will also provide a comparison of the results to appropriate MTCA screening criteria to address the following:

- Assess whether COPCs are above regional background levels (where available) and, if so, whether the concentrations are above MTCA screening criteria for occupational and construction/excavation worker receptors.
- Assess whether COPCs are above regional background levels (where available) and, if so, whether the concentrations are above MTCA screening levels for the potential leaching to groundwater pathway.

If COPCs are detected above background and applicable risk screening criteria, additional Phase II investigation may include:

- Additional delineation of the lateral extent of COPCs in soil.
- Additional delineation of the vertical extent of COPCs in soil.

3.3.3 Sediment/Surface Water

3.3.3.1 Summary of Relevant Historical Information

As discussed in Section 2.4, available metals and/or ammonia data on sediments in the Project Area were collected during two Port projects: a 1998 sediment sampling event and characterizations conducted in support of a 2015 dredging project. The Port data include copper and ammonia data in sediment in the navigable channel. The sediments were not analyzed for nitrate (or nitrite) as those analytes are not regulated under the Washington Sediment Management Standard. Figures depicting the location of sediment samples from the Port's pre-dredge event, are provided on Figure 2 of Floyd Snider, 2015a. The results of the dredge sampling indicated that copper and ammonia concentrations were low and consistently below the sediment management standards (freshwater SCO of 400 mg/kg and 230 mg/kg, respectively).

The Port sediment characterization projects primarily focused on the navigation channel and there are two areas located between the navigation channel and the shoreline that have not historically been sampled for copper or fertilizer constituents; these two areas are shown on Figure 19.

3.3.3.2 Phase I Objectives

Based on the sediment data collected during the Port dredge work, there are two sediment areas adjacent to Berth 7 that have not been investigated for metals, nitrate, or ammonia. Based on the identified data gaps, the Phase I objective for sediment/surface water investigation is to assess whether COPCs are present in ~~sediment~~these sediments in the Port Berth 7 area at potential concentrations of concern.

3.3.3.3 Phase I Investigative Actions

To meet the Phase I objective, a sediment investigation will be conducted in the areas shown on Figure 19. The Phase I sediment sampling locations have been selected to collect data from the areas with the highest potential for COPC impacts. These include:

- Immediately adjacent to the KMBT copper concentrate handling areas.
- Immediately adjacent to potential dust to river depositional areas from fertilizer handling activities and historical outfalls associated with the former Port stormwater system.

3.3.3.4 Phase I Evaluation and Potential Phase II Work

The results of the sediment investigation will be evaluated including the tabulation of data and preparation of figures depicting the magnitude and extent of COPCs in sediment in the Project Area. COPCs will be compared to applicable regulatory levels and the aerial extent of sediments exceeding applicable regulatory levels will be identified, if applicable. If the results of the Phase I investigation indicate that one or more of the COPCs are present at concentrations of potential concern and the extent has not been defined by the Phase I results, additional sediment

Commented [MJ(150]: Please explain better about the Port Dredge sampling. Parametrix 2019d says there were events in 2015 and 2017. Provide the reports supporting reference 2019d.

Commented [MJ(151]: Clarify if you are talking about only the 2015 data here? What was the 1998 event for? What was tested?

Commented [MJ(152]: Please better explain what you mean, and show the two areas on the figure – they are not shown.

Commented [MJ(153]: As we discussed at the meeting on March 25, please show the previous sample locations mentioned above on the figure, or perhaps better to include the Floyd/Snider figures. Also, there ARE many locations on the figure which are not explained or discussed here – so this section should explain those too. Use notes on the legend to explain which are which.

Commented [MJ(154]: Fertilizer was transloaded at Berths 3, 8, and 9 as well, so they need to be included in the scope. Also, show the old outfalls in those vicinities on Figure 19

Commented [MJ(155]: The vicinity of outfall T40 from the Site Storm system should also be included.

Commented [SA(156]: Berth 8 and 9?

Commented [MJ(157]: There are not regulatory standards from some of the fertilizer constituents and potential metals, therefore we will need to collect background samples for comparison.

DRAFT

investigation will be conducted during a Phase II investigation. Additionally, if the Phase I data suggest that COPC concentrations in sediments might present a potential concern to surface water quality, a surface water assessment will be conducted during the Phase II investigation. The PLPs will work with Ecology to identify the appropriate sediment screening levels to use to assess the Phase I data.

Commented [MJ(158]: To the extent possible, these should be included in this document

Commented [SA(159]: This should be now.

If COPCs are not identified in sediments at concentrations of concern, then further sediment investigation is not anticipated. Results from both the sediment investigation and groundwater investigation immediately adjacent to the river will be evaluated to determine if surface water investigation is warranted.

3.3.4 Outdoor Air

As discussed in Section 2.4, the Port conducted sampling of sediment accumulated in roof gutters to assess the potential for ore concentrate migration via airborne dust. The results showed metals concentrations in roof gutter sediment exceeded regional background levels in soil in most of the samples, with the highest concentrations located near the bulk terminal and attenuating with distance.

While it is recognized that additional assessment is needed to better understand the extent and distribution of metals COPCs in outdoor air via fugitive dust, these assessments will be conducted as a part of the Phase II investigation. The results of the Phase I soil investigation will be used to inform the requirements and the methodology for the Phase II outdoor air evaluation.

3.3.5 Stormwater

As discussed in Section 2.4, two recent studies were completed to assess the potential of the stormwater system as a complete pathway to groundwater. The results did not identify evidence that the conveyance system, including sumps and associated pipeline, is a source of contaminants to the subsurface and potentially to groundwater.

Stormwater sampling will not be addressed as part of the first phase of RI. The results of the Phase I investigation will inform the need for and, if needed, the scope and methodology for stormwater evaluation in Phase II of the investigation. At present, KMBT, NuStar, and the Port sample their stormwater as part of regular National Pollutant Discharge Elimination System (NPDES) compliance sampling.

4.0 SCOPE OF WORK FOR SUPPLEMENTAL REMEDIAL INVESTIGATION

The subsections below summarize the proposed phased-approach to the supplemental RI as well as the approach, rationale and procedures for Phase I investigation of groundwater, soil, sediment, and surface water. As mentioned in Section 1.1, Ecology has recommended additional VOC delineation in the vicinity of NuStar monitoring well MW-26 (located off the NuStar Leasehold to the west). The last portion of this section describes the work scope and procedures for additional VOC investigation requested by Ecology.

4.1 SUMMARY OF PHASED APPROACH TO INVESTIGATION

The table below summarizes the investigative actions proposed as “Phase I” of the supplemental RI investigation. The Parties acknowledge that additional activities will likely be required after the data from the first phase of the investigation are evaluated. However, the following Phase I investigation is proposed as a reasonable first step in evaluating the sources, transport mechanisms, and extent of COPCs in the Project Area.

Phase I Investigation	Phase II Investigation
Surface soil in unpaved areas of copper concentrate and fertilizer operations.	Conduct further surface soil investigation if not adequately defined in Phase I.
Shallow soil in historically unpaved copper ore operation areas.	Conduct further shallow soil investigation if not adequately defined in Phase I.
Assess riverbank for potentially erodible areas.	If erodible areas present, conduct surface soil sampling in these riverbank areas.
Redevelop and re-sample selected wells.	
Conduct grab groundwater (e.g., push probe) investigation.	Conduct further groundwater assessment if extent not defined by Phase I groundwater investigation. Conduct surface water sampling if groundwater data suggest a potential for groundwater containing COPCs at concentrations of potential concern to migrate to Columbia River.

Phase I Investigation	Phase II Investigation
Conduct sediment investigation.	Conduct additional sediment investigation if extent not adequately defined. Conduct surface water investigation if COPCs are present at concentrations of potential concern in sediment.
	Conduct an outdoor air assessment to define the extent of outdoor airborne particle deposition.
	Conduct stormwater assessment if soil, groundwater, and/or sediment data collected during Phase I indicate the potential for COPCs in stormwater at concentrations of potential concern.

4.2 APPROACH, RATIONALE, AND SCOPE FOR PHASE I GROUNDWATER INVESTIGATION

This section describes the general sampling approach for evaluating COPCs in groundwater, a rationale for the proposed sample locations, and a discussion of the proposed sampling methodology and procedures.

4.2.1 Approach/Rationale

The following table summarizes how each portion of the Project Area will be investigated to evaluate the source/transport mechanism of COPCs to groundwater. The table includes the area to be investigated, the objective for each investigation area, and the proposed sampling locations to meet these objectives. Boring and well locations are shown on Figure 17. A detailed description of the proposed approach and rationale for each boring follows the table.

Commented [RC(160]: Fig 17 has a un-numbered sample location in the Columbia River, looks like a typo?

Investigation Area	Objective	Boring or Well Location to Address
Project Area-Wide	Further assess whether groundwater affected by sediment entering well	Redevelop and Resample Wells: MW-1, MW-14, MW-17, S-1, S-2, MW-9, MW-10, MW-12, MW-13, MW-22i, MW-E Install and sample borings: 15, 16, 17, 18, 22, 23, 24, 40
Unpaved Areas including KMBT Rail Unloading Area (De-tarping area)	Assess potential impact of COPCs in shallow soil leaching to groundwater	Borings 25, 26, 27, 34, 41,42, and 44.

Project Area-Wide – Eleven wells (MW-1, MW-14, MW-17, S-1, S-2, MW-9, MW-10, MW-12, MW-13, MW-22i, and MW-E) have been selected to be redeveloped and sampled to better assess whether soil containing COPCs is entering the wells and affecting groundwater quality. These wells were selected because copper, nitrates, and/or ammonia have been identified in these wells in the recent past and they are proximal to copper concentrate and/or fertilizer handling areas. The wells will be sampled prior to redevelopment (as part of a quarterly monitoring event), and then again after redevelopment.

Additionally, following redevelopment of the monitoring wells and at the time of the resampling of the wells, groundwater samples will be collected at 11 boring locations (15, 16, 17, 18, 22, 23, 24, 25, 26, 27, and 40) using push probe technology; boring locations are shown on Figure ~~18~~17. As described in Section 3.3.1.3, groundwater data collected from these borings and from the redevelopment/sampling of the identified monitoring wells will be used to assess the potential transport mechanisms for COPCs at ground surface to enter groundwater in the Project Area. More detail on the rationale for the selected sampling locations is provided below.

Paved Areas – Seven boring locations (15 through 18, and 22 through 24) are proposed in paved areas to better assess the possible effect on groundwater of soil containing COPCs entering monitoring wells. Two or three borings are each located in the vicinity of three monitoring wells at spaced intervals to assess whether COPC concentrations taper with distance from the well. A pattern of higher concentrations in well samples diminishing quickly with distance from the well could suggest a source to groundwater of soil containing COPCs entering the wells. If the concentrations are relatively consistent between the wells and nearby borings, the distribution could suggest that leaching to groundwater from COPCs at the ground surface may be a source to groundwater. The wells and borings selected in the paved areas to facilitate this assessment are:

Well MW-10 and Borings 22, 23, and 24. This area is located in both the NuStar fertilizer handling area and under the KMBT conveyor system. Well MW-10 will be sampled, redeveloped,

Commented [RC(161]: Disagree with this time line. Redevelopment is going to change water quality in the formation surrounding the wells redeveloped and potentially allow collection of unrepresentative groundwater results. So grab sampling to determine the contaminant lateral extent should be done before redevelopment.

Commented [RC(162]: Looks more like one to three borings at each monitoring well.

Commented [RC(163]: Ecology is recommending another boring to collect shallow groundwater sample for fertilizer compound evaluation by MW-21i-105. This is because of the high nitrate level at MW-8 and also at MW-21i-105.

and then sampled again. Groundwater samples will be collected from borings 22, 23, and 24 located in a ~~parallel~~ line approximately 100, 50, and 25 feet, respectively, from MW-10.

Well MW-13 and Boring 15. This area is located near fertilizer handling and copper ship-loading portions of the Project Area. Well MW-13 will be sampled, redeveloped, and then sampled again. Groundwater samples will be collected from location 15, located between well MW-13 and the Columbia River. Well MW-13 and boring 15 are located at the top of the riverbank and data from these locations will also help inform whether further COPC data are needed to better assess the groundwater to river pathway.

Wells S-1 and S-2 and Borings 16, 17, and 18. This area is located near the copper loading area at Berth 7. Well S-2 is screened from 45 to 50 feet bgs but does not screen first encountered groundwater; well S-1 is screened in Intermediate zone groundwater with a screened interval of 69 to 74 feet bgs. Both wells S-1 and S-2 will be sampled, redeveloped, and then sampled again. Groundwater samples will be collected from borings 16, 17, and 18, which are located in a line perpendicular to the riverbank and between wells S-1 and S-2 and the Columbia River and spaced approximately 25, 50, and 100 feet from the S-1/S-2 well pair, respectively. Groundwater samples will be collected from three depth intervals from each boring: first encountered groundwater (estimated to be at approximately 25 to 30 feet below grade depending upon the season and river stage); 45 to 50 feet – equivalent to the screened interval for well S-2, and from 69 to 74 feet – equivalent to the screened interval for well S-1. These depth intervals will provide data to access whether first encountered groundwater has been impacted by fertilizer and/or copper concentrate, and whether or not the COPC concentrations observed in wells S-1 and S-2 are consistent with a larger groundwater plume or are indicative of an isolated area of "higher concentration". Results from borings 16 through 18 will also be used to evaluate if groundwater in close proximity to the river contains COPCs at concentrations of concern for aquatic receptors.

Unpaved Areas – Seven boring borings (25, 26, 27, 34, 40, 41, and 42) have been proposed in unpaved areas of the Project Area to evaluate the soil leaching to groundwater pathway. Details regarding the approach and rationale for each location are provided below:

Well MW-9 and Borings 25, 26, and 27. This area is in an unpaved rail corridor and is located between two warehouses in which fertilizer is handled and in close proximity to the KMBT copper conveyor system. Well MW-9 will be sampled, redeveloped, and then sampled again. Groundwater samples will be collected from borings 22, 23, and 24 located in a ~~parallel~~ line from MW-9. Borings 25 and 26 are located approximately 150 feet and 50 feet, respectively, to the west of MW-9; boring 27 is located approximately 50 to the east of MW-9.

Borings 34, 42, and 44. Proposed borings 34, 42, and 44 are located in an unpaved rail corridor. Boring 34 is west of the former railcar unload building, 42 is to the west of the KMBT railcar unload building 2877, and 44 is north of the a-frame storage building and south of the former railcar unload facility in an area that was formerly paved.

Commented [RC(164]: Seems each of the borings should be in the same groundwater flow scenario so the results are comparable. Concerned that 24 might be in an up-gradient location relative to MW-10 and 22-23 in potentially down-gradient locations.

Commented [RC(165]: There has to be two lines if something is going to be parallel.

Commented [RC(166]: These are supposed to be borings 25, 26 and 27, correct?

Commented [RC(167]: Seems each of the borings should be in the same groundwater flow scenario so the results are comparable. Concerned that 27 might be in a different groundwater flow orientation than 25 and 26 relative to MW-9.

Commented [RC(168]: For the each location where soil and gw samples are collected. Suggest using one push boring for the gw grab sample and another boring for the soil samples.

Boring 40. Proposed boring 40 is located south of the sand shed, near the center east-to-west.

Boring 41. Proposed boring 41 is located in an unpaved area approximately 100 feet north of the former sand shed and approximately 50 feet east of building 2745 (the Coverall Building).

4.2.2 Procedures

Methods to complete the groundwater investigation will include preparatory activities, advancing borings at the locations shown on Figure 17, field screening and/or (potentially) sampling of vadose zone soil, depth discreet sampling of groundwater, monitoring well redevelopment, and monitoring well sampling. The procedures for each of these methods are described below.

4.2.2.1 Preparatory Activities

Prior to the investigation, the public utility notification center will be contacted, and a private utility locator will be contracted to check for the presence of buried utilities or infrastructure in the work area. It should be noted that the presence of buried utilities or infrastructure, or other access issues, may result in the relocation of the proposed borehole locations from those presented on Figure 17. In addition to the utility locator, each boring will be advanced using a hand auger or air knife down to 8 feet to further assess for the potential presence of utilities or other buried materials in the near surface.

4.2.2.2 Boring Installation

Borings will be advanced using a direct push rig at the locations shown on Figure 17. A licensed drilling subcontractor will be retained to advance the borings, and a field engineer or geologist will oversee the installation under the supervision of a registered professional. The investigation will be conducted in accordance with the SOPs for direct-push explorations, which are included in Appendix E.

4.2.2.3 Field Screening

Continuous soil samples will be collected during push-probe activities for the purpose of documenting the lithology encountered and for field screening for VOCs[2] with a photoionization detector (PID). These procedures are detailed in the field screening SOPs in Appendix E.

4.2.2.4 Temporary Pre-Pack Well Screen Installations for COPC Analyses

Temporary wells will be installed in the borings where groundwater samples are to be collected for COPC analysis (i.e., borings 15 through 18, 22 through 27, 34, 40, 41, 42, and 44) to facilitate the collection of groundwater samples representative of the formation. The borings will be

[2] Although VOCs are not a Supplemental RI COPC, there is ongoing monitoring and remedial action to address VOCs in soil and groundwater in the Project Area; therefore, soil samples will be screened for VOCs to supplement the VOC data for the Site.

advanced to the bottom depth of the screened interval of the nearest monitoring well using a push-probe rig and temporary pre-packed well screens will be installed in the borehole to screen the approximate equivalent screened interval of the adjacent well. For borings 40, 41, 42, and 44, where there is not an immediately adjacent well, the boring will be advanced to the first significant saturated zone; shallow and thin (perched) saturated zones may be ignored.

Prepacked well screens are typically built around a slotted PVC casing that can be threaded onto standard flush-threaded PVC well casing. The casing is wrapped with fine stainless steel mesh and the annular space between the casing and the screen is filled with well sand. The casing slots and the sand size should be selected to match the expected soil types; generally, finer mesh sand is used in finer soil types to prevent the formation soil from passing through the well assembly and into the well. The drive casings for pre-packed temporary wells will be driven to their target sample depths through undisturbed formation using a sealed expendable drive-point to prevent contaminant drag down.

Where the sample interval is in the intermediate aquifer, precautions will be taken to prevent cross contamination between the upper and intermediate aquifers. Typically, this involves driving a larger diameter casing to the upper portion of the lower permeability zone separating the Shallow and Intermediate groundwater zones. The borehole is then advanced within this secondary casing to the targeted screened interval in the intermediate zone, and the temporary well is then constructed as described above.

Groundwater samples will be collected from each of the pre-packed temporary wells using low-flow sampling equipment using the technology described below in Section 4.2.2.7.

When the samples have been collected, the temporary wells will be abandoned in compliance with Washington State regulations.

4.2.2.5 Monitoring Well Redevelopment

Prior to well development, the depth to water and total depth of the well will be measured and the casing volume will be calculated.

The wells will be developed using a submersible pump and by conducting vigorous over-extraction of the groundwater until the removed water is visually clear to the extent practicable; this is generally referred to as the "downhole pump method" for well development. The intake of the pump will be placed in the center of the screened interval of the monitoring well. A minimum of three well volumes of water will be pumped from the well while raising and lowering the pump line through the screened interval to remove silt laden water. The well will continue to be pumped until the water removed is free of visible suspended material and at least 10 casing volumes are removed. The downhole pump method may be combined with manually surging the well with a surge block (referred to as "the surge block method") if the sustainable extraction rate from the submersible pump is not sufficient to efficiently complete the well redevelopment.

Commented [RC(169]: Suggest using available gw depths from site monitoring wells to help select appropriate sampling depths.

Commented [RC(170]: Do not recognize the term "well sand", please define.

Commented [RC(171]: The soil is also removed from that casing to prevent contaminant drag down when inserting the drive point back in to the well casing.

The surge block method involves using a plunger or "block" to force the water within the well through the well screen and out into the formation; the surge block is pulled up, pulling the water back through the screen into the well along with fine soil particles that may have accumulated in the well pack material. First, an initial surging involving short plunger strokes of approximately 3 feet, will allow material that is blocking the screen to separate and become suspended. After 5 to 10 plunger strokes, the surge block will be removed and the well will be purged using a pump. The process is repeated ~~at~~ slowly increasing depths until the bottom of the well screen is reached. The cycle of surging and purging is continued until the water yielded by the well is free of visible suspended material.

Commented [RC(172]: Each well will be redeveloped to remove any and all fines from the well assembly, including the sump. Any fines in the well may contain material that could have entered the well from the surface and potentially be contaminated.

For either removal method, field parameters (temperature, pH, and conductivity) will be measured for each volume removed. After the removal of eight casing volumes, field parameters will be monitored for stability. Field parameters will be considered stable if temperature, pH, and conductivity are within 10 percent for three consecutive casing volumes. The well will be considered developed after field parameters have stabilized (minimum of 10 casing volumes), and sediment is no longer visible in the purged water. Purge water will be placed in DOT approved drums or high-capacity tank and will be managed and disposed of as investigation derived waste (IDW).

4.2.2.6 Monitoring Well Sampling

The monitoring wells proposed for well redevelopment (MW-1, MW-14, MW-17, S-1, S-2, MW-9, MW-10, MW-12, MW-13, MW-22i, and MW-E) will be sampled prior to and at least 48 hours after monitoring well redevelopment.

Groundwater samples will be collected from each of the referenced wells using SOPs for low-flow groundwater sampling provided in Appendix E. Prior to initiating the groundwater sampling, water levels in the wells will be measured and recorded for the purpose of determining groundwater elevations and gradient. The wells will be opened, and the water level allowed to equilibrate before the measurements are taken. Measurements of the depth to water will be made to the nearest 0.01 foot using an electronic water level indicator.

Commented [RC(173]: It would help with data comparability if the well and grab sampling techniques are the same or close to the same.
Before sampling each well the amount of sediment in the well bottom should be measured and documented.
Water level measurements to establish gradient should be done in rapid succession due to the very flat gradient and high aquifer transmissivity.

Groundwater will then be purged using low-flow sampling equipment (e.g., peristaltic or bladder pump) at a rate no greater than the recharge rate of the groundwater to prevent water table drawdown. Per the SOPs, the flow rate should range between 0.1 to 0.5 liter per minute (L/min), with 0.2 to 0.3 L/min typically appropriate for the conditions at this site. The sample tubing/pump will be lowered to the middle of the screened interval. Groundwater field parameters (pH, electrical conductivity, and temperature) will be measured using a water quality meter and flow cell connected to the discharge tubing of the sample pump to assess the effectiveness of purging. Purging will be considered complete when the water quality parameters (i.e., pH, temperature, and specific conductance) stabilize within 10 percent for three consecutive 3-minute intervals. Purge water will be placed in DOT-approved drums.

The samples will be uniquely labeled, stored in insulated coolers with ice, and transported under chain-of-custody protocol to the analytical laboratory for chemical analysis. Because of varying hold-times for the analyses in the analytical program (see Section 4.2.2.7), samples may be submitted to the laboratory under more than one chain-of-custody for the same sampling event.

4.2.2.7 Groundwater Analytical Program

~~Grab~~Monitoring well and ~~G~~grab groundwater samples will be submitted to a Washington accredited laboratory for analysis of the following COPCs (see Section 2.7):

- Nitrate as nitrogen and nitrite as nitrogen by EPA Method 300.0;
- Ammonia as nitrogen by EPA Method 350.1;
- Total and dissolved copper by EPA Method 6020A;
- Total RCRA 8 metals by EPA Method 6020A except mercury by EPA Method 7471B; and
- Total suspended solids (TSS).

Groundwater samples to be submitted for dissolved copper analysis will be field-filtered using an 0.45 µm (micron) membrane filter, prior to transport for analysis.

The laboratory hold time for nitrate and nitrate is 48 hours, thus these samples will be submitted to the laboratory the same day as collection for immediate sample preparation and analysis. The remaining samples may be submitted to a laboratory with less urgency under a separate chain-of-custody.

4.3 SOIL INVESTIGATION SCOPE

The following sections describe the general sampling approach for evaluating COPCs in soil, a rationale for the proposed sampling locations, and details regarding sampling methodology and procedures.

4.3.1 Approach/Rationale

The approach of the proposed soil investigation was prepared to meet the Phase I objectives described in Section 3.3.2.2 above; namely, to establish a baseline understanding of the presence of COPCs in shallow soils and, if present, the potential of the COPCs to adversely impact shallow groundwater~~;~~, migrate via stormwater at concentrations of potential concern, or present an unacceptable risk to human receptors via direct contact or inhalation pathways.

Commented [RC(174]: This sentence is missing text.

The following table summarizes how each portion of the Project Area will be evaluated for the presence of metals, ammonia, and nitrate/nitrites. The table includes the investigation area, the objective for each investigation area, and the proposed sampling locations to meet these objectives. Soil sampling locations are shown on Figure 18.

Commented [RC(175]: Fig 18 has un-marked boring location at MP-1. Is boring location 43 or a typo?

Investigation Area	Objective	Location to Address
Unpaved Ground Surface	Assess COPC concentrations in surface soil ~~at concentrations of potential concern~~.	Borings 25 through 38, 41, 42
SVE Vault	Assess COPCs in soil beneath the vault and the potential to adversely impact groundwater.	Boring 43
Historically Unpaved Ground Surface	Assess whether COPCs are present at concentrations of potential concern.	Borings 39, 15
High Use Areas	Assess whether COPCs are present at concentrations of potential concern.	Borings 40, 44
Riverbank	Identify whether erodible soil is present on the riverbanks in the investigation area.	Qualitative field observation

Commented [RC(176]: Already said.

Commented [RC(177]: Boring location not on any figure?

Two samples will be collected at each location: a surface sample and an additional sample at 2 to 3 feet bgs. The surface samples will be collected from 0 to 1 foot beneath the subgrade of the pavement in paved areas ~~and from 0 to 1 foot~~ and the same depth in unpaved areas. The rationale for the boring locations is identified by operations area below.

NuStar Leasehold – Ten boring locations have been proposed on the NuStar Leasehold for collection of soil samples using direct push technology. These borings include:

- **Boring 15.** Boring 15 is located in a paved area between monitoring well MW-13 and the Columbia river. Historical aerial photos show that a small area near that location was historically not paved. This boring will be used to evaluate whether shallow soil is impacted with COPCs from historical operations.
- **Borings 25 through 32.** These sample locations are located in the unpaved portion of the NuStar Leasehold, along the railway corridor that runs east to west through the NuStar Leasehold.
- **Boring 43.** Boring 43 is located within the vault of one of the SVE wells on the NuStar Leasehold (VE-1-2). The SVE well vaults, including VE-1-2, were installed in 2008 in native soil and do not have a concrete bottom. Ecology has requested that a sample be taken from beneath the SVE vault to evaluate for the presence of COPCs.

KMBT Operations Area – Nine shallow soil sample locations have been proposed on the KMBT Operations Area. A discussion of the approach for investigation and rationale for selection of the sample location is detailed below:

- **Borings 33 through 38.** These sample locations are located in the unpaved portions of the KMBT Operations Area. They are located along the facility northern portion near the railroad tracks, railroad unloading area (building 2877) and Coverall Building 2745 – see Figure 2.
- **Boring 39.** This boring is located in a historically unpaved portion of the bulk material operations area. Boring 39 is located between buildings 2745 and 2685.
- **Borings 40 and 44.** These two borings are located in paved high use areas. Boring 40 is located immediately south of the former Sand Shed building footprint (west of building 2695) which is currently used to store tire chips. Boring 44 is located between the rail unloading area (building 2877) and the material storage building (buildings 2725 and 2745).
- **Riverbank Erosion.** The riverbank will be visually inspected for the presence of apparent erodible soils that could provide a potential pathway for COPCs to enter the river. If erodible areas are observed, riverbank sampling will be proposed as a part of the Phase II investigation.

4.3.2 Procedures

Methods to complete the soil investigation will include preparatory activities and collecting shallow soil samples at the locations shown on Figure 18. Procedures for each of these methods are described below.

4.3.2.1 Preparatory Activities

Prior to the investigation, the public utility notification center will be contacted, and a private utility locator will be contracted to check for the presence of buried utilities or infrastructure in the work area. It should be noted that the presence of buried utilities or infrastructure, or other access issues, may result in the relocation of the proposed borehole locations from those presented on Figure 18.

4.3.2.2 Soil Sampling

At each utility-cleared location, a borehole will be advanced using a hand auger or air knifing technologies. A licensed subcontractor will be retained to core through and repair the asphalt or concrete and provide as needed air-knife services to advance each boring. A representative from Cascadia and Antea will oversee the work. Soil samples will be collected at each location at 0 to 1 foot bgs (below any pavement and associated subgrade aggregate) and 2 to 3 feet bgs using a decontaminated stainless-steel hand auger. The investigation will be conducted in accordance with Cascadia and KMBT SOPs for soil grab sampling and management which are included in Appendix E.

4.3.2.3 Soil Analytical Program and Testing Protocol

Soil samples will be submitted to a Washington accredited laboratory for analysis. Analytical testing will be completed using the following protocol and EPA test methods.

- Nitrate as nitrogen and nitrite as nitrogen by EPA Method 300.0;
- Ammonia as nitrogen by EPA Method 350.1;
- Total copper by EPA Method 6020A; and
- Total RCRA 8 metals by EPA Method 6020A except mercury by EPA Method 7471B.

4.4 SEDIMENT INVESTIGATION SCOPE

Commented [MJ(178]: Note – I will be discussing the Yakama Nation comment about bioassays with Laura and Jessica on April 6 – reserving comment about bioassays until after that.

The following sections describe the general sampling approach for evaluating COPCs in sediment, a rationale for the proposed sample locations, and detail regarding sampling methodology and procedures. The objective of the Phase I sediment sampling, as detailed in Section 3.3.3.2, is to assess whether metals or fertilizer COPCs are present in sediment in the Port Berth 7 area at concentrations of potential concern. Sediment samples will also be analyzed for VOCs to assess whether reductions in concentrations in groundwater at the NuStar Leasehold have led to reduced VOC concentrations in sediment. To assist with the latter objective, sediment sampling locations will be co-located to the extent feasible with sediment sampling locations advanced during previous sediment investigations conducted in support of the NuStar VOC RI, as described further below.

Commented [MJ(179]: Should be expanded to berths 8, 9 and possibly 3-5, as well as vicinity of outfall T40

Sediment sampling will be conducted in accordance with the SMS (Chapter 173-204 WAC) and guidance in the Sediment Cleanup User's Manual II (Ecology, 2019).

4.4.1 Approach/Rationale

Commented [MJ(180]: I recommend adding a few status thus;

5 samples riverward (map south toward the dredge channel) of the green dots on the map. This would help delineate the extent of contaminants into the river. I need to know more about the bathymetry and timing of dredging in this area to help decide best placement. Some of these could be archived in Phase I, as long as the holding times are long enough.

One sample similarly placed to #46 but at the west end of the dock near outfall T-40.

A sample underneath the dock, if possible (are there any trapdoors or ports?).

Three samples along the waterward face of Berths 8 and 9 (depending on dredging and bathymetry).

Possibly add sampling near Berths 3, 4, and 5, need to know more about history of use and expected scope of this project

We need to collect several background samples for comparison for chemicals without criteria

Proposed sediment sampling locations are shown on Figure 19. As discussed in Section 3.3.4, these locations are located immediately adjacent to the KMBT and NuStar operations areas, are located in a portion of the river outside of the navigation channel that are not subject to maintenance dredging, and are co-located with previous VOC sediment sampling efforts where appropriate. A discussion of the approach for investigation and rationale for selection of the sample locations is detailed below:

1. **Sediment Locations 3 through 13 (VOC Confirmation and COPC Investigation Sample Locations).** These sediment locations are co-located with historical sediment sample locations from a 2016 sediment sampling event for VOCs. Several of the sediment samples from 2016 were co-located with sediment samples from 2011 or 2012 sediment investigations for VOCs. There was a noted reduction in VOC concentration between 2011/2012 and 2016 (Apex, 2017). The VOC analyses from this proposed sampling event will be used to evaluate if the concentration of VOCs has decreased in response to the upland bioremediation injection interim action in 2016. As these locations are also located

Commented [MJ(181]: I'd like to request a spreadsheet of coordinates for proposed samples so I can plot on Google Earth.

adjacent to the KMBT vessel loading dock (for metals) and the NuStar fertilizer handling areas, these sample locations will also be analyzed for copper, ammonia, and nitrate to see if there are COPCs in sediment associated with Project Area activities.

2. **Locations 45 and 46 (VOC and COPC Investigation Samples).** These two locations are placed adjacent to former stormwater outfall locations to assess for the presence of VOCs, fertilizer, and/or copper concentrate COPCs that might be associated with historical discharges from these former outfalls.

3. **Location 14 (Defining Extent).** This location is upstream of the KMBT vessel loading area and the fertilizer handling areas and may provide a delineation point should copper or ammonia/nitrate be detected in sediment. Furthermore, this location is outside the historical extent of VOCs in river sediment, as shown on Figure 19, and will be used to confirm the delineation of VOCs in the Project Area.

4. **Locations 1 and 2.** These locations are proposed based on their proximity to the copper vessel loading area.

Commented [MJ(182]: Is it possible to get the sampling vessel into this area? Are the nearby structures tall enough to pass beneath?

Surface sediment grabs and core samples will be collected at each of the proposed sample locations.

Commented [MJ(183]: Will all cores and all surface samples be analyzed for all COPCs?

4.4.2 Procedures – Sediment Investigation

The following sections describe the methods and procedures for the proposed sediment investigation.

4.4.2.1 Understanding of Shoreline and River Bathymetry

A seawall borders much of the Property Area along the boundary with the Columbia River. The United States Army Corp of Engineers navigation channel within the Columbia River and the Port operational berths are maintained at the authorized dredge depth of -43 ft Columbia River Datum[3] (CRD) plus a 2-foot allowable overdredge. The area between the docking berths and the seawall is not dredged as no vessels navigate the landward side of the docking berths. The seawall and approximate extent of river dredging are shown on Figure 19.

Commented [MJ(184]: South of the seawall is rip-rap slope that falls away to …? Does this flatten out? Is it full of rip-rap or more of a natural substrate? This could affect the logistics of getting samples. A cross-section sketch would be helpful. Clarify the timing and extent of last dredge event.

4.4.2.2 Sampling Locations and Depths

Sediment samples will be collected from proposed locations 1 through 14, as shown on Figure 19. Actual sample locations will be determined in the field using proposed coordinates, mud-line elevation, and presence/absence of rip-rap or debris. If refusal at the desired sampling location occurs due to debris or obstructions, attempts will be made to offset slightly parallel to the shoreline in order to maintain as constant a depth as possible. If rip-rap continues to be

Commented [MJ(185]: What about rest of locations?

---

[3] Which is approximately -36.5 to-43.5 feet msl referenced to the North American Vertical Datum of 1988 (NAVD88).

encountered, the sampling location may be offset in the direction perpendicular to the shoreline. Samples will be collected within ±10 feet of the proposed locations.

Up to four sediment samples will be collected at each location. Sampling depths will include the top 10 centimeters (cm), and subsurface intervals at approximately 1 to 3 feet, 3 to 5 feet, and 5 to 7 feet below the mudline. Based on previous investigations, refusal is typically encountered between 5 and 7 feet below mudline.

Commented [RC(186]: Indicate sampling depths are consistent with previous sediment sampling locations and protocol.

4.4.2.3 Sampling Procedures

The following subsections summarize sediment sampling procedures. Additional information on sampling procedures is provided in the Sediment SAP provided in Appendix F. The Sediment SAP describes procedures for sample location control, documentation, sediment sampling, sample processing, sample containers and handling, equipment decontamination, IDW management, and data quality assurance.

Sampling Procedures. Sediment samples will be collected using two methodologies. Surface grab samples will be collected using a stainless-steel pneumatically-operated grab sample deployed from a vessel (a.k.a. "power grab"). The power grab sampler will be used to collect surface sediment from 0 to 10 cm below the mudline over approximately a 2-square-foot area. The top of the sampler will have rubber cover that prevents sediment from washing out when the sampler is retrieved.

After collection of the surface samples, sediment cores will be collected at the same location. The cores will be collected using a vessel equipped with a Vibracore sediment coring instrument, or similar, in accordance with Section 2.2 of the SAP. After cores are collected, the cores will be sealed and stored upright on the vessel, until the vessel returns to shore for processing. Processing will be conducted in accordance with Section 2.2 of the SAP.

Commented [RC(187]: Are these cores continuous across the sample interval mudline to 7 feet below mudline?

Commented [MJ(188]: Also need to describe process for the surface grabs.

The sediment core samples will be logged for lithology and screened for VOCs using a PID. Field screening measurements are intended to comply with SOPs and are not intended to replace laboratory analytical data.

The sediment collected for VOC analysis must be a grab sample and cannot be composited. For all other analytes (copper, ammonia, etc.), the sediment from the identified sampling interval (e.g., 1 to 3 feet, 3 to 5 feet, etc.) will be composited and homogenized prior to placing in laboratory supplied containers for analysis. General convention is that VOC samples are collected first, followed by samples of other analytes. Details on sample collection and compositing is provided in the SAP. The samples will be submitted to a Washington accredited laboratory for analysis within the appropriate method specific hold-time.

Commented [MJ(189]: need to check on whether it is appropriate to homogenize ammonia and nitrate – are there issues with volatilization or oxidation?

4.4.2.4 Control of Station and Sample Locations

A positioning procedure will be utilized to ensure that the proposed sampling stations are achieved and to accurately determine the horizontal and vertical positions of the sampling stations. This determination will be achieved by referencing each sampling location to state plane coordinates

Commented [RC(190]: Indicate sampling locations are consistent with previous sediment sampling locations and protocol.

through the use of known survey control points, onshore landmarks, and a differential global positioning system (GPS). The following parameters will be documented at each sampling location:

- Time and date;
- Horizontal location in local grid coordinates, referenced to North American Datum of 1983 (NAD83); and
- River level and mudline elevations referenced to NAVD88.

These parameters will be measured from the sampling vessel using a combination of differential GPS, pre-surveyed visual horizontal triangulation to known control points (e.g., surveyed on-site monitoring wells, benchmarks, etc.) and/or permanent structures onshore, single beam echo sounder data, and weighted tape measures. Additional information on vertical and horizontal sample control is provided in Section 1.0 of the SAP (Appendix F).

4.4.2.5 Sediment Analytical Program

Sediment samples will be submitted to a Washington accredited laboratory for analysis of the following:

- Chlorinated VOCs by EPA Method 8260B;
- Nitrate as nitrogen and nitrite as nitrogen by EPA Method 300.0;
- Ammonia as nitrogen by EPA Method 350.1; ;
- Total organic carbon (TOC) by EPA Method 9060A;
- Copper by EPA Method 6020A; and
- Total RCRA 8 metals by EPA Method 6020A except mercury by EPA Method 7471B.

Sample analysis will include percent solids and the data will be reported in dry weight. In addition to the analyses listed above, one sample container from each sampling interval will be collected and held for potential future grain size analysis.

Sample results will be reported in mg/kg as dry weight.

4.5 ADDITIONAL VOC INVESTIGATION SCOPE

As discussed in Section 1.1, Ecology has requested additional VOC delineation to the west of NuStar monitoring well MW-26. To that end, borings 19 through 22 are proposed to delineate VOCs in Shallow zone groundwater west of well MW-26. The proposed locations of the borings are shown on Figure 17.

Commented [MJ(191]: Add phosphorus due to past practices

Commented [MJ(192]: I need to learn more about these methods – if consultants have experience with this, ok for now

Commented [MJ(193]: Instead of RCRA 8, just list metals needed. RCRA 8 includes barium, chromium, selenium, silver, which you may not need.

Commented [MJ(194]: Based on past transloading of products with manganese, potassium and aluminum, those should be added to the metals list.

Commented [RC(195]: Do you mean 19 -21? This is consistent with language below and boring 22 is used to determine lateral contamination extent around MW-10.

4.5.1 Groundwater Sampling Procedures for VOC Locations

To be consistent with previous groundwater investigations, borings to be sampled for VOC analysis (locations 19 through 21) will be advanced using push probes and the groundwater sampled using depth discrete sampling techniques. Samples will be collected from a 5-foot interval directly above the silt layer that marks the bottom depth of the Shallow groundwater zone at the NuStar Leasehold, anticipated to be encountered at a depth of approximately 43 feet bgs based on the lithologic logs for well MW-26 (Apex, 2013) and boring AGP-55 (Ash Creek, 2006b). Borings will be advanced to the bottom depth of the uppermost targeted groundwater sampling interval. A temporary well with a 4-foot-long well screen will be installed through the push probe rod, and the rod will be pulled up 4 feet to allow the temporary well screen to be placed across the targeted sampling interval. A groundwater sample will be collected from the temporary well using low flow methodology in accordance with the Low Flow Groundwater Sampling Method SOPs contained in Appendix E. Following collection of the uppermost groundwater sample, the borehole will continue to be advanced to the bottom depth of the next targeted interval, and a new temporary well will be installed as described above across the second targeted interval. This process will continue until each targeted interval for the designated boring has been sampled.

Commented [RC(196]: Which VOCs and by what method?

Commented [RC(197]: Depth discrete sampling techniques gives the impression more that one groundwater sample per boring will be collected but only the 5-foot interval directly above the silt layer that marks the bottom depth of the Shallow groundwater zone is detailed?

Commented [RC(198]: A five foot sample interval with a 4 foot screen?

Commented [RC(199]: Is there a reason this gw grab sampling is going to be done differently than used at the other gw grab sample locations like boring 15 and 22-24, etc?

Commented [RC(200]: Which is? Please detail all target intervals.

5.0 SUPPLEMENTAL PHASE I INVESTIGATION SUMMARY REPORT

Commented [MJ(201]: Also discuss EIM upload? We need the data uploaded by the time we review the report.

After completion of the investigative activities summarized in this SRIWP, the PLPs will submit to Ecology a Supplemental Phase I Investigation Summary Report. The report will include, at a minimum the following information:

- A summary of the Phase I investigative activities conducted;
- Documentation from any deviations from the scope identified in this SRIWP, if applicable;
- A discussion of the results of the investigation, which will include a discussion of whether or not the objectives outlined for the various media were met; and
- Remediations for Phase II Investigative activities, if applicable, and a schedule for completion of the Supplemental RI.

Commented [MJ(202]: Recommendations

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Commented [RC(203]: The references here are the same as listed in the text. A number of the reports referenced here are accessed through the SharePoint site, but are not given the same reference label (i.e. Apex 2017) making it cumbersome to locate the correct reference.

Commented [SP204]: I don't think this was referenced in the text.

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TABLES

FIGURES

APPENDIX A

SAFETY DATA SHEET FOR COPPER CONCENTRATE

APPENDIX B

GEOLOGIC CROSS-SECTIONS

APPENDIX C

PORT OF VANCOUVER STORMWATER SYSTEM MAP

APPENDIX D

NUSTAR SVE SYSTEM MAP

APPENDIX E

STANDARD OPERATING PROCEDURES –

SOIL AND GROUNDWATER INVESTIGATION

APPENDIX F

SEDIMENT SAMPLING AND ANALYSIS PLAN

Cascadia
Associates, LLC

CONTENTS

Commented [MJ(1]: Include a section outlining key personnel; subcontractors, labs to be used.

Commented [MJ(2]: Include a section describing the naming/numbering scheme for sample locations and individual samples

TABLES

Commented [MJ(3]: A table of sample locations and analytes/depths at each location should be provided, unless all have the exact same analysis/depths.

FIGURE

1.0 SAMPLE LOCATION CONTROL

The horizontal and vertical positions of the sediment sampling locations will be determined by referencing each sampling location to state plane coordinates through the use of survey control points, onshore landmarks, and differential global positioning systems (DGPS). The following information will be documented at each sampling station:

- Time and date;
- Horizontal location in local grid coordinates, referenced to the North American Datum of 1983 (NAD83); and
- River level and mudline elevations referenced to the NAVD88 datum.

Positioning while sampling will be performed using a DGPS. Horizontal locations of samples will be collected within +/- 10 feet of the proposed location. Vertical locations of sediment samples will be located to an accuracy of +/- 0.1 foot. Care will be taken to achieve horizontal and vertical accuracy to the maximum extent possible, so that samples can be taken from the same location during future sampling events.

Columbia River stage levels will be evaluated prior to the investigation. River mudline elevations, and thus the vertical control on sediment sample locations, will be determined by subtracting depth to mudline (from the sampling vessel) from the river surface elevation. The depth of surface water samples will be determined by subtracting the depth to the sample intake point from the river surface elevation. River surface elevation will be estimated using tide/river stage prediction data provided by the National Oceanic and Atmospheric Administration (NOAA) for Vancouver Tide station #9440083 located approximately 0.5 mile to the east of the project area. During periods of extreme precipitation, dam openings, snow melt, etc., actual river levels may significantly exceed river stage levels predicted on the tidal charts. Predicted river stage levels must approximate actual verified levels to ensure vertical accuracy during investigation activities. Therefore, the close monitoring of the factors that affect river stage will be essential in timing the investigation.

Commented [KH4]: Somewhere in the beginning of the SAP and Work Plan text you will want to describe that all proposed sampling described in this SAP will be performed in accordance with the SMS SCUM II guidance etc. (Example text copied below.)

Sediment sampling will be conducted in accordance with the Sediment Management Standards (SMS; Chapter 173-204 WAC) and guidance in the Sediment Cleanup User's Manual II (Ecology 2019).

Commented [MJ(5]: A list of target coordinates should be included in a table.

Commented [MJ(6]: Field crew should record individual coordinates for the core vs. the grab – they may be same but we like to look at plot to get a sense of how accurate the co-location is.

Commented [MJ(7]: Are there logistical concerns with currents if the river is at a high stage? (e.g., inability to maintain location while sampling). May need to take that into consideration when planning the sampling date.

DRAFT

2.0 SEDIMENT SAMPLING

Commented [MJ(8]: Add an overview here – it was not clear in the work plan either – are all samples being analyzed for all analytes?

Sediment samples will be collected using two methodologies. Surface grab samples will be collected using a stainless-steel pneumatically-operated grab sampler deployed from a vessel (a.k.a. "power grab"). The power grab sampler will be used to collect surface sediment from 0 to 10 centimeters (cm) below the mudline over approximately a 2-square-foot area. The top of the sampler will have a rubber cover that prevents sediment from washing out when the sampler is retrieved.

After collection of the surface samples, sediment cores will be collected at the same location. The cores will be collected using a vessel equipped with a Vibracore sediment coring instrument, or similar.

2.1 EQUIPMENT LIST

The following general equipment will be required during collection procedures:

- Personal protective equipment as required by the project health and safety plan (HASP);
- Navigation and site maps;
- Sampling vessel;
- Vibracore;
- Aluminum core barrel;
- Decontamination materials;
- Weighted tape measure calibrated in 0.1-foot increments;
- Duct tape;
- Camera;
- Field notebook;
- Stainless steel bowls and spoons
- Sample jars and labels;
- Sample analysis plan; and
- Chain-of-custody forms.

2.2 SEDIMENT COLLECTION USING CORING DEVICE

Commented [MJ(9]: A section describing the protocols for the grab samples is needed. Explain how the VOC sample will be collected to avoid loss.

At the majority of the sample locations, a power grab will be used to collect surface sediment samples and sediment cores will be collected to obtain subsurface sediment samples. The coring device is comprised of an outer aluminum jacket with a polycarbonate liner. The Vibracore system utilizes a high frequency vibrating head to break down the frictional resistance of the sediment, which allows the core tube to penetrate into the sediment with minimal disruption. Sediment coring will be conducted using the following procedures:

- Maneuver the sampling vessel to the target sample location. Secure the vessel in place using spuds, anchors, or tie lines in a two- or three-point anchoring system.

- Drop a weighted object (i.e., measuring tape) to the anticipated mudline to evaluate whether the river sediments are accessible or covered with rock. If rocky, the field personnel should be able to feel the weighted object impact the rock. If rocks are present at the river bottom, and core penetration is a low probability, the vessel will be relocated approximately5 feet away and another attempt will be made to assess the subsurface. In general, offsets will be made parallel to the shoreline, but may be offset perpendicular to the shoreline if the area is particularly rocky. Up to four attempts will be made at each location to reach the target core depth and obtain the goal of 60 percent recovery. After up to four attempts, the sampling team will move to within 25 feet of the target location to try again.

Commented [MJ(10]: This seems low to me.

- Failed attempts will be documented in the field notes.
- Once the targeted area is deemed suitable for core collection, select an appropriate 3- or 4-inch (outside diameter) core tube type and length based on the bathymetry data and target elevation. Mount a clean coring tube into the vibracore device. A core catcher will be inserted into the base of the coring tube – which will allow sediment into the core but will prevent it from falling out when the core is lifted.
- Lower the coring apparatus with the core tube attached vertically through the water column, tube end first, until the mudline is reached.
- Vibrate the core into the sediment to the targeted depth or point of refusal, whichever is shallower. Measure and record the depth of core tube penetration into the sediments in the field notebook.
- Pull the apparatus upward (using a winch) to the surface while maintaining the core in a vertical position. Cap the bottom of the core tube with the core catcher remaining in place.
- Allow water overlying the core tube in the coring apparatus to drain prior to removing the core tube.
- Estimate the recovered length of the sediment core and record it in the field notebook.
    - The length of the cores recovered in the tubing will be determined indirectly by tapping the outer aluminum core with a metal rod from top to bottom. The spot where the pitch of the sound changes corresponds to the approximate top of the recovered core.
    - The distance between the top of the sediment in the core tube and the bottom of the coring tube corresponds to the estimated length of the recovered core.
- Compare the length of the recovered core with the core penetration depth.
    - If the recovered length of the sediment core is more than 60 percent of the penetration depth, keep the core.

- If there is less than 60 percent recovery, the core will be retained until a core with greater recovery is obtained at this location. If a core with greater recovery is not obtained, the core with the best recovery will be retained. If a core with greater recovery is obtained, the core(s) with an insufficient amount of material will be discarded over the side of the sampling vessel. Care will be taken to discard the material away from the sampling area to avoid cross contamination.
- An additional attempt will be made at an approximate distance of 5 feet from the previously attempted location.
- A maximum of four attempts to advance a core will be made for a given location.
- Rinse the core tubes with river water between consecutive attempts.
- If all four attempts to collect a core are unsuccessful based on recovery alone (i.e., less than 60 percent recovery), retain the core with the greatest recovery and/or best penetration depth for analysis and indicate that the targeted recovery was not achieved.

- Remove the core tube from the vibracore device and place a second cap on top of the core tube. Secure the cap in place with duct tape. Rinse the outside of the core tube with a small amount of river water.
- Label each core with the station identification, core length, and an arrow indicating the top of the core. Label the core by scratching into the surface of the core barrel and with an indelible marker.
- Store the core vertically while on the vessel and transport to the processing area.

2.3 SEDIMENT SAMPLE COLLECTION PROCEDURES

The following subsections describe the methods for collecting the sediment samples from the sample coring device.

2.3.1 Sample Collection and Processing Methods

Once sediment coring is complete, the cores will be transported in an upright position, on ice, to a location onshore for processing. Processing will occur using an electric saw to cut along the length of the core in two places, forming two D-shaped core halves. Only the barrel, not the sediments, will be cut by the saw. When sediment is collected from the core, care will be taken not to collect sediment in contact with the core barrel. For volatile organic compound (VOC) collection, samples will not be composited because of the potential for loss of volatiles during the mixing process that could result in low-biased analytical results. If additional volume is needed to collect samples for copper, ammonia and nitrate, composite samples may be collected.

Commented [MJ(11]: And other metals?

Core sections will not be opened until the sampler is ready to collect samples. The sediment collected for VOC analysis must be a grab sample and cannot be composited. For all other analytes (copper, ammonia, etc.), the sediment from the identified sampling interval (e.g., 1 to 3 feet, 3 to 5 feet, etc.) will be composited and homogenized prior to placing in laboratory supplied containers for analysis. Therefore, upon opening the core the sediment will be screened for VOCs using a photoionization detector (PID). Immediately upon completion of PID screening, the VOC sample will be collected from the approximate center of the core sample intervals. Following collection of the VOC sample, the lithology of each sample interval will be logged in the field notes.

Once the VOC samples are collected, the remaining material from each sampling interval will be placed in a steel bowl and homogenized. The composited, homogenized sediment will be placed into an 8-ounce laboratory provided sample jar for metals analysis. The steel bowls will be cleaned in a Liquinox solution, rinsed with tap water, followed by a rinse with deionized water prior to each use.

In addition, two 6-ounce or greater laboratory provided sample jars will be collected at each sample location for total organic carbon (TOC) and percent solids analyses. If sufficient sample volume is available, a sample may be collected for future grain size analysis. A smaller sample may be collected if there is insufficient volume of material that is similar in color, grain size, etc. to the analytical sample. As discussed above, if additional volume is needed to make (non-VOC) sample volume requirements, then multiple cores may be collected from the same approximate location, and composited.

Sample containers, analytical methods, preservation methods, and maximum laboratory hold time for each COPC are provided in Table F-1.

2.3.2 Sample Selection

For evaluating the vertical extent of contamination, the following subsampling scheme will be used for the cores. The top 10 cm of the power grab sample will be collected as the surface sample. Subsurface samples via coring will be collected at 2-foot intervals beginning approximately 1 foot below the surface sample. Therefore, the first subsample will be the approximately 1- to 3-foot section below mudline, and the subsamples will continue in 2-foot segments down to 7 feet below the mudline (i.e., 3 to 5 feet; 5 to 7 feet).

Sample jars will be labeled and placed in a cooler on ice. To the extent possible, samples will be submitted to the laboratory within 24 hours of sample collection.

Commented [MJ(12]: How is screening done? Should screen at intervals alon core. Also, what is method of screening – are you removing some and placing in bags for the screening?

Commented [MJ(13]: Describe type of jar and protocol to minimize loss of VOC. Using method 5035B? See Ecology implementation Memo #5

Commented [MJ(14]: Clarify – center of each interval? Also, Why not collect from spot with highest PID?

Commented [MJ(15]: Protocols for ammonia should include not homozenizing sample, no head space in jar, immediate cooling.

Commented [MJ(16]: Is 8 oz enough for all analytes? The overall strategy of which samples have which analysis needs to be explained somewhere.

Commented [MJ(17]: The core intervals should start at 1' below sediment surface, not 1' below the 10 cm grab.

Commented [MJ(18]: Will samples be move to a refrigerator or will cooler ice be maintained the whole time? For VOCs is there a time limit for having them extracted to prevent loss?

DRAFT

3.0 DOCUMENTATION

Field activities and samples must be properly documented during the sampling process. Documentation of field activities provides an accurate and comprehensive record of the work performed sufficiently for a technical peer to reconstruct the day's activities and provide certification that all necessary requirements were met. General requirements include:

- Use of bound field books as the primary source for information collection and recording. Field books should be dedicated to the project and appropriately labeled.
- Surface Sediment Collection and Subsurface Sediment Collection forms will be used to formally document activities and events as a supplement to bound field books. The Sediment Collection forms can be a standard or project-specific form. Preprinted standard forms are available for many activities and should be used whenever possible. These forms will provide prompts and request additional information that may be useful and/or needed, and that the author is not aware of at the time. Project-specific field forms may be generated or existing forms may be modified to meet specific project needs. As required, client-supplied forms may be substituted.
- Appropriate header information documented on each page, including project title, project number, date, weather conditions, changes in weather conditions, other persons (if any) in the field party, and author. The specific information requested depends on the nature of the work being performed and on the form being used. Information fields that are not applicable should be noted "N/A" or with other appropriate notations.
- Field documentation entries using indelible ink.
- Legible data entries. A single line should be drawn through incorrect entries and the corrected entry should be written next to the original strikeout. Strikeouts are to be initialed and dated by the originator.
- Applicable units of measurement with entry values.
- Field records maintained in project files.

3.1 DOCUMENTATION ENTRIES

A chronology of field events will be recorded. General entry requirements include:

- Visitors to the site, including owner and regulatory representatives;
- Summary of pertinent project communications with the client, regulators, or other site visitors;
- Other contractors working on site;

- A description of the day's field activities, in chronological sequence using military time notation (e.g., 9:00 am: 0900, and 5:00 pm: 1700);
- If applicable, calibration of measuring and test equipment and identification of the calibration standard(s) and use of a Calibration Log, if available, with cross-reference entered into the field book;
- Field equipment identification, including type, manufacturer, model number, or other specific information;
- General weather conditions, including temperature, wind speed, and direction readings, including time of measurement and units;
- Safety and/or monitoring equipment readings, including time of measurements and units;
- Presence of vessels/ship at the dock or in nearby vicinity, including time of arrival and departure;
- If applicable, reference in the field notebook to specific forms used for collection of data;
- Subcontractor progress and/or problems encountered;
- Changes in the scope of work; and
- Other unusual events.

3.2 SPECIFIC REQUIREMENTS

Sample Collection. Field event information will be documented in a field notebook. Sample collection data and information will be documented on sample collection and processing forms. Where both are being used, information contained in one is cross-referenced to the other. Entries will include at a minimum:

- Sample identification number, location taken, depth interval, sample media, sample preservative, collection time, and date;
- Sample collection method and protocol;
- Physical description of the sample;
- Quality-control-related samples collected (e.g., duplicates, blinds, trip blanks, field blanks);
- Container description and sample volume;
- Pertinent technical data such as headspace reading;
- Pertinent technical comments; and
- Identification of personnel collecting the sample.

Sample Labeling. Sample labels must be prepared and attached to sample containers. Labels will either be provided by the laboratory performing the analyses or will be generated internally. The information to be provided includes:

- Sample identification number;
- Sample date and collection time;
- Physical description of the sample (e.g., water, sediment, etc.);
- Analytical parameters;
- Preservatives, if present;
- Sample location; and
- Client.

Core Logs. Surface and subsurface sediment samples are to be recorded in bound field books. Sediment logging information will be recorded on a core log sheet (Figure F-1). Personnel completing the log are to supply the following information:

- Names(s) of personnel logging sampling;
- Administrative and technical information included in the header, including horizontal datum, tide elevation, water depth, mudline elevation, drive penetration, recovery length, percent of recovery and drive notes;
- Types of equipment used;
- Subcontractor/driller used;
- Descriptions of subsurface materials encountered and the number and type of samples collected, if any;
- Subsurface exploration depth and units of measure;
- Length of recovery;
- Sample type and sample number for geotechnical or analytical samples collected (these data are also to be entered on the sample collection log, if used, and the sample label);
- Classification standard protocol used, if any;
- Narrative description of the sediment (using standard classification system) and other pertinent information;
- Description of consistency of cohesive sediments;
- Observations of sheen or odor if present; and
- PID measurements.

Equipment Calibration Documentation. If field equipment requiring calibration is used, calibration will be performed on field parameter probes at the beginning of each day of intended use. Subsequent calibration during the day will be performed if needed (e.g., if an instrument malfunctions).

Commented [MJ(19]: Will there by any field equipment requiring calibration for this project?

Records must be maintained for each piece of calibrated measuring and test equipment and each piece of reference equipment. The records must indicate that established calibration procedures have been followed.

Records for periodically calibrated equipment must include the following minimum information:

- Type and identification number of equipment;
- Calibration frequency and acceptance tolerances;
- Calibration dates;
- The individual and organization performing the calibration;
- Reference equipment and/or standards used for calibration;
- Calibration data;
- Certificates or statements of calibration provided by manufacturers and external organizations; and
- Documentation of calibration acceptance or failure and of repair of failed equipment.

An individual file folder should be established to maintain records for each piece of measuring and testing equipment. Equipment calibration files should contain an equipment calibration and maintenance record, calibration data forms and/or certification of calibration provided by manufacturers or external organizations, and notice of equipment calibration failure.

Measuring and testing equipment used for field investigations will typically be calibrated as part of operational use. For this equipment, records of the calibrations or checks will be documented as part of the test data (e.g., in the field notebook). Equipment-specific forms may also be developed. These records should include information similar to that required for periodically calibrated equipment. Documentation related to malfunctioning equipment or equipment that fails calibration should also be included in the individual equipment file.

Calibration files for equipment requiring periodic calibration should be sent with equipment that is transferred to allow a continuously updated record to be maintained. Recalibration of sensitive equipment should be performed following the transfer. When measuring and testing equipment is rented or leased, procurement documents must specify that a current certificate of calibration must accompany the equipment. This certificate must be maintained with the project documentation calibration records.

4.0 SAMPLE CONTAINERS AND HANDLING

4.1 CONTAINER REQUIREMENTS

Requirements for sample containers are given in Table F-1. Containers will be supplied by the analytical laboratory. The laboratory will certify that all sample containers were prepared according to standard EPA protocol.

4.2 LABELING REQUIREMENTS

A sample label will be affixed to each sample container before sample collection. The information to be included on the sample label is as follows:

- Project identification number;
- Sample number;
- Initials of person collecting the sample;
- Date and time of sample collection; and
- Type of preservative (if any).

4.3 PACKAGING AND SHIPPING REQUIREMENTS

Samples will be sampled and preserved in accordance with Table F-1 and will be submitted to the laboratory within the acceptable hold time, taking into account shipping time, laboratory business hours, etc. To the extent possible, samples will be shipped to the laboratory within 24 hours of sample collection. Samples will be packed with ice (or blue ice) to maintain a shipment cooler temperature of 4 degrees Celsius (ºC) or below and will be shipped overnight for next day delivery to the laboratory. One copy of the chain-of-custody form will be placed in a sealed plastic bag taped to the inside of the cooler lid.

Commented [MJ(20]: Where is the lab?

5.0 DECONTAMINATION PROCEDURES

Consistent decontamination procedures will be used for sampling. The objectives of decontamination are to prevent the introduction of contamination into samples from sampling equipment or other samples, to prevent contamination from leaving the site via sampling equipment or personnel, and to prevent exposure of field personnel to contaminated materials.

5.1 PERSONNEL DECONTAMINATION

Personnel decontamination procedures depend on the level of protection specified for a given activity. The site health and safety plan identifies the appropriate level of protection for each type of field work involved in this project. Regardless of the level of protection required, field personnel should thoroughly wash their hands and faces before taking any work breaks and at the end of the day.

5.2 SAMPLING EQUIPMENT

Decontamination procedures are designed to remove trace level contaminants from sampling equipment to prevent the cross contamination of exploration locations and samples. The sediment coring devise shall be decontaminated using high-pressure washing, steam cleaning, or cleaning with detergent (see below) before use and between locations.

To prevent cross contamination between sampling events, clean dedicated sampling equipment will be used for each sampling event and discarded or cleaned after use. Cleaning of non-disposable items will consist of washing in a detergent (e.g., Liquinox®) solution, rinsing with tap water, followed with a deionized water rinse.

Commented [MJ(21]: This water is collected?

6.0 INVESTIGATION DERIVED WASTE HANDLING

As discussed in Sections 2.2 and 2.3, sediment cores or grab samples not meeting acceptance criteria may be emptied overboard the vessel. Sediments that have been brought to shore for processing, as well as equipment decontamination water, will be considered investigation-derived waste (IDW). IDW will be placed in Department of Transportation (DOT)-approved drums. Each drum will be labeled with the project name, general contents, and date. The drummed IDW will be stored at terminal drum storage area. The selected disposal option will be determined based on analytical results from the samples from the explorations.

Disposable items, such as gloves, protective overalls (e.g., Tyvek®), paper towels, etc., will be placed in plastic bags after use and deposited in trash receptacles for disposal.

7.0 QUALITY ASSURANCE PLAN

The purpose of the Quality Assurance Plan (QAP) is to specify procedures and methods for office and field documentation, sample handling and custody, recordkeeping, equipment handling, and laboratory analyses that will be used during sampling and analysis.

7.1 QUALITY ASSURANCE OBJECTIVES FOR DATA MANAGEMENT

The general quality assurance (QA) objectives for this project are to develop and implement procedures for obtaining and evaluating data of a specified quality that can be used to evaluate sediment conditions. To collect such information, analytical data must have an appropriate degree of accuracy and reproducibility, samples collected must be representative of actual field conditions, and samples must be collected and analyzed using unbroken chain-of-custody procedures.

Apex Laboratories of Portland, Oregon was consulted regarding laboratory reporting limits for the constituents proposed in this work plan. The sediment limits, listed in Table F-2, are the expected reporting limits, based upon laboratory calculations and experience. If site conditions are such that reporting limits exceed screening levels, additional work may be required to evaluate an acceptable alternative, including reanalysis or resampling.

Commented [MJ(22]: Please compare reporting limits to standards to ensure they are low enough to compare to standards

Commented [MJ(23R22]:

Specific QA objectives are as follows:

1. Establish sampling techniques that will produce analytical data representative of the media being measured.
2. Collect and analyze a duplicate samples (at least one per every 20 sediment samples) to establish sampling precision. Laboratory duplicates of the same sample will provide a measure of precision within the sample (sample homogeneity).
3. Analyze a sufficient number of analytical duplicate samples to assess the performance of the analytical laboratory.
4. Analyze a sufficient number of blank, standard, duplicate, spiked, and check samples within the laboratory to evaluate results against numerical QA goals established for precision and accuracy.

Commented [MJ(24]: Is this a split after homogenizing? Will there be a duplicate for VOCs?

Commented [MJ(25]: How does this relate to the statement in #3 below?

Precision, accuracy, representatives, completeness, and comparability parameters used to indicate data quality are defined below. Table F-3 lists the QA samples that will be collected as part of the sediment investigation.

7.1.1 Precision

Precision is a measure of the reproducibility of data under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value. For duplicate measurements, precision can be expressed as the relative percent difference

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(RPD). Analysis of field duplicate sample will serve to measure the precision of sampling. In addition, a minimum of one laboratory duplicate will be analyzed per batch of samples.

Commented [MJ(26]: One per 20 samples

7.1.2 Accuracy

Accuracy is the measure of error between the reported test results and the true sample concentration. True sample concentration is never known due to analytical limitations and error. Consequently, accuracy is inferred from the recovery data from spiked samples.

Because of difficulties with spiking samples in the field, the laboratory will spike samples. The laboratory shall perform sufficient spike samples of a similar matrix (sediment) to allow the computation of the accuracy. One matrix spike sample (MS) sample and one matrix spike duplicate (MSD) sample will be analyzed per sample batch.

Perfect accuracy is 100 percent recovery.

Commented [MJ(27]: For all QA elements, are the ranges of acceptance criteria shown in a table somewhere?

7.1.3 Representativeness

Representativeness is a measure of how closely the results reflect the actual concentration of the chemical parameters in the medium sampled.

Sampling procedures, as well as sample-handling protocols for storage, preservation, and transportation, are designed to preserve the representativeness of the samples collected. Proper documentation will confirm that protocols are followed. This helps to assure the sample identification and integrity.

Laboratory method blanks will be run in accordance with established laboratory protocols.

7.1.4 Completeness

Completeness is defined as the percentage of measurements, made which are judged to be valid measurements. The completeness goal is essentially that a sufficient amount of valid data be generated to allow for the evaluation of site cleanup.

7.1.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The objective of this QAP is to assure that all data developed during the sampling are comparable. Comparability of the data will be assured by using EPA-defined procedures which specify sample collection, handling, and analytical methods.

7.1.6 Documentation

Essentially EPA Level II documentation will be generated during sampling/analysis. This includes any 24-turnaround analyses requested (if necessary) of the laboratory. This level of documentation is generally considered legally defensible and consists of the following:

- Analytical Report
- Chain of Custody (COC) Form
- Method Blank (MB) Results
- Matrix Spike and Matrix Spike Duplicate (MS/MSD) Summary
- Reporting Limits (RL)
- Laboratory Control Samples (LCS)
- Surrogate Recoveries
- Case Narrative, upon request or if applicable
- Corrective Action Reports, if applicable

Commented [MJ(28]: The lab should always provide a case narrative documenting holding times wer ement, explaining the qa/qc results and any qualifiers used

7.2 SAMPLING PROTOCOLS

7.2.1 Methods

Sampling methods are presented in Sections 2 and 4. These procedures are designed to ensure that:

- Samples collected are consistent with project objectives; and
- Samples are identified, handled, and transported in a manner that does not alter the representativeness of the data from the actual site conditions.

Quality assurance objectives for sample collection will be accomplished by a combination of the following items:

- Following and documenting standardized procedures.
- **Laboratory QA.** Laboratory duplicate measurements will be carried out on at least five percent of all laboratory samples. Analytical procedures will be evaluated using the protocols of the analytical laboratory. These protocols can be submitted upon request.
- **Chain of Custody.** Described in Section 5.3.

Commented [MJ(29]: 7.1.1 says one per batch – is this consistent?

7.2.2 Sample Containers, Preservation, and Holding Times

Sample containers, preservation, and holding times to be used for the project are listed in Table F-1.

7.3 SAMPLE AND DOCUMENT CUSTODY PROCEDURES

The various methods used to document field sample collection and laboratory operation are presented below.

7.3.1 Field Chain-of-Custody Procedures

Sample chain of custody refers to the process of tracking the possession of a sample from the time it is collected in the field through the laboratory analysis. A sample is considered to be under a person's custody if it is:

- In a person's physical possession;
- In view of the person after possession has been taken; or
- Secured by that person so that no one can tamper with the sample or secured by that person in an area which is restricted to authorized personnel.

A chain-of-custody form is used to record possession of a sample and to document analyses requested. Each time the sample bottles or samples are transferred between individuals, both the sender and receiver sign and date the chain-of-custody form. When a sample shipment is transported to the laboratory, a copy of the chain-of-custody form is included in the transport container (i.e., ice chest).

The chain-of-custody forms are used to record the following information:

- Sample identification number;
- Sample collector's signature;
- Date and time of collection;
- Description of sample;
- Analyses requested;
- Shipper's name and address;
- Receiver's name and address; and
- Signatures of persons involved in chain of custody.

7.3.2 Laboratory Operations

The analytical laboratory has a system in place for documenting the following laboratory information:

- Calibration procedures;
- Analytical procedures;
- Computational procedures;
- Quality control procedures;

- Bench data;
- Operating procedures or any changes to these procedures; and
- Laboratory notebook policy.

Laboratory chain-of-custody procedures provide the following:

- Identification of the responsible party (sample custodian) authorized to sign for incoming field samples and a log consisting of sequential lab-tracking numbers; and
- Specification of laboratory sample custody procedures for sample handling, storage, and internal distribution for analysis.

7.3.3 Corrections to Documentation

Original data are recorded in field notes and on chain-of-custody forms using indelible ink. Documents will be retained even if they are illegible or contain inaccuracies that require correction.

If an error is made on a document, the individual making the entry will correct the document by crossing a line through the error, entering the correct information, and initialing and dating the correction.

7.4 EQUIPMENT CALIBRATION PROCEDURES AND FREQUENCY

Instruments and equipment used during this project will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations. Operation, calibration, and maintenance will be performed by laboratory personnel fully trained in these procedures.

The PID used on-site will be calibrated on a daily basis according to the manufacturer's specifications. The PID generally utilizes a 10.2 eV probe and is calibrated using a manufacturer-supplied standard gas (100 ppm isobutylene).

7.5 ANALYTICAL PROCEDURES

Commented [MJ(30]: Add chemicals per Ecology Comments on work plan

Sediment samples will be analyzed for the following:

- VOCs using EPA Method 8260B.
- TOC by Method 9060A.
- Copper by EPA Method 6020A (ICPMS)
- Ammonia by SM 4500-NH3 G (gas diffusion and colorimetric detection)
- Nitrate-Nitrogen by EPA 9056A (anions by ion chromatography)

Commented [MJ(31]: I believe this is primarily a water method. We need to determine best approach for sediments. SCUM manual states "Plumb, 1981".

If sufficient sample material is available, the sample may be analyzed for grain size by ASTM C136/C117 Methods

7.6 DATA REDUCTION, VALIDATION, AND REPORTING

Reports generated in the field and laboratory will be included with project reports.

The Project Manager will assure validation of the analytical data. The laboratory generating analytical data for this project will be required to submit results that are supported by sufficient backup and quality assurance/quality control (QA/QC) data to enable the reviewer to determine the quality of the data. Validity of the laboratory data will be determined based on the objectives outlined in Section 8.1 — Quality Assurance Objectives for Data Management, and Section 8.8 — Data Measurement Assessment Procedures. Upon completion of the review, the Project Manager will be responsible for assuring development of a QA/QC report on the analytical data. Data will be stored and maintained according to the standard procedures of the laboratory. The method of data reduction will be described in the final report.

Commented [MJ(32]: Cascadia project manager or lab pm?

Commented [MJ(33]: Electronic data deliverables from the lab need to be compatible with EIM

7.7 PERFORMANCE AUDITS

Performance audits are an integral part of an analytical laboratory's standard operating procedures and are available upon request.

7.8 DATA MEASUREMENT ASSESSMENT PROCEDURES

The quality of the data will be assessed based on precision, accuracy, and completeness. Procedures to compute each are discussed below.

7.8.1 Precision

The RPD is used to assess the precision of the analytical method and is calculated using the following equation:

$$RPD = \frac{X_s - X_d}{(X_s + X_d)/2} \times 100\% \qquad (1)$$

where:

X_s = analytical result of the sample
X_d = analytical result of the duplicate sample

7.8.2 Accuracy

The accuracy of the data set is determined from the analysis of spiked samples. The accuracy is calculated using the following equation:

(2) $$A = \frac{(X_{ss} - X_s)}{T} \times 100\%$$

where:

A = accuracy
X_{ss} = analytical result obtained from the spiked sample
X_s = analytical result obtained from the sample
T = true value of the added spike

The overall accuracy is the arithmetic mean of all the spiked samples.

7.8.3 Completeness

Completeness (percent complete, or PC) of the data is determined by the following equation:

(3) $$PC = \frac{\text{Number of samples with acceptable data}}{\text{Number of samples collected}} \times 100\%$$

7.9 CORRECTIVE ACTIONS

The quality assurance sample results will be evaluated along with the project sample analytical results to determine if the complete data package is acceptable for the intended use. The results of an individual quality assurance sample/parameter may be out of acceptable control limits, yet the dataset is still considered of good quality if QA parameters indicate that the accuracy and precision of the overall analysis is acceptable. If the quality control audit detects unacceptable analysis accuracy and/or precision, the Project Manager will be responsible for developing and initiating corrective action. Corrective action may include the following:

- Reanalyzing the samples, if holding time criteria permit;
- Resampling and analyzing;
- Evaluating and amending sampling and analytical procedures; and
- Accepting data and acknowledging level of uncertainty or inaccuracy by flagging the data.

7.10 QUALITY ASSURANCE REPORTS

A QA review will be conducted that presents a QA/QC evaluation of the data collected during the sampling activities for inclusion in the final report. In addition to an opinion regarding the validity of the data, the QA/QC evaluation will address the following:

- Any adverse conditions or deviations from the SAP;
- Assessment of analytical data for precision, accuracy, and completeness;

- Significant QA problems and recommended solutions; and
- Corrective actions taken for any problems previously identified.

TABLES

FIGURE