Geosyntec consultants

engineers | scientists | innovators

AGENCY REVIEW DRAFT REMEDIAL INVESTIGATION REPORT

BLAKELY HARBOR PARK SITE BAINBRIDGE ISLAND, WASHINGTON

Prepared for:

Port Blakely Tree Farms
1501 Fourth Avenue, Suite 2150
Seattle, Washington 98101

Prepared by:

Geosyntec Consultants, Inc.
520 Pike Street, Suite 2600
Seattle, Washington 98101

For submittal to:

Washington State Department of Ecology
Olympia, Washington

Ecology Facility Site ID Project No.: 14770

Project Number: PNG0900

August 14, 2024

Agency Review Draft Remedial Investigation Report

Blakely Harbor Park Site

Prepared for:

Port Blakely Tree Farms
1501 Fourth Avenue, Suite 2150
Seattle, Washington 98101

Prepared by:

Geosyntec Consultants, Inc.
520 Pike Street, Suite 2600
Seattle, Washington 98101

For Submittal to:

Washington State Department of Ecology, Olympia Washington

DRAFT

Anne Fitzpatrick, LHG WA
Senior Principal

DRAFT

Cindy Bartlett, LG WA
Principal Geologist

Project Number: PNG0900

August 14, 2024

TABLE OF CONTENTS

1. INTRODUCTION 1
1.1 Project Organization 1
1.2 Report Organization 2

2. SITE BACKGROUND 3
2.1 Site Location 3
2.2 Pre-Industrial Harbor History and Cultural Resources 3
2.3 Mill History and Historical Land Use 5
2.3.1 Industrial Property Ownership History 5
2.3.2 Historical Operations and Past Land Use 5
2.3.3 Possible Sources of Contamination 6
2.4 Current and Future Land Ownership and Uses 6
2.4.1 Shoreline Parcel Ownership and Zoning 6
2.4.2 Current Site Use 6
2.4.3 Surrounding Land Use 7
2.4.4 Tribal Use 7
2.4.5 Anticipated Future Use 8

3. PHYSICAL AND ENVIRONMENTAL SETTING 9
3.1 Site Geology 9
3.1.1 Regional Geology 9
3.1.2 Site Geology and Topography 9
3.1.3 On-Site Geologic Conditions 11
3.2 Site Hydrogeology 12
3.2.1 Single Water-Bearing Unit 12
3.2.2 Groundwater Elevations and Flow Directions 13
3.2.3 Tidal Exchange 13
3.2.4 Surface Water Quality 13
3.3 Natural Resources 14
3.3.1 Upland and Shoreline Habitats 14
3.3.2 Aquatic Habitats 15
3.3.3 Sensitive and Endangered Species and Habitat 16
3.4 Climate and Climate Change vulnerability 17
3.5 Environmental Justice Screening 18

4. FIELD INVESTIGATION 20
4.1 Summary of Previous Environmental Investigations 20

4.1.1 Shannon & Wilson Inc. (1991, 1992) 20
4.1.2 Anchor Environmental LLC (2009) 20
4.1.3 Ecology 2019 (GeoEngineers and Leidos and NewFields) 21
4.1.4 Dioxin/Furan 2020 Results of Ecology Archived Samples 22
4.2 Remedial Investigation 23
4.2.1 Physical Surveys 24
4.2.2 Timber Pile Sampling 27
4.2.3 Asbestos-Containing Material Inspection and Abatement 28
4.2.4 Soil Sampling and Analysis 28
4.2.5 Groundwater Sampling and Analysis 29
4.2.6 Sediment Sampling and Analysis 29
4.2.7 Inadvertent Discovery Plan 30
4.2.8 Field Quality Assurance 30
4.2.9 Investigation-Derived Waste Disposal 30
4.2.10 Modifications and Deviations from Work Plan 31

5. SITE SCREENING LEVELS, COPCS, AND COCS 33
5.1 Screening Levels 33
5.2 COPCs 34
5.2.1 Development of Total cPAH TEQs 34
5.2.2 Development of Total TCDD TEQs for Dioxins/Furans 35
5.2.3 Organic Carbon Normalization of Sediment Results 35
5.3 COCs 35

6. NATURE AND EXTENT OF CONTAMINATION 37
6.1 Nature and Extent of Contamination 37
6.1.1 Soil Results 37
6.1.2 Groundwater Results 41
6.1.3 Sediment Results 41
6.2 Extent of Wood Debris 43
6.3 Assessment of Benthic Infauna Impairment 43
6.4 Evaluation of Benthic Toxicity 44
6.4.1 Bioassay Testing 45
6.4.2 Bioassay Results 46
6.5 Data Quality Summary: Chemistry 46
6.5.1 Field Duplicates 47
6.5.2 Qualifications 47
6.5.3 Chemistry Summary 47

6.6 Data Quality Summary: Bioassays 48
6.7 RI Boundary Determination 49
6.8 Interpolated Distribution of COCs 50
6.9 Nature and Extent Summary 50
6.9.1 North Upland 51
6.9.2 South Upland 51
6.9.3 Mill Pond 51
6.9.4 Inner Harbor 52
6.9.5 Outer Harbor 53

7. CONCEPTUAL SITE MODEL AND RISK EVALUATION 54
7.1 Contaminant Sources 54
7.1.1 Historical Sources from Site Operations 54
7.1.2 Current Potential Sources 56
7.2 Fate and Transport Pathways 57
7.2.1 Erosion of Surface Soil 57
7.2.2 Atmospheric Deposition 58
7.2.3 Redistribution of Sediment via Erosion 58
7.2.4 Upward Migration from Subsurface Sediment 59
7.2.5 Natural Attenuation 59
7.3 Potential Receptors and Exposure Pathways 61
7.4 Human Health Risk Evaluation 62
7.4.1 Direct Contact in Soil and Sediment 62
7.4.2 Human Heath Bioaccumulation 63
7.4.3 Cumulative Risk 63
7.5 Ecological Evaluation 64
7.5.1 Soil Terrestrial Ecological Evaluation 64
7.5.2 Sediment Benthic 65
7.5.3 Sediment Wildlife Bioaccumulation 65
7.6 Evaluation of Wood Debris and Indicators 65
7.6.1 Indicators of Wood Debris Decomposition 66
7.6.2 Correlation between Wood Debris and other Analytes 66
7.6.3 Overlap Analysis with Areas with Sediment Exceedances 67
7.7 Summary of Site Risks 67
7.8 Uncertainty 68
7.8.1 Historical Data 68
7.8.2 Method Detection Limits 68
7.8.3 Unrestricted Land Use Assumptions 68

7.8.4 Assumptions for Bioaccumulative COCs in Sediment 69
7.8.5 Depth of Contamination 69
7.8.6 Consideration of Background 69
7.8.7 Surface Water 70
7.9 Conceptual Site Model Summary 70

8. PROPOSED CLEANUP STANDARDS 72
8.1 Soil Cleanup Standards 72
8.1.1 Preliminary Soil Cleanup Levels 72
8.1.2 Points of Compliance for Soil 73
8.1.3 Ecological Cleanup Level Considerations 73
8.2 Groundwater Cleanup Standards 73
8.3 Sediment Cleanup Standards 74
8.3.1 Preliminary Sediment Cleanup Levels 74
8.3.2 Points of Compliance for Sediment 75

9. RI CONCLUSIONS 76

10. REFERENCES 77

LIST OF TABLES

Table 1-1 Project Contact Information

Table 4-1 Site History and Timeline
Table 4-2 Summary of RI Field Activities
Table 4-3 RI Sample Locations and Dates Sampled
Table 4-4 Remedial Investigation Analytical Sample Count

Table 5-1 Refined Screening Level Selection: Soil
Table 5-2 Refined Screening Level Selection: Groundwater
Table 5-3a Refined Screening Level Selection in Dry Weight Basis: Sediment
Table 5-3b Refined Screening Level Selection in Organic Carbon Basis: Sediment
Table 5-4 Summary Statistics for Chemicals of Potential Concern: Soil
Table 5-5 Summary Statistics for Chemicals of Potential Concern: Groundwater
Table 5-6 Summary Statistics for Chemicals of Potential Concern: Sediment
Table 5-7 Identification of Initial Chemicals of Concern: Soil
Table 5-8 Identification of Initial Chemicals of Concern: Groundwater
Table 5-9 Identification of Initial Chemicals of Concern: Sediment
Table 5-10 Identification of Refined Chemicals of Concern: Soil
Table 5-11 Identification of Refined Chemicals of Concern: Groundwater

Table 6-1 Surface Sediment Bioassay Results
Table 6-2 Bioassay Results and Carbon Load in Surface Sediment

Table 7-1a Summary of COCs and Risk Screening
Table 7-1b Risk Screening Summary
Table 7-2 Human Health Direct Contact Risk Screening: Soil
Table 7-3 Human Health Direct Contact Beach Play Risk Screening: Intertidal Sediment
Table 7-4 Human Health Direct Contact Clamming Risk Screening: Intertidal Sediment
Table 7-5 Human Health Direct Contact Net Fishing Initial Risk Screening: Surface Sediment
Table 7-6 Bioaccumulative Risk Screening: Surface Sediment

Table 7-7 Ecological Direct Contact/Bioaccumulation Risk Screening: Soil
Table 7-8 Ecological Benthic Risk Screening: Surface Sediment
Table 7-9a Wood Debris and Wood Decomposition Indicators in Surface Sediment
Table 7-9b Surface Sediment Indicators of Wood Debris Potential Impact
Table 7-10 Correlation between Percent Wood Debris and Wood Indicators in Surface Sediments
Table 7-11 Exceedances at Depth in Soil and Sediment
Table 7-12 Summary of CSM and COC

Table 8-1 Correlation of Sediment Organic Compounds with Total cPAH TEQ
Table 8-2 Proposed Cleanup Levels for Identified Soil COCs with Risk
Table 8-3 Proposed Cleanup Levels for Identified Sediment COCs with Risk

LIST OF FIGURES

Figure 2-1 Vicinity Map
Figure 2-2 Blakely Harbor Site Layout
Figure 2-3 1917 Mill Structures and Historical Features
Figure 2-4 Blakely Harbor Park Site Tax Lot Parcels

Figure 3-1 RI Sampling Locations
Figure 3-2 Cross-Section Plan View
Figure 3-3a Cross-Section A-A'
Figure 3-3b Cross-Section B-B'
Figure 3-3c Cross-Section C-C'
Figure 3-3d Cross-Section D-D'
Figure 3-4a October 2022 Groundwater Contour Map
Figure 3-4b January 2023 Groundwater Contour Map
Figure 3-4c April 2023 Groundwater Contour Map
Figure 3-4d August 2023 Groundwater Contour Map
Figure 3-5 Shoreline Habitats

Figure 4-1 Historical Sample Locations
Figure 4-2a Shoreline Structure
Figure 4-2b Location of Seeps along the Shoreline
Figure 4-3 Extent of Slag

Figure 5-1 Decision Flowchart for Identifying COCs

Figure 6-1 Arsenic Concentrations in Soil/Sediment
Figure 6-2 Chromium Concentrations in Soil/Sediment
Figure 6-3 Copper Concentrations in Soil/Sediment
Figure 6-4 Lead Concentrations in Soil/Sediment
Figure 6-5 Mercury Concentrations in Soil/Sediment
Figure 6-6 Zinc Concentrations in Soil/Sediment

Figure 6-7 Total cPAH TEQ Concentrations in Soil/Sediment
Figure 6-8 Total TCDD TEQ Concentrations in Soil
Figure 6-9 Cadmium Concentrations in Soil/Sediment at Depth
Figure 6-10 Total LMW PAHs Concentrations in Soil/Sediment at Depth
Figure 6-11 Total HMW PAHs Concentrations in Soil/Sediment at Depth
Figure 6-12a Successional Stage of Benthic Infauna vs. Wood Debris
Figure 6-12b RPD Depth and Wood Debris Measurements via SPI
Figure 6-12c Methane Measurements and Wood Debris
Figure 6-13 Proposed RI Boundary
Figure 6-14a Interpolated Arsenic Concentrations in Surface Soil (0 to 2 feet) - Soil
Figure 6-14b Interpolated Arsenic Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Figure 6-14c Interpolated Arsenic Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)
Figure 6-15a Interpolated Copper Concentrations in Surface Soil (0 to 2 feet)
Figure 6-15b Interpolated Copper Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Figure 6-15c Interpolated Copper Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)
Figure 6-16a Interpolated Lead Concentrations in Surface Soil (0 to 2 feet)
Figure 6-16b Interpolated Lead Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Figure 6-16c Interpolated Lead Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)
Figure 6-17a Interpolated Mercury Concentrations in Surface Soil (0 to 2 feet)
Figure 6-17b Interpolated Mercury Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Figure 6-17c Interpolated Mercury Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)
Figure 6-18a Interpolated Zinc Concentrations in Surface Soil (0 to 2 feet)
Figure 6-18b Interpolated Zinc Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Figure 6-18c Interpolated Zinc Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)

Figure 6-19a Interpolated cPAH TEQ Concentrations in Surface Soil (0 to 2 feet)
Figure 6-19b Interpolated cPAH TEQ Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Figure 6-19c Interpolated cPAH TEQ Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)
Figure 6-20a Interpolated TCDD TEQ Concentrations in Surface Soil (0 to 2 feet)
Figure 6-20b Interpolated TCDD TEQ Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Figure 6-20c Interpolated TCDD TEQ Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)
Figure 6-21a Interpolated Bis(2-ethylhexyl)phthalate Concentrations in Surface Soil (0 to 2 feet)
Figure 6-21b Interpolated Bis(2-ethylhexyl)phthalate Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Figure 6-21c Interpolated Bis(2-ethylhexyl)phthalate Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)
Figure 6-22a Interpolated Arsenic Concentrations in Surface Sediment (0 to 10 cm below mudline)
Figure 6-22b Interpolated Arsenic Concentrations in Sediment Cores (>10 cm below mudline)
Figure 6-23a Interpolated Copper Concentrations in Surface Sediment (0 to 10 cm below mudline)
Figure 6-23b Interpolated Copper Concentrations in Sediment Cores (>10 cm below mudline)
Figure 6-24a Interpolated Lead Concentrations in Surface Sediment (0 to 10 cm below mudline)
Figure 6-24b Interpolated Lead Concentrations in Sediment Cores (>10 cm below mudline)
Figure 6-25a Interpolated Mercury Concentrations in Surface Sediment (0 to 10 cm below mudline)
Figure 6-25b Interpolated Mercury Concentrations in Sediment Cores (>10 cm below mudline)
Figure 6-26a Interpolated Zinc Concentrations in Surface Sediment (0 to 10 cm below mudline)
Figure 6-26b Interpolated Zinc Concentrations in Sediment Cores (>10 cm below mudline)
Figure 6-27a Interpolated cPAH TEQ Concentrations in Surface Sediment (0 to 10 cm below mudline)
Figure 6-27b Interpolated cPAH TEQ Concentrations in Sediment Cores (>10 cm below mudline)
Figure 6-28 Interpolated TCDD TEQ Concentrations in Surface Sediment (0 to 10 cm below mudline)

Figure 6-29a Interpolated Bis(2-ethylhexyl)phthalate Concentrations in Surface Sediment (0 to 10 cm below mudline)
Figure 6-29b Interpolated Bis(2-ethylhexyl)phthalate Concentrations in Sediment Cores (>10 cm below mudline)
Figure 6-30a Visual Extent of Wood Debris at Surface (0-1 ft) and Bioassay Results
Figure 6-30b Visual Extent of Wood Debris at depth

Figure 7-1 Conceptual Site Model
Figure 7-2 Stormwater Conveyance System
Figure 7-3 Bathymetric Change 2009 through 2020
Figure 7-4 series Distribution of selected COC in Site Surface and Subsurface Sediment
Figure 7-4a Arsenic Distribution in Site Sediment
Figure 7-4b Mercury Distribution in Site Sediment
Figure 7-4c Lead Distribution in Site Sediment
Figure 7-4d cPAH TEQ Distribution in Site Sediment
Figure 7-4e TCDD TEQ Distribution in Site Sediment
Figure 7-5 series Distribution of selected COC in Historical and RI Surface Sediment
Figure 7-5a Arsenic Distribution in Historical and RI Surface Sediment
Figure 7-5b Mercury Distribution in Historical and RI Surface Sediment
Figure 7-5c Lead Distribution in Historical and RI Surface Sediment
Figure 7-5d cPAH TEQ Distribution in Historical and RI Surface Sediment
Figure 7-5e TCDD TEQ Distribution in Historical and RI Surface Sediment
Figure 7-6a Conceptual Site Model and Potential Human Receptors
Figure 7-6b Conceptual Site Model and Potential Ecological Receptors
Figure 7-7a Overlay of cPAH TEQ Interpolated Concentrations in Soil Wood Debris Extent
Figure 7-7b Overlay of TCDD TEQ Interpolated Concentrations in Soil Wood Debris Extent
Figure 7-8a Overlay of cPAH TEQ Interpolated Concentrations in Sediment Wood Debris Extent
Figure 7-8b Overlay of TCDD TEQ Interpolated Concentrations in Sediment Wood Debris Extent
Figure 7-9 Overlay of Wood Debris and Slag Extents with Exceedance Footprints

LIST OF APPENDICES

Appendix A Cultural Resources Report
Appendix B Bathymetry and Lidar Survey Report
Appendix C Soil Boring Logs
Appendix D Field Sampling Report
Appendix E Vulnerable Population Screening Report
Appendix F Sediment Profile Imaging and Plain View Survey Report
Appendix G Shoreline and Habitat Survey Field Report
Appendix H Shoreline Seeps and Structures Survey
Appendix I Slag Survey Summary
Appendix J Probing and Wood Debris Evaluation
Appendix K Timber Pile Mapping and Sampling
Appendix L Asbestos Inspection and Sampling Report
Appendix M Chemistry Tables
Appendix N Laboratory Reports and Chains of Custody
Appendix O Data Quality Assessment
Appendix P Data Handling

ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
µg/kg	micrograms per kilogram
ACM	asbestos-containing material
AESI	Associated Earth Sciences, Inc
Anchor	Anchor Environmental, LLC
AO	Agreed Order
ARARs	applicable or relevant and appropriate requirements
aRPD	apparent redox potential discontinuity
AVS	acid volatile sulfide
bgs	below ground surface
BI Parks	Bainbridge Island Metropolitan Parks and Recreation District
bml	below mudline
cm	centimeters
COC	chemical of concern
COPC	chemical of potential concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSL	Contaminant Screening Level
CSM	conceptual site model
CUL	cleanup level
DAHP	Washington State Department of Archaeology and Historic Preservation
DCAP	draft cleanup action plan
DF	detection frequency
DPS	distinct population segment
DQOs	data quality objectives
DRO	diesel range organics
DVR	data validation report
dw	dry weight
EC50	effective concentration
Ecology	Washington State Department of Ecology
EF	exceedance factor

EHD	Environmental Health Disparities
EJ	environmental justice
ELCR	excess lifetime cancer risk
EPA	United States Environmental Protection Agency
ERIS	Environmental Risk Information Services
ESA	Endangered Species Act
FOE	frequency of exceedance
FS	feasibility study
ft	feet/foot
Geosyntec	Geosyntec Consultants, Inc.
GIS	geographic information systems
GPS	global positioning system
HI	hazard index
HMW	high molecular weight
HPAH	high molecular weight polycyclic aromatic hydrocarbon
IDW	inverse-distance weighting
Integral	Integral Consulting Inc.
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
LiDAR	light detection and ranging
LMW	low molecular weight
MDL	method detection limit
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
Mill	former Port Blakely Mill Company
MLLW	mean lower low water
MS/MSD	matrix spike/matrix spike duplicate
MTCA	Model Toxics Control Act
NAVD88	North American Vertical Datum of 1988
NB	natural background
ng/kg	nanograms per kilogram
NOAA	National Oceanic and Atmospheric Association

PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
POC	point of compliance
Port Blakely	Port Blakely Tree Farms
PQL	practical quantitation limit
PSEP	Puget Sound Estuary Program
PV	Plan View Survey
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCW	Revised Code of Washington
RI	remedial investigation
RMF	relative mobility factor
SAP	Sampling and Analysis Plan
SCO	Sediment Cleanup Objective
SCUM	Sediment Cleanup User's Manual
Shannon & Wilson	Shannon & Wilson, Inc.
SIM	selected ion monitoring
SL	screening level
SM/ML	silty sand/sandy silt
SMS	Sediment Management Standards
SPI	sediment profile imaging
SSG	sand, silt, and gravel
State waters	Waters of the State of Washington
SVOCs	semi-volatile organic compounds
SWACs	spatially weighted average concentrations
TBT	tributyltin
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCLP	toxicity characteristic leachate procedure
TEE	Terrestrial Ecological Evaluation
TEF	toxicity equivalency factor

TEQ	toxic equivalence quotient
the Site	Blakely Harbor Park Site
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TVS	total volatile solids
U&A	Usual and Accustomed
USGS	United States Geological Survey
UTL	upper tolerance limit
VOC	volatile organic compound
WA DNR	Washington Department of Natural Resources
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
Work Plan Addendum	RI/FS Work Plan/Sampling Analysis Plan Addendum
Work Plan	Remedial Investigation/Feasibility Study Work Plan

1. INTRODUCTION

On June 24, 2020, the Washington State Department of Ecology (Ecology) entered into an Agreed Order (AO) with Port Blakely Tree Farms (Port Blakely) (AO No. DE 16944; Ecology and Port Blakely Tree Farms, 2020) to conduct a remedial investigation and feasibility study (RI/FS) and prepare a draft cleanup action plan (DCAP) at the Blakely Harbor Park Site (the Site) located in Bainbridge Island, Washington. The RI/FS is being conducted in accordance with the AO, pursuant to the Model Toxics Control Act (MTCA) Revised Code of Washington (RCW) Chapter 70A.305 (MTCA Statute), Washington Administrative Code (WAC) Chapter 173-340 (MTCA Regulations), and Sediment Management Standards (SMS) Regulations Chapter 173-204 WAC.

MTCA WAC Section 173-340-200 defines "site" by the nature and extent of contamination associated with one or more releases of hazardous substances prior to any cleanup of the contamination. This Site will be defined as the extent of contamination caused by release of hazardous substances from historical operations associated with the former Port Blakely mill (Mill), which ceased operations in 1923. The overall purpose of the Blakely Harbor RI is to characterize the nature and extent of contamination at the Site. The area investigated during this RI is called the Study Area.

In July 2021, Ecology provided conditional approval of the *RI/FS Work Plan* (Work Plan). Geosyntec Consultants, Inc. (Geosyntec) completed the Phase 1 field investigation in September of 2021,[1] and Ecology approved the final Work Plan in January 2022 (Geosyntec, 2022). An *RI/FS Work Plan/Sampling Analysis Plan* (SAP) *Addendum* (Work Plan Addendum) was submitted in April 2023 (Geosyntec, 2023a) to fill data gaps identified in soil, groundwater, and sediment media after Ecology requested further Site characterization following review of the Phase 1 data results. Results of Phase 2 investigations were summarized in a technical memorandum submitted to Ecology in August 2023 (Geosyntec, 2023b). A Field Change Request was submitted in November 2023 (Geosyntec, 2023c) to fill data gaps identified in soil and sediment media after review of the Phase 2 data results collected in 2022. Data collection in association with the Field Change Request was conducted in December 2023.

1.1 Project Organization

The RI/FS is being conducted by Geosyntec on behalf of Port Blakely. Ecology is providing regulatory oversight of the RI/FS activities. In accordance with the AO, the designated Project Coordinators and their contact information are provided in Table 1-1.

The Project Coordinator for Ecology is Rachel McDermott. She is responsible for the regulatory oversight of all RI/FS activities, including review and approval of this RI report and all other AO deliverables. The Project Coordinator for Ecology is also responsible for ensuring implementation of the AO for the Site and coordination with the Suquamish Tribe.

Port Blakely's Project Coordinator is Cindy Bartlett of Geosyntec. She is responsible for overall project management, implementation of the AO, and oversight of RI/FS activities. The Project

[1] Bathymetry and Sediment Profile Imaging and Plan View Surveys were completed in 2020 (Geosyntec, 2020a and 2020b, respectively).

Coordinator role is to provide technical consulting and coordination of all efforts, including on the following tasks: project planning and scheduling; project deliverables; data collection and analysis; and coordination with the Ecology Project Coordinator and Port Blakely representatives. Port Blakely's Technical Advisor is Anne Fitzpatrick of Geosyntec. She is responsible for technical oversight of RI/FS activities.

Port Blakely is a signatory of the AO and has agreed to complete the RI/FS and DCAP in accordance with the AO. The representative for Port Blakely is Mike Warjone, President of United States Forestry.

1.2 Report Organization

The remainder of this report is organized into the following sections:

- Section 2, Site Background, describes the Site location, historical uses of the Site, including Native American uses, industrial land development, current land use and ownership and reasonably anticipated future uses.
- Section 3, Physical and Environmental Setting, describes the Site physical conditions including topography and bathymetry, the regional geology, and Site hydrogeological conditions based on RI field studies and regional information.
- Section 4, Field Investigation, summarizes previous environmental investigations conducted at the Site and describes the scope of field investigations conducted in support of the RI, including physical surveys and analytical sampling for chemicals of potential concern (COPCs). This Section also describes any modifications/deviations to the approach outlined in the Work Plan and SAP Addendum, as applicable.
- Section 5, Site Screening Levels, COPCs, and chemicals of concern (COCs), presents the methodology to refine the preliminary screening levels (SLs) and Site COCs. Background concentrations are discussed in this section.
- Section 6, Nature and Extent of Contamination, describes the distribution of COPCs in Site environmental media. It also provides estimated extent of wood debris and a summary of sediment toxicity bioassay results.
- Section 7, Conceptual Site Model and Risk Evaluation, provides a synthesis of the collective information about the Site to identify potential sources of contamination, evaluate the mechanisms of fate and transport, assess potential exposure pathways and related risks, and summarize the areas and media to be further evaluated.
- Section 8, Proposed Cleanup Standards, summarizes proposed cleanup levels and points of compliance.
- Section 9, RI Conclusions, summarizes the RI Report.
- Section 10, References, provides list of reference materials cited in the RI Report.

Tables and figures are located at the end of the text, followed by appendices.

2. SITE BACKGROUND

This section provides detail regarding the Site location, a description of the Site history, including a description of pre-industrial history and historical Mill operations, a description of current land use of the Site and nearby properties, and a description of anticipated future Site use.

2.1 Site Location

The Site is located on the southeast side of Bainbridge Island, Washington (Figure 2-1), at Northeast Blakely Avenue and 3-T Road.[2] The upland portion of the Site is located within Blakely Harbor Park, a public park owned and managed by City of Bainbridge Island Parks (BI Parks). The Site is a marine embayment located in the westernmost portion of Blakely Harbor, which includes approximately 26 acres of vacant and forested upland area, a 7.5-acre former Mill Pond, 7,500 linear feet (ft) of shoreline, and approximately 74 acres of intertidal/subtidal marine harbor. This total Study Area is about 100 acres (Figure 2-1).

The Blakely Harbor Park property is bounded to the west by Northeast Country Club Road and to the north by Northeast Blakely Avenue and private property. Blakely Harbor Park is bounded to the south by private residential property located along Northeast Country Club Road. The western portion of the harbor is owned by BI Parks and private property owners; the eastern portion of the harbor and beyond is owned by the State of Washington and managed by Washington State Department of Natural Resources (WA DNR). A pedestrian bridge was installed by BI Parks in 2020 across the narrow inlet between the former Mill Pond and the Inner Harbor. This bridge connects the southern and northern shorelines of the harbor for park users (Figure 2-2). The Facility/Site ID is 60939, and the Ecology Cleanup Site ID is 14770. Figure 2-2 shows the tax parcel lot lines.

2.2 Pre-Industrial Harbor History and Cultural Resources

Human occupation within the Pacific Northwest and Western Washington began at least 10,000 years ago. The first archaeological evidence of that occupation are large projectile points, with the Clovis point being the most widely recognized. The sparse archaeological record up to about 5,000 years ago may be, in part, due to geological events that may have submerged or buried any archaeological sites. However, a relatively common site-type observed in the Puget Sound, called an "Olcott" site, originates from the Middle Holocene period (8,000 to 5,000 years ago). Olcott sites typically contain utilitarian cobble tools and Cascade-style leaf-shaped projectile points located near small streams on upland terraces. During the later Holocene, archaeological sites become more frequent and widespread, often indicating a greater reliance on marine and littoral resources based on the presence of shell middens.

Beginning about 2,000 years ago, large village sites became more frequent in riverine and littoral settings, with surrounding specialized seasonal camps associated with larger villages. These larger villages have been interpreted as indicators of aggregating winter populations with a heavy reliance

[2] The Site address in the AO is Blakely Avenue and 3-T Road Bainbridge Island, Washington 98110. The figures in this document show "Northeast" in front of most roads because that is what is used on the Tax Lot Parcel layer provided by Kitsap County.

on salmon. These winter village sites are associated with the quintessential Northwest cultural traits and account for the highest frequency of known precontact site types in the region. An example would be a winter village/occupation site located at West Point, roughly 5.5 miles northeast of Blakely Harbor, which includes a large shell midden (Larson and Lewarch, 1995).

The Study Area lies within the traditional territory of the Suquamish people and their ancestors, who occupied much of the Kitsap Peninsula and the western shores of Puget Sound. The Suquamish lived in autonomous villages but were widely affiliated with neighboring peoples through language, intermarriage, trade, and material culture. In fact, a winter village is known to have been located on the south shore of Blakely Harbor (Suquamish Tribe, 2021). Three ethnographic place names have also been recorded for the Blakely Harbor vicinity: Tuts3xolo'sEb is a miry area at the upper end of Blakley Harbor meaning "clayey ground;" Kwalqs was the name of the promontory at the north end of the Blakely Harbor; and Sba'badid was the name of the seastack outside Blakely Harbor now holding a navigation light (Waterman et al., 2001). Seasonal camps existed along the shoreline of Blakely Harbor and likely at least at one village existed in this area as well. Although not on the harbor side, a spring Suquamish village was also recorded on the south side of Restoration Point by George Vancouver in May 1792.

Ethnographic and archaeological evidence demonstrates that the Suquamish Tribe inhabited the area in and around Blakely Harbor and has utilized its natural resources (including fish and shellfish) for thousands of years. The Suquamish Tribe has indicated that Blakely Harbor and the surrounding area have been and continue to be an important cultural place of the Suquamish Tribe.

The Site, in its entirety, falls within the boundaries of the historical lumber Mill and milltown, recorded as archaeological site 45KP110 by Dennis Lewarch of Larson Anthropological Archaeological Services Limited. The archaeological site was first recorded with the State of Washington in 1995, although its eligibility for listing in the National Register of Historic Places (NRHP) was not determined at that time. The archeological site is currently listed in the Washington Information System for Architectural and Archaeological Records Data (WISAARD) as "potentially eligible" (Lewarch, 1995). According to the 1995 archeological site record, site 45KP110 is the former Mill and milltown of Port Blakely dating between 1863 and 1920. When the archeological site was recorded in 1995, foundations, ornamental plants, abandoned roadbeds, and pilings associated with the old wharves were observed (Lewarch, 1995). The archeological site record also notes that all but two of the buildings were burned or torn down when the Mill closed. The locations of the former buildings and structures are well documented on the Sanborn Fire Insurance map from 1893.

A field visit conducted September 10, 2020, by Jacobs Solutions Inc. archaeologist, Matthew Sterner, confirmed the presence of building remnants associated with the Mill, including foundations, structural depressions, and pilings. While most of the archeological site is obscured by vegetation, historical materials such as glass and ceramic fragments, bricks, structural wood beams, slag, and structural remnants are common across the archeological site. Similar remnants were recorded in a 1992 survey (Carlsson, 1992). Some of these materials have been presumably collected or handled by residents or other park users and purposefully stacked along existing cut logs at the eastern end of the Site; this suggests the possibility that materials associated with the "archeological site's period of significance" may be present.

The 2019 upland and intertidal sampling activities were observed in the field by a representative of the Washington State Department of Archaeology and Historic Preservation (DAHP) for the possible presence of cultural artifacts during sampling. No archaeological artifacts were found during the field activities conducted for the RIs, which are further discussed in Section 4. Additional details regarding Site history and cultural relevance are provided in Appendix A.

2.3 Mill History and Historical Land Use

The Site's industrial development and operation began in 1863, peaked in the early 1900s, and ended in 1923. The historical ownership, the harbor's industrial timeline, and the historical facilities are presented below.

2.3.1 Industrial Property Ownership History

In 1863, Captain William Renton purchased land around Blakely Harbor and established a sawmill (the Mill), doing business as the Port Blakely Mill Company. During the 60 years of the Mill's operation and the years since the Mill shut down, the Mill was owned by entities bearing the name "Port Blakely," including but not limited to Port Blakely Mill Company (California), Port Blakely Mill Company (Washington), Blakely Mill Corporation, and Port Blakely Tree Farms Limited Partnership. Port Blakely Tree Farms Limited Partnership transferred ownership to BI Parks in two transactions, one involving an assignment of a purchase option by the Bainbridge Island Land Trust to BI Parks in December 1999 and the other in November 2001.

2.3.2 Historical Operations and Past Land Use

The former Mill, once considered the world's largest sawmill under one roof, began operations in 1863 and operated until 1923, sometimes under lease to third parties (Price, 1989). The Mill was torn down in 1924. The original sawmill was situated east-west on a spit that separated a pond used for log storage (former Mill Pond) from the natural harbor to the east (Figure 2-1). Between 1863 and 1880, the Mill complex was gradually expanded to the east along the northern shore of the harbor to include a planked-loading dock, the 75-room Bainbridge Hotel, a Masonic Hall, a school, and living and dining quarters for the sawmill laborers (Carlsson, 1992; Environmental Risk Information Services [ERIS], 2019a). In 1880, the Hall Brothers Shipbuilding Company (a separate entity) relocated to Blakely Harbor, approximately a quarter mile east of the Mill. Rail tracks were built along the shoreline to connect the two entities (Port Blakely Mill Company, 2019). In 1882, the Mill was producing 140,000 board-ft of lumber per day and 40 million board-ft per year.

In February 1888, the original Mill burned down, but it was subsequently rebuilt with increased capacity in August of that same year. Heading northeast from the Mill, a boardwalk was set partly on a pier and partly on dry land and lined with residential housing. As the Mill continued to increase operations, a railroad slip for barges was built in 1898 at the lumber yard on the south side of the harbor. Finished lumber could then be loaded directly into rail cars, which were barged to the main railroad line in Seattle. A year later in 1899, a telegraph crossarm factory was built near the railroad barge slip (Price, 1989; Port Blakely Mill Company, 2019). In 1903, Hall Brothers Shipbuilding relocated their operations north to Eagle Harbor to expand their shipbuilding capacity.

At the height of operations in 1904, the Mill complex included a machine shop, a blacksmith shop, an oil house, a foundry, steam dry kilns, a planing mill, and warehouse facilities, as well as an expansive wharf extending east into the harbor, used for loading/unloading materials onto ships (Price, 1989; Port Blakely Mill Company, 2019; Figure 2-1). In April 1907, an overheated journal box set fire to and burned down approximately half of the Mill, including a portion of the wharf (Carlsson, 1992). Construction of a smaller replacement Mill began the same year and was not completed until 1909. In 1916, Port Blakely Mill Company leased the Mill to the Dominion Mill Company, which operated the Mill until it closed in 1923 (Port Blakely Mill Company, 2019). Between 1923 and 1929, the Mill was gradually decommissioned and demolished. BI Parks acquired portions of the Site in 1999 and 2001.

2.3.3 Possible Sources of Contamination

Historical sources of contamination include potential spills and releases to soils and groundwater from Mill operations, including those formerly occurring in the machine shop, powerhouse, blacksmith shop, oil house, hog fuel/refuse burner, foundry, steam dry kilns, planing mill, and warehouse facilities. Overwater activities that might have resulted in spills and releases included Mill operations such as debarking, rafting logs, and loading and unloading materials onto ships at the wharf. Potential releases during these nearshore activities might then be transported to sediment or from soil and/or groundwater to sediment or surface water via seeps.

In addition, the Mill burned down and was rebuilt twice during the period of operations. The fires occurred in 1888 and 1907, and both upland and overwater structures were destroyed in the fires. Remnants of burnt wood debris and byproducts of the fires could accumulate in soil and sediment and constitute a secondary source of contamination for the adjacent media. Construction debris, including brick mounds in the upland area and remnants of Mill buildings, may also serve as sources of contamination and wood debris throughout the upland area.

2.4 Current and Future Land Ownership and Uses

Current and potential future land uses of the Site and surrounding area are described below.

2.4.1 Shoreline Parcel Ownership and Zoning

The majority of the upland portion of the Site, the former Mill Pond, and portions of the Inner Harbor area are currently owned and operated by BI Parks (31 acres). This portion of the Site is located on Kitsap County Parcel No. 022402-3-032-2000, which is referred to by the Kitsap County Assessor's office as Parcel A. The legal description for Parcel A includes Government Lots 3 (former Mill site), 4 (former Mill Pond), and 5 (western and southern shoreline), collectively shown on Figure 2-4 as the "BI Parks Tax Lot Property Boundary."

The Study Area also includes subtidal areas extending east from the Blakely Harbor shoreline. The Inner Harbor includes intertidal and submerged land owned by BI Parks and private property owners; the Outer Harbor includes submerged lands managed by the WA DNR (State waters). The subtidal area of the Site is visible on Figure 2-2.

2.4.2 Current Site Use

The upland portion of the Site is a public park (Blakely Harbor Park), which includes approximately 0.5 miles of walking trails for recreational day use. A pedestrian footbridge was

installed in 2020 to traverse a narrow inlet through the isthmus connecting the north and south sections of the park. This inlet connects the former Mill Pond to Blakely Harbor and is subject to tidal influence. Blakely Harbor Park contains remnants of the former Mill structures, including the former powerhouse, pontoon wall used to close off the former Mill Pond, slag piles along the northern shoreline, scattered brick piles and building debris now covered with vegetation, and partially eroded wharf pilings. The park is used by the Suquamish Tribe as discussed in Section 2.4.4 and is frequented by recreational users for passive recreation, such as picnicking, kayaking, trail walking, and wildlife viewing. The primary access points to the park are the small parking lot in the northeast corner of the park, near the intersection of Northeast Blakely Avenue and Northeast Halls Hill Road, and the harbor via small watercraft.

The portion of the Study Area located in the subtidal zone, east of the park boundary, consists of multiple parcels of private residential property along the southern shoreline on Northeast Country Club Road. These private properties extend approximately 300 ft from the southern shoreline into Blakely Harbor. Private ownerships along the northern shoreline extend less than 150 ft in the harbor. State waters, which are managed by WA DNR, begin approximately 200 ft from the Blakely Harbor Park shoreline and extend east to make up the rest of Blakely Harbor. The subtidal area is primarily used for recreation, including boating, kayaking, and swimming, and for anchoring boats in the mid-harbor.

2.4.3 Surrounding Land Use

The surrounding area is a mix of residential and vacant and heavily forested properties. Adjacent current land uses are summarized below:

- North—Northeast Blakely Avenue and residential properties are directly adjacent to the Site, followed by approximately 1/4 mile of vacant and heavily forested land, followed by Port Blakely Cemetery.
- South—Residential properties along the shoreline, followed by Northeast Country Club Road, followed by vacant and heavily vegetated land, and then residential development.
- West—Northeast Country Club Road, followed by approximately 1/3 mile of vacant and heavily forested land.
- East—Blakely Harbor and the residential properties that line its southern and northern shores.

2.4.4 Tribal Use

The Suquamish and other Tribes have identified the Site as lying within their adjudicated usual and accustomed (U&A) fishing area. As a part of the 1855 Treaty of Point Elliot, the United States and the Suquamish and other Tribes agreed that the Tribes would cede certain portions of their aboriginal lands while reserving the right to use and occupy their U&A lands and waters. Because of these rights, Ecology has determined that the Tribes with U&A at MTCA sites should have the opportunity to review the potential impacts on their treaty rights in relation to their historical and future use of the Site.

An aboriginal right retained under the Treaty of Point Elliot includes the immemorial custom and practice to hunt, fish, and gather within the U&A area; these customs and practices were the basis of the Suquamish Tribe's source of food and culture in the past. Treaty-reserved resources include, but are not limited to, fishery resources situated within the Suquamish Tribe's U&A fishing area. The Suquamish Tribe U&A area extends well beyond Port Madison Indian Reservation, and their fishing places include: marine waters of Puget Sound from the northern tip of Vashon Island to the Fraser River in Canada, including Haro and Rosario Straits; and the streams draining into the western side of Puget Sound and also Hood Canal. The U&A area of the Suquamish Tribe also extends west into Jefferson County and south into Mason County. The Port Madison Reservation comprises 7,657 acres and is located in proximity of the City of Poulsbo, approximately 10 miles north of the Site and across the Agate Passage.

The Suquamish Tribe has taken a leadership position in the efforts to protect, restore, and enhance the marine waters of Puget Sound to ensure protection of the Suquamish Tribe's treaty and cultural resources. The Suquamish Tribe has historically harvested and consumed fish and shellfish from waters in and around Bainbridge Island and has indicated its intent to do so in the future.

2.4.5 Anticipated Future Use

The portion of the Site that is Blakely Harbor Park is expected to remain a public park. The other portions of the Site, the submerged lands managed by the WA DNR and the private property, are expected to remain as such.

3. PHYSICAL AND ENVIRONMENTAL SETTING

This section describes Site characteristics, including Site geology, Site hydrogeology, natural resources, climate and climate change vulnerability, and a vulnerable population screening.

3.1 Site Geology

The general description of Bainbridge Island's regional geology and hydrogeology included in this report is based on information provided by the United States Geological Survey (USGS) (2005 and 2011). Site-specific geology and hydrogeology conditions are based on information gathered during historical environmental investigations conducted at or near the Site (Shannon & Wilson, Inc. [Shannon & Wilson], 1991, 1992a, and 1992b; Anchor Environmental, LLC [Anchor], 2009; GeoEngineers, 2019; Leidos and NewFields, 2019) and during remedial investigation activities conducted by Geosyntec.

3.1.1 Regional Geology

Bainbridge Island lies within the Salish Lowland Physiographic province (USGS, 2005). The northern and central portions of Bainbridge Island are primarily underlain by Pleistocene glacial deposits, namely the Vashon Till. The southern end of Bainbridge Island, including Blakely Harbor, is underlain by the Blakely Harbor Formation, which consists of Miocene Age volcanic-lithic sandstone, siltstone, conglomerate, and peat deposits. Blakely Harbor is situated within the Seattle Fault zone, a broad zone of shallow east-west thrust faults that runs from Seattle through the southern half of Bainbridge Island.

Two geotechnical investigations provide information about the local geology around Blakely Harbor (Associated Earth Sciences, Inc. [AESI], 2000, 2001). Exploratory borings advanced approximately 0.25 miles east of the Site, along Halls Hill Road, showed a mixture of clayey silt with gravel (native topsoil interpreted to be weathered or reworked from the Blakely Harbor Formation) and sandy gravel fill material from the surface to 3 ft below ground surface (bgs) (AESI, 2001). The surface material is underlain by bedrock (conglomerate, sandstone, and mudstone) deposits that extended to at least 27.5 ft bgs. Test pits from another geotechnical investigation, approximately 0.4 miles west of the Site, showed 0.5 to 1 ft of organic-rich sandy silt topsoil underlain by a weathered Blakely Harbor Formation to the depth of exploration (between 5 and 6 ft bgs) (AESI, 2000).

3.1.2 Site Geology and Topography

The upland portion of the Site is relatively flat, with elevations ranging from about -4.3 to 9.7 ft (North American Vertical Datum of 1988 [NAVD88])[3] in the northwest corner of the Site. The intertidal shoreline area at the Site can be characterized by relatively flat and low-angle slopes, gently sloping towards Blakely Harbor as detailed in the bathymetric and light detection and ranging (Lidar) survey report provided in Appendix B.

[3] Converted from ft above mean sea level to ft NAVD88 based on data from National Oceanic and Atmospheric Association (NOAA) tide station ID 9447130 in Seattle, Washington.

The interpretation of the Site geology presented below is based on borings logs for the RI. Historical exploration logs from AESI (2000, 2001), Shannon & Wilson (1992b), and Anchor (2009) were used for informative purposes but are not shown on the cross-sections since depth and elevation controls were tied into the same datum. The locations of historical and RI Site explorations are shown in Figure 3-1. Field sampling results are discussed in more detail in Section 4.

Subsurface investigations have identified three distinct units, consisting of seven subunits, based on their depositional characteristics (see Figures 3-2, and 3-3a through 3-3d for exploration locations and cross-sections):

- **Fill Material (Fill Unit)**: Anthropogenic fill material, likely a result of erosional processes and development of the Mill. The surficial subunit of fill material generally consists of surficial topsoil and sand. The fill material includes the lithological subunits of sand fill, wood debris, other debris fill, and sand, silt, and gravel (SSG) fill.
    - *Sand fill* is characterized by surficial topsoil and sand. Sand fill was observed primarily in the upper 2 ft of upland borings and a few intertidal sediment cores.
    - *Wood debris* is characterized by sawdust, dimensional lumber, and wood chips. Wood debris was observed in both soil borings and sediment cores throughout the Site, although it was primarily observed on the north/northeast section of the Site in areas where historical structures were located. Wood debris was typically encountered below the surficial sand Fill Unit and above the native unit.
    - *Other debris fill* is characterized by building and wood debris including slag, bricks, and glass. Debris fill was primarily observed in the former Mill area.
    - *SSG fill* is characterized as fill material with varying percentages of sand, silt, and gravel. SSG fill was observed at various depths across the site.
- **Recent Deposition (SM/ML):** Recent deposition is characterized as a silty sand/sandy silt (SM/ML) with no fill material (i.e., no wood or debris were observed within the unit). SM/ML was observed in two upland borings and in sediment cores as the recent depositional unit above the native contact.
- **Native Alluvial Deposits (Native A and Native B, collectively Native Deposits)**: The native contact was observed in the majority of borings, except for a few that were too shallow or hit refusal before the native contact. The native alluvial deposits are characterized by two lithological subunits, Native A and Native B, described below:
    - Native A is characterized by a greenish-gray gravelly silt and/or sand with no shell material. Native A was observed as deep as 20 ft bgs.
    - Native B is characterized by a greenish-gray gravelly silt and/or sand/gravelly sand with silt and shell material present. Native B was typically observed below Native A. Native B was observed as deep as 20.5 ft bgs.

A sandstone (bedrock) was encountered in two shallow borings (HA-31 and HA-32) at approximately 1.4 and 1.7 ft bgs. An outcropping of the sandstone is visible to the west of HA-31 and is interpreted to be part of the Blakely Formation.

The current understanding of subsurface geological conditions at the Site is depicted in cross-sections provided on Figures 3-3a through 3-3d. Key observations of each cross-section are described below:

- Cross-Section A-A' (Figure 3-3a). Cross-section A-A' is aligned generally west-southwest to east-northeast and transects the deepest section of the Mill Pond and former structures of the Mill. The maximum depth of borings in this cross-section was 20 ft bgs (approximately -5 ft elevation). Wood debris was observed in the majority of borings. The fill-native interface, where encountered, was generally found at an elevation of approximately 0 ft. Groundwater monitoring well GW-27 is screened across the native unit.
- Cross-Section B-B' (Figure 3-3b). Cross-section B-B' is aligned generally south-southwest to north-northeast and transects the east side of the Mill Pond, pedestrian bridge, and former Mill structures. The borings' depth in this cross-section was a maximum of 20.5 ft bgs (approximately 0 ft elevation). Wood debris was encountered in the borings within the historical Mill area. The fill-native interface, where encountered, was generally found between -5 ft and 5 ft elevation. Groundwater well GW-24 is screened across the Fill Unit where wood debris was observed.
- Cross-Section C-C' (Figure 3-2c). Cross-section C-C' is aligned generally east to west and transects the park to the west, the Mill Pond and former Mill, and then extending into Blakely Harbor. The deepest boring was completed to a depth of 17 ft bgs (approximately -5 ft elevation). The fill-native interface in the upland borings, where encountered, was generally found between -5 ft and 5 ft elevation, with a thick unit of wood material above the native interface in the area of former Mill structures. Moving east into Blakely Harbor, the topographic/bathymetric surface dips, and sediment cores show a top unit of SM/ML, with a native contact encountered in only one core at an elevation of approximately -33 ft.
- Cross-Section D-D' (Figure 3-2d). Cross-section D-D' is aligned generally west-southwest to east-northeast, just north of and parallel to A-A'. Cross-section D-D' transects the deepest section of the Mill Pond and former structures of the Mill. The deepest boring was completed to a depth of 20 ft bgs. Wood debris was observed in the majority of borings. The fill-native interface was generally found between -5 ft and 5 ft elevation. Groundwater monitoring wells GW-26 and GW-27 are screened across the native unit.

3.1.3 On-Site Geologic Conditions

Soil types at the Site generally consisted of brown, gravelly, silty, well-graded sand with intermittent debris fill material, including wood debris. Test pits and subsurface cores in shoreline sediment and soil indicated the presence of considerable amounts (up to 100%) of inorganic (e.g., red brick and glass fragments) and wood debris including dimensional lumber, piling stubs, sawdust, and logs in the upper 8 ft (Anchor, 2009; Shannon & Wilson, 1992a). Native gray sands and gravels (Native A and Native B) with no wood or inorganic debris were encountered below fill material typically around elevations of 4 to -10 ft (depths between 4 and 8 ft bgs, extending to

total depths of 20 ft bgs). Native B was also encountered to a depth of 11 ft below mudline (bml) (approximately -38 ft elevation) in Blakely Harbor.

Percent fines (i.e., the sum of silt and clay grain size fractions) in Blakely Harbor surface sediment varies between 7% and 67% (Anchor, 2009; GeoEngineers, 2019; Leidos and NewFields, 2019). Percent fines were highest in the former Mill Pond sediment (higher than 40%) and lowest along the southern portion of the Study Area in subtidal sediment (lower than 20%). Total organic carbon (TOC) in intertidal and subtidal surface sediment collected from Blakely Harbor ranged from 0.45% and 22%. The TOC range found in Blakely Harbor also exceeds the average TOC in Puget Sound, which is approximately 2% (these results are discussed and presented in Section 6). The highest TOC concentrations were identified in the former Mill Pond and in the intertidal area along the western shoreline of Blakely Harbor. TOC concentrations generally decreased with increasing distance from the shoreline and were lowest in the Outer Harbor and along the eastern and southern portions of the Study Area. Summary statistics for grain size and TOC data are also presented in Section 6.

During an initial Site visit, slag debris were observed as black, aggregate chunk piles along the shoreline near the former foundry, machine shop, and blacksmith shop (Figure 2-3). Shannon & Wilson also noted scatted slag-like debris in the former Mill Pond (Shannon & Wilson, 1992a), but these prior observations were not confirmed during the RI field work (additional discussion in Section 4.2.1.5). A more comprehensive slag survey was conducted for the RI and is discussed in Section 4. In addition, subsurface RI explorations identified slag in the upper 1 to 2 ft of borings located in the uplands near historical Mill structures. The deepest observed slag was encountered at 6 ft bgs on the hillside to the north of the historical Mill structures (SB-23). Boring logs are provided in Appendix C.

3.2 Site Hydrogeology

Site-specific hydrogeology conditions are based on information gathered during historical environmental investigations conducted at or near the Site (Shannon & Wilson, 1991, 1992a, 1992b; AESI, 2000, 2001; Anchor, 2009; GeoEngineers, 2019; Leidos and NewFields, 2019) and during RI field investigations conducted by Geosyntec.

Site groundwater flow observations have been described in two previous studies and additional information was gathered during RI investigations. Groundwater was characterized during RI investigations through the installation and monitoring of temporary and permanent groundwater monitoring wells and during shoreline seep surveys. The locations of historical and RI Study Area explorations are shown in Figure 3-1. Groundwater monitoring well construction logs are provided in Appendix C, and field observations are discussed in Appendix D. This section describes the water-bearing unit and summarizes groundwater elevations and flow directions, tidal exchange, and surface water quality.

3.2.1 Single Water-Bearing Unit

The available information indicates that the saturated portions of the combined Fill Unit and Native Deposits form a single water-bearing unit within the depth of exploration. While the Fill and Native Deposits contain variable percentages of silt, no continuous and laterally extensive layer of silt

(aquitard) has been observed to indicate there are vertically distinct water-bearing zones within the combined unconsolidated deposits.

3.2.2 Groundwater Elevations and Flow Directions

Site groundwater is encountered at shallow depths ranging from approximately 3.7 ft bgs to 8.5 ft bgs. Based on one year of quarterly monitoring in the four monitoring wells, groundwater levels seem to fluctuate seasonally by approximately 1 to 3 ft, with elevations highest in the spring and relatively consistent throughout remainder of the year. Groundwater elevations measured in temporary wells ranged between 6.9 and 10.6 ft bgs and were within the ranges measured in monitoring wells in autumn 2022 (3 to 12 ft bgs).

Groundwater in the shallow water-bearing zone flows from the park upland to the south towards Blakely Harbor (Figures 3-4a through Figures 3-4d). Groundwater seep observations along the shoreline provide evidence of shallow groundwater discharging into Blakely Harbor (Anchor, 2009). However, variability in subsurface lithology due to local wetlands, streams, ditches, and fill can influence the local shallow groundwater flow direction. Likewise, sudden rises in the water table following heavy rains or due to tidal influences can cause temporary and local changes to the groundwater flow regime.

3.2.3 Tidal Exchange

Blakely Harbor has two tidal cycles per day ranging from a maximum low tide elevation of about -2.5 ft mean lower low water (MLLW) to a high-water elevation of about +12.5 ft MLLW throughout the year. Tidal fluctuations and tidal exchange, along with harbor geometry, are mechanisms that can strongly affect harbor circulation, sediment transport, and groundwater chemistry and flow at coastal sites. The zone of nearshore groundwater that mixes with marine water is termed the transitional zone.

The extents to which tidal fluctuations and tidal exchange affect groundwater conditions in Blakely Harbor have not been quantified, as there have been no tidal studies at the Site. However, groundwater flow observations have been described in two previous studies (Shannon & Wilson, 1992a; Anchor, 2009) and additional information was gathered during RI investigations by Geosyntec. Saltwater intrusion was confirmed along the shoreline through field parameter (electrical conductivity) monitoring during the 1992 test pit excavations (Shannon & Wilson, 1992a). Anchor (2009) documented intertidal groundwater seeps that discharged saline water from the transitional zone during low tide conditions to Blakely Harbor. Groundwater quality field parameters (e.g., electrical conductivity, salinity, and others) were collected during groundwater monitoring at the Site in 2022-2023, and these field parameters are discussed in Section 4.2.

3.2.4 Surface Water Quality

According to Ecology, surface waters in Blakely Harbor are classified as Category 2, waters of concern, for bacteria based on one exceedance of water quality standards in November 2001 (Ecology, 2020c). Surface water from Blakely Harbor was subsequently sampled and analyzed in 2007, 2008, and 2009 for bacteria, and no exceedances were found. However, Blakely Harbor surface water remains classified as a Category 2 water body, as the most recent data were deemed insufficient to indicate that this water body meets water quality standards. Average salinity in the Harbor is expected to be above 25 parts per thousand.

3.3 Natural Resources

The Site includes upland, shoreline (riparian zones), and aquatic habitats, with their associated flora and fauna. The Site shoreline includes features of the upland ecology (soil or sediment substrate, plants, and debris distribution); therefore, the upland and shoreline habitats are discussed jointly. A description of these habitats is included below.

The Washington Department of Fish and Wildlife (WDFW) has indicated that Blakely Harbor hosts estuarine and marine habitats that provide spawning and foraging grounds for a variety of fish species including Endangered Species Act (ESA)-listed Puget Sound Chinook and Steelhead (WDFW, 2020). Sensitive and endangered species and their habitats are also discussed below.

3.3.1 Upland and Shoreline Habitats

The upland and shoreline areas of the Study Area occupy approximately 26.5 acres,[4] mostly within Blakely Harbor Park. Upland and shoreline Site habitats include areas of frequent public use (by park visitors) within the Park and lesser-frequented areas (e.g., wetland patches of aquatic plants, evergreen trees; and invasive or volunteer blackberries). The areas of frequent public use within Blakely Harbor Park include restrooms (portable restrooms and a permanent structure), boardwalks, picnic and beach facilities, decks, footbridges, small wildlife viewing structures, wildlife habitat restoration structures, interpretive displays and picnic areas, a gravel parking area, and a launch for human-powered boats.

The National Wetland inventory and the Kitsap County System registry[5] identify the upland and shoreline habitats as WA DNR surveyed or potential wetlands. These wetland areas are shown in Figure 3-5 and include the following:

- Freshwater Forested/Shrub Wetland or Palustrine Forested Seasonally Flooded (PFOC) Wetland in the South Upland. The Palustrine System includes nontidal wetlands dominated by trees, shrubs, persistent emergent mosses or lichens, and such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 part per trillion. The forested class includes area with wood vegetation that is 6 meters tall or taller. The seasonally flooded regime includes areas where surface water is present for extended periods in the growing season with a variable water table after flooding ceases.
- Estuarine and Marine Wetland or Estuarine Aquatic Bed Unconsolidated Shore Regularly Flooded (E2AB/USN) in part of the North Upland. The Estuarine System consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi enclosed by land but have open, partly obstructed, or sporadic access to marine surface water bodies. The substrate in these habitats is flooded and exposed by tides, including the associated splash zone. The aquatic bed unconsolidated shore class includes wetlands dominated by plants that grow principally on or below the surface of the water with unconsolidated substrates with less than 75% areal cover of stones, boulders, or bedrock and less than 30% areal cover

[4] As measured to mean higher high water (MHHW).
[5] The Kitsap County parcel search geographic information system (GIS) was used to identify wetland areas; the web portal was accessed on March 11, 2024, at the following link: https://psearch.kitsap.gov/psearch/index.html

of vegetation. The regularly flooded regime includes landforms such as beaches, bars, and flats that are exposed at least once daily by tidal flood.

Additional detail on the shoreline types is discussed in Section 4.2.1.3.

3.3.2 Aquatic Habitats

The in-water areas of the Study Area occupy approximately 74.1 acres within the Blakely Harbor marine embayment.

Habitat survey data from Ecology's online Coastal Atlas of Washington show patchy salt marsh along the shoreline of the former Mill Pond, patchy kelp along portions of the northern harbor and east of the Site, and patchy to continuous eelgrass along the southern shoreline both within and outside the Blakely Harbor Park Site (Ecology, 2020c). The National Wetland inventory[6] and the Kitsap County System registry[7] identify the marine embayment habitats as shown in Figure 3-5 and include the following:

- Estuarine and Marine Wetland or Estuarine Aquatic Bed Unconsolidated Shore Regularly Flooded (E2AB/USN) in the Mill Pond and part of the Inner Harbor. This system was described in Section 3.3.1.
- Estuarine Unconsolidated Bottom Subtidal (E1UBL) in the Outer Harbor and part of the Inner Harbor. The Estuarine System consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to marine surface water bodies. The substrate in these habitats is continuously covered with tidal water (i.e., located below extreme low water). The unconsolidated bed class includes wetlands and deepwater habitats with at least 25% cover of particles smaller than stones (less than 6-7 centimeters [cm]) and a vegetative cover less than 30%. The subtidal regime includes substrate continuously covered by tidal salt water.

According to a 2017 eelgrass survey conducted on Bainbridge Island by WA DNR, about 90% of the eelgrass along the Bainbridge Island shoreline grows in the elevation between 0 and -4.5 meters MLLW, with a median depth of -1.5 meters MLLW (WA DNR, 2017). Approximately two-thirds of the eelgrass around Bainbridge Island was classified as subtidal, growing at water depths greater than -1 m MLLW. In Blakely Harbor, both *Zostera marina* and *Zostera japonica* eelgrass species were documented in the nearshore subtidal areas along the southern Blakely Harbor shoreline. Eelgrass was absent from the Inner Harbor and northern shorelines of Blakely Harbor (WA DNR, 2017).

[6]The Wetlands Mapper is the primary public interface to the wetlands geospatial dataset that spatially integrates National Wetland Inventory data with additional natural resource information and political boundaries; the web portal was accessed on March 11, 2024, at the following link: https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/.

[7] The Kitsap County parcel search GIS was used to identify wetland areas; the web portal was accessed on March 11, 2024, at the following link: https://psearch.kitsap.gov/psearch/index.html.

3.3.3 Sensitive and Endangered Species and Habitat

The potential presence of ESA-listed species is discussed below based on preferred habitats available on-site. A wildlife study prepared for a nearby forested area by BI Parks reports the lack of ESA-listed species' preferred habitat in upland areas (Ecological Land Service, 2021).[8] The WDFW Priority and Habitat and Species (PHS) website identifies the potential presence of priority habitat and species areas in aquatic areas in the vicinity of the Site, including spawning and foraging grounds for two ESA-listed fish species (WDFW, 2020).[9]

The species mapped for western Washington as threatened include the marbled murrelet (*Brachyramphus marmoratus*), the streaked horned lark (*Eremophila alpestris strigata*), the yellow-billed cuckoo (*Coccyzus americanus*), and the bull trout (*Salvelinus confluentus*). The two fish species considered potentially foraging and spawning within the Blakely Harbor embayment are the Puget Sound Chinook Salmon and the Puget Sound Steelhead (*Oncorhynchus mykiss*). A detailed description of habitat for each ESA-listed species is provided in the subsections below.

3.3.3.1 Marbled Murrelet

Marbled murrelet habitat generally consists of greater than 500 acres of low-elevation forests with at least 30% late-successional or old-growth forest components within 40 miles of the coastal shoreline (United States Fish and Wildlife Service [USFWS] 1997, Federal Register 1992). Old-growth forests provide important nesting habitat for murrelets because they have developed the broad, horizontal-branching structure necessary for nest platforms. Marbled murrelets feed in ocean waters as well as within inland bays and fjords. There is no suitable habitat available for this species within the Site.

3.3.3.2 Streaked Horned Lark

Streaked horned larks are found in western Washington where they occupy open landscapes such as prairie-oak habitats, sandy islands, wet prairies, oak savannahs, grasslands found at airports, coastal spits, and coastal dune communities. They can also occur within moderately to heavily grazed pastures, gravel roads or shoulders of lightly traveled roads. It is unknown whether this species is present within the Site.

3.3.3.3 Yellow-billed Cuckoo

Suitable breeding habitat for the yellow-billed cuckoo is defined as patches of mature willow and cottonwood riparian vegetation that are greater than 50 acres in size. Yellow-billed cuckoos are found in a variety of vegetation types during migration, including coastal scrub, secondary growth woodland, hedgerows, humid lowland forests, and forest edges. It is unknown whether this species is present within the Site.

3.3.3.4 Bull Trout (Salvelinus confluentus)

The Coastal-Puget Sound distinct population segment (DPS) Bull Trout was listed in 1999 (DOI, 1999). The designated ESA critical habitat for the bull trout includes freshwater, estuarine, nearshore, and offshore marine areas. Typical bull trout timing for spawning is from August through November (McPhail and Murray 1979; Pratt 1992). Sub-adult and adult bull trout feed

[8] This study was for a trail being constructed on Bainbridge Island 6 miles north of the Site.
[9] This study includes habitat in streams and wetlands habitat in Bainbridge Island.

mostly on fish in marine/estuarine areas of northern Puget Sound (e.g., smelt, herring, and juvenile salmonids). It is unknown whether this species is present at the Site.

3.3.3.5 Puget Sound Chinook Salmon

The evolutionarily significant unit (ESU) of Chinook salmon includes all naturally spawned populations from rivers and streams flowing into Puget Sound. Adult Chinook salmon are opportunistic pelagic feeders and are found in Puget Sound during their migration to and from the open ocean and their upriver spawning grounds. Designated ESA critical habitat for Chinook salmon in and around the Site includes freshwater, estuarine, nearshore, and offshore marine areas. Adult Chinook salmon could be present at any time of year.

*3.3.3.6 Puget Sound Steelhead (***Oncorhynchus mykiss***)*

The Puget Sound Steelhead's designated ESA critical habitat includes freshwater, estuarine, nearshore, and offshore marine areas. The Puget Sound DPS of steelhead includes all naturally spawned anadromous winter-run and summer-run populations. Winter-run and summer-run population histories are defined based on the timing of adult returns to their natal spawning streams and by their degree of sexual development at the time they enter freshwater (NMFS, 2005). Juvenile steelhead out-migrate from freshwater and enter marine waters at a much larger size and have a higher rate of survival than other salmonid species. The majority of steelhead appear to migrate directly to the open ocean and do not rear extensively in the estuarine or coastal environments (Burgner et al., 1992). Therefore, juvenile steelhead would not be expected to be present at the Site. Adult steelhead could be present at any time of year.

3.4 Climate and Climate Change vulnerability

The Puget Sound basin has a maritime climate with temperate winters and summers. Substantial winter snowfall occurs at high elevations, but snow rarely falls in the lowlands. Storms with duration longer than one day mostly occur in the late fall and winter and are controlled by large-scale synoptic weather systems. Bainbridge Island is located in a temperate rainforest, and the climate is mild.

Average temperatures in Bainbridge Island range from a low of 40 degrees Fahrenheit (°F) in winter to the mid-70s°F during summer months; the lowest and lowest temperatures in the past 20 years were 36°F in February and 76°F in July and August, respectively.[10] Average precipitation throughout the year is approximately 44 inches of rain and 4 inches of snow.

The northwest United States is vulnerable to climatic stressors, including warming air temperatures and variable precipitation patterns, which will likely result in significantly altered snowpack, stream flows, and water availability (Snover et al., 2013; Mote et al., 2014). Stressors will result in potential inundation, erosion, and modification of the overall shoreline profiles. Bainbridge Island contains 53.3 miles of shoreline, 82% of which is currently in residential, recreational, commercial, or industrial use. Areas most susceptible to inundation are the uplifted beach terraces on the southern third of the island and the majority of the bays and coves on the island (Huppert et al., 2009), which includes the Site. Wave action is expected to be mild in Bainbridge Island

[10] Data available here: Bainbridge Island climate: Average Temperature by month, Bainbridge Island water temperature (climate-data.org)

because of limited magnitude of energy. Bluff erosion can, however, occur after heavy rains, and erosion rates average between 2 and 6 inches per year, depending on beach profile, substrate, and slope angle, as well as the presence or absence of human-built protective structures such as bulkheads (Herrera Environmental Consultants, 2011).

3.5 Environmental Justice Screening

The MTCA Cleanup Regulations require determination of whether the population threatened by a contaminated site includes a likely vulnerable population or overburdened community during a remedial investigation for the limited purposes of site prioritization (WAC 173-340-340, 173-340-350 through 173-340-390). The MTCA Cleanup Regulations define the terms "vulnerable population" and "overburdened community" to mean the same as under the Healthy Environmental for All (HEAL) Act, Chapter 70A.02 RCW (WAC 173-340-2007). The Implementation Memorandum No. 25 provides guidance to identifying likely vulnerable populations and overburdened communities under MTCA (Ecology, 2024).

The presence of vulnerable populations at the Site was assessed using the Environmental Health Disparities (EHD) Index from the EHD Map maintained by the Washington State Department of Health (2022) and the Environmental Justice (EJ) Screening and Mapping Tool (United States Environmental Protection Agency [EPA], 2024). According to Ecology guidance, a potentially exposed population is defined as a vulnerable population or overburdened community when located in a census tract that

- ranks 9 or 10 on the EHD Index, or
- is at or above the Washington State 80th percentile of the Demographic Index or the Supplemental Demographic Index from the EPA EJScreen tool.

The EHD map shows an assigned environmental health disparity index for a community based on census tracts with population ranging between 2,000 and 8,000. The EHD Index utilizes a 1 to 10 ranking scale, with 1 being low risk and 10 being high risk for environmental health disparities.

The Site is under the 091000-census tract and had an overall EHD ranking of 1, indicating the population at the Site is not considered at risk of environmental health disparity. The EHD ranking is calculated based on 19 indicators that are grouped in four categories listed below:

- Environmental exposures, which considers exposure to particulates (PM2.5), diesel emissions, and ozone concentration; proximity to heavy traffic roadways and toxic release from facilities (RSEI model); this category was ranked low (3) for the Site.
- Environmental effects, which is assessed based on risk of exposure to lead from housing, proximity to hazardous waste treatment, storage, and disposal facilities, Superfund Sites, risk management plan facilities and wastewater discharge. This category was ranked medium (5) for the Site, likely due to the proximity to the Wyckoff/Eagle Harbor Superfund Site.
- Presence of sensitive populations, which is evaluated based on factors like incidence of death from cardiovascular disease and low birth weight. This category was ranked low (2) for the Site.

- Socioeconomic factors, which are evaluated based on the prevalence of limited English-speaking communities, high school diplomas, percent of population living below federal poverty level, unemployment, and race distribution. This category was also ranked low (1) for the Site.

A screenshot of the EHD map for the Site is included in Appendix E.

The EJScreen tool was used to generate a report of EJ indices and socioeconomic indicators for an area of about 506 acres including the Site and a buffer area extending 0.2 miles from the Site; the detailed report is included as Appendix E. There are 13 EJ indices that aim to characterize pollution and proximity of potential pollution sources at the Site.[11] Socioeconomic indicators inform on the demographic and economic status of the Site communities.[12] The Demographic Index (low income and people of color) for the Site is within the 10th percentile for the state and 12th percentile for the nation. The Supplemental Demographic Index (low income, unemployment, lack of English proficiency, less than high school education, and low life expectancy) for the Site is within the 8th percentile for the state and 7th percentile for the nation.

The screening performed according to Ecology guidance indicates that the potentially exposed population at the Site does not include a likely vulnerable population or overburdened community.

[11] EJ indices include concentrations of air particulate matter, ozone, and diesel particulate matter; air toxic cancer risk and respiratory hazard index, toxic release air, traffic proximity, lead paint, superfund proximity, Risk Management Program (RMP) facilities, hazardous waste proximity, presence of underground storage tanks, and wastewater discharges.

[12]Socioeconomic indicators evaluated by the EPA EJ Screening and Mapping tool include demographic and supplemental demographic indices, race and income information, unemployment rates, limited English-speaking households, less than high school education, population under age 5 and over age 64.

4. FIELD INVESTIGATION

This section summarizes previous investigations and the subsequent RI activities. Appendices referenced in this section provide additional detail.

4.1 Summary of Previous Environmental Investigations

Several previous Site investigations were conducted at Blakely Harbor from 1990 through 2019. These studies are listed in the Site history and timeline of activities (Table 4-1) and summarized in the Work Plan (Geosyntec, 2022). In brief, previous Site investigations include the following:

- Shannon & Wilson in 1991 and 1992 (soil, sediment, groundwater)
- Anchor in 2008 (sediment, shoreline samples, seeps)
- GeoEngineers and Leidos and NewFields in 2019 for Ecology (soil and sediment)

Historical sampling locations are shown in Figure 4-1 and details regarding sampling rationale for these investigations are included in their respective reports and briefly summarized below.

4.1.1 Shannon & Wilson Inc. (1991, 1992)

Over the course of two years, Shannon & Wilson collected 10 sediment samples, 17 surface soil samples, nine groundwater samples, and one surface water sample as part of a phased Environmental Site Assessment on behalf of Port Blakely (Shannon & Wilson, 1991, 1992a, 1992b). This work was performed by Port Blakely to satisfy property transfer requirements to BI Parks at the time of the sale. The field investigation included limited sampling of the former Mill Pond and Blakely Harbor sediments (near surface) and backhoe test pits advanced in the upland area to estimate the extent of wood debris. Groundwater was collected from temporary well points. A total of 10 soil samples, 19 sediment samples, and 10 water/seep samples were collected. Samples were analyzed for total petroleum hydrocarbons (TPH) and metals, and some soil samples from test pits were analyzed by toxicity characteristic leachate procedure (TCLP) for metals. The test pits provided good visual documentation of subsurface conditions and the extent of wood debris from former Mill operations. TPH concentrations were below the method detection limit of 50 milligrams per kilogram (mg/kg), total metals concentrations were below the state and federal regulations at that time, and TCLP metals concentrations were below criteria for designation as characteristic dangerous waste.

These data were not included in the RI dataset because of data quality concerns[13] but were retained as a line of evidence in our conceptual understanding of Site conditions.

4.1.2 Anchor Environmental LLC (2009)

In 2008, Anchor collected sediment and seep samples and conducted diver probing for the City of Bainbridge Island, Washington, as part of an investigation of potential shoreline restoration

[13] Quality of data collected during the Shannon & Wilson investigations was not considered acceptable due to the age of the data (more than 20 years old) and the use of obsolete analytical methods resulting in elevated method detection limits.

options (Anchor, 2009). The scope of work included 11 sediment piston-core locations, three seep samples, sediment composite sampling from three test pits, and three diver probing surveys to estimate the extent of wood debris. Sediment samples were collected from the nearshore intertidal and shallow subtidal areas of Blakely Harbor and the former Mill Pond. Limited subsurface sediment samples were also collected from three test pits adjacent to the historical Mill structures. A combination of hand-probing, steel probe soundings (using rebar), hand-driven piston cores at low tide, and test pits were used to collect samples. Three diver swim-along transects were completed using hand-probing tools to visually estimate the extent of wood debris perpendicular to the shore. Sediment samples were analyzed for an array of parameters (depending on the location), including grain size, total solids, total volatile solids (TVS), TOC, total ammonia and sulfides, metals, semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), TPH, polychlorinated biphenyls (PCBs), pesticides, and dioxins/furans. Water samples were also analyzed[14] for tributyltin (TBT).

Results of sediment chemical analysis indicated potential impacts from metals, polycyclic aromatic hydrocarbons (PAHs) and significant wood debris in the vicinity of historical Mill structures. A slight oily sheen was observed in surface sediment sample BH-02. Anchor completed a data validation review and considered all data usable for decision-making.

The shoreline was inspected at low tide for groundwater discharge seeps, and three predominant seeps were observed. Seep samples were collected at these locations using a stainless-steel well point with a 1-ft-long screen interval inserted into the sediment at approximately 1 ft below the sediment surface. Discrete samples were collected using a peristaltic pump with low-flow methods and analyzed for ammonia and sulfides. The area around the seeps was visually inspected and found the presence of *Beggiatoa sp*, a white, filamentous bacteria attached to wood surfaces at seep BH-22.

These data were not included in the RI dataset because of data quality concerns[15] but were retained as a line of evidence in our conceptual understanding of Site conditions.

4.1.3 Ecology 2019 (GeoEngineers and Leidos and NewFields)

In 2019, on behalf of Ecology, GeoEngineers collected six intertidal surface sediment samples and five soil samples. Surface sediment samples were collected during low tide from 0 to 0.3 ft bml (0 to 10 cm) using hand sampling methods. Soil samples were collected from a depth of 0 to 1 ft bgs and below vegetative layers. All samples were located in the vicinity of the historical wharf and former Mill operations (GeoEngineers, 2019). Chemical analyses included metals, SVOCs (including PAHs), dioxins/furans, and conventionals (grain size, TOC, ammonia, sulfides). EcoChem, Inc. of Seattle, Washington, completed the data validation.

[14] Water samples were collected from a composite sample of sediment and debris material to evaluate potential restoration, reuse, or disposal options, and sample was analyzed accordingly to the Dredge Material Management Program (DMMP).

[15] Quality of data collected during the Anchor investigation was not considered acceptable for use in the RI due to the age of the data (more than 15 years old) and the use of obsolete analytical methods resulting in elevated method detection limits.

As part of the same 2019 study for Ecology, Leidos and NewFields collected an additional 40 surface sediment and 5 duplicate samples from the former Mill Pond, intertidal nearshore locations, and subtidal Outer Harbor areas of Blakely Harbor (Leidos and NewFields, 2019). These samples were analyzed for the same constituents as the samples collected by GeoEngineers. Leidos completed the Stage 2b data validation for all SMS chemical data and Stage 4 validation for the dioxins/furans data. Leidos considered all data usable for decision-making, but quality assurance/quality control (QA/QC) qualifiers were applied to some of the data because of laboratory method blank contamination and low recoveries. Potential impacts to sediment were identified in areas of historical Mill operations and included presence of wood debris,[16] metals, PAHs, phenols, and dioxins/furans.

The Leidos and NewFields report included the following recommendations: (1) collect additional data to fill spatial data gaps; (2) perform marine biological testing to determine biological effects; (3) test archived samples for dioxins/furans;[17] and (4) perform additional extract cleanup or use higher resolution analytical methods (e.g., selective ion monitoring [SIM]) for future SVOC analysis.

The data collected during the GeoEngineers and NewFields investigations were considered acceptable for use in the RI and are included in the RI dataset.

4.1.4 Dioxin/Furan 2020 Results of Ecology Archived Samples

In 2020, two soil samples and 18 sediment samples from the archived (frozen) 2019 field efforts were selected for dioxin/furan testing with permission from Ecology. These data underwent Stage 4 data validation by the Geosyntec chemistry group, and the data were found to be useable to support project objectives. However, some J-qualifiers were applied to the results because of hold time and QC issues. Since these samples were analyzed at a later date, these dioxin/furan results were not included in the GeoEngineers or Leidos reports.

Total dioxin/furan concentrations for the two soil samples were 8.6 and 79 nanograms per kilogram (ng/kg) toxic equivalence quotient (TEQ). The higher concentration (S-5-0-1) exceeded the MTCA Method B direct contact level (13 ng/kg TEQ dioxins/furans) by a factor of 6.1. This sample was located in the vicinity of the former Mill operations. Total dioxin/furan sediment concentrations ranged from 0.27 to 14.9 ng/kg TEQ, with higher concentrations located closer to shore. Three sediment samples exceeded the Puget Sound natural background 90/90 upper tolerance limit (UTL) value (4 ng/kg).

The dioxin/furan data were validated and provided to Ecology in November 2020; Ecology approved them for use in the RI.

[16] Wood debris as referred to in this document consist of wood material that has been identified and characterized as described in the Standard Operating Procedure #107 of the Work Plan (Geosyntec, 2022).
[17] Additional testing of archived samples was initiated by Port Blakely in consultation with Ecology. Testing was initiated in June/July 2020, and results are provided in Appendix F.

4.2 Remedial Investigation

The RI sampling and analysis was conducted in accordance with the Ecology-approved Work Plan (Geosyntec, 2022), the Work Plan Addendum (Geosyntec, 2023a), and Field Change Request FCR-001 (Geosyntec, 2023c). The RI sampling activities were conducted in phases (from 2020 to 2023), allowing results of the initial phases to inform future phases. A list of RI sampling activities and associated data quality objectives (DQOs) is reported in Table 4-2 and sampled locations are shown in Figure 3-1 and reported in Table 4-3. A summary of soil, groundwater, and sediment samples collected during the remedial investigation is reported in Table 4-4.

Investigation activities began in 2020 with preliminary physical surveys. RI physical surveys included the following:

- Cultural resources survey (Section 2.2)
- Physical surveys
- Bathymetry and Lidar surveys
- Sediment profile imaging and plan view survey (SPI/PV)
- Shoreline surveys for habitat, seeps, and structures
- Surveys for slag and wood debris
- Timber pile mapping
- Timber pile sampling
- Soil (surface and subsurface) sampling and analysis
- Groundwater monitoring well installation, sampling, and analysis
- Sediment (surface and subsurface) sampling, analysis, and bioassay testing
- Asbestos inspection and sampling

The results of the physical survey informed the 2021 multi-media sampling events, including collection of soil, groundwater, and sediment samples. Results of Phase 1 investigations were reviewed in collaboration with Ecology, and areas requiring further delineation were identified for Phase 2 sampling.

Phase 2 RI field activities began in 2022 and included a slag survey, installation of monitoring wells and quarterly groundwater sampling, collection of additional soil and sediment step-out samples, and bioassay testing. Results of Phase 2 investigations were summarized in a technical memorandum submitted to Ecology in August 2023 (Geosyntec, 2023b). Data gaps identified after review of Phase 2 data were targeted for Phase 3 sampling. Phase 3 RI field activities included collection of additional surface soil and sediment step-out samples for further delineation of COPCs.

The details of the RI field activities are described below and in referenced appendices.

4.2.1 Physical Surveys

Physical surveys conducted during the RI are described below.

4.2.1.1 Bathymetry and Lidar

In the fall of 2020, David Evans and Associates, Inc (DEA) conducted a comprehensive high-resolution airborne Lidar and a high-resolution multi-beam bathymetric survey (supplemented with single beam bathymetric data where necessary). The purpose of the survey was to collect detailed Study Area elevation data to support the RI/FS field activities. Initially, these ground elevations were used to help scope the field investigation and boat access to the intertidal area and under the pedestrian bridge. The survey included four components: geodetic control survey for establishing control points, an aerial Lidar survey of the upland topography, an in-water high resolution multi-beam bathymetric survey, and single beam bathymetric echosounder acoustic survey to in-fill spatial data gaps. The work product was a comprehensive Study Area-wide elevation contour map of upland topography and in-water bathymetry. Methods and results are discussed in Appendix B.

The fly-over Lidar survey was conducted at low spring tide to optimize aerial coverage over the shallow mudflats and allow observation of shoreline structures. The survey was conducted on September 28, 2020, during a low tide of 0.5 ft MLLW. The bathymetric survey was conducted by boat during a high spring tide to maximize area available for surveying.

The horizontal datum for the survey is North American Datum of 1983 (NAD83) projected to Washington State Plane Coordinate System (SPCS), North Zone, with units in United States Survey Feet. The vertical datum is referenced to MLLW elevation in ft.

The upland area is topographically flat near the shoreline with ground elevations ranging from 1 to 38 ft MLLW near the former Mill structures. Near the former powerhouse, the ground elevations are between 10 and 16 ft MLLW and subject to high tide marine water inundation during a king tide (marshy habitat is present). Elevations of the vacant and forested upland area range from 15 to 40 ft MLLW. The elevation of the former Mill Pond is topographically flat, with elevations ranging between -5 and 15 ft MLLW. The deepest part of the former Mill Pond is near the pedestrian footbridge, where the elevation decreases to -2 ft MLLW. The approximately 50 acres of intertidal/subtidal marine harbor ranges from elevation of 0 MLLW near the pedestrian footbridge to depths of approximately -50 ft MLLW in the Outer Harbor. The elevation of the shoreline around the Study Area ranges approximately from 0.7 and 17 ft MLLW.

Two shipwrecks were noted during the surface near the edge of the former wharf footprint at approximately -15 to -20 ft MLLW. One boat is about 18 ft long and the other is 26 ft long. The diver probing confirmed the presence of these sunken vessels. The Bathymetric and Lidar Survey Report is included as Appendix B.

4.2.1.2 Sediment Profile Imaging and Plan View Survey

The SPI-PV survey was conducted in October 2020 by Integral Consulting Inc. (Integral) during Phase 1 of the RI. The purpose of the SPI-PV survey was to collect camera profile images and plan-view images of the surface sediment to characterize the biologically active zone, evaluate the presence and abundance of wood debris, and assess the successional stages and biological features in the Study Area.

The survey was conducted in two separate phases because of boat access constraints:

1. SPI images were collected in the former Mill Pond at low tide by overland access on foot. This survey was conducted using a lightweight, handheld SPI camera prism and housing. A Trimble® global positioning system (GPS) unit was used for location control. A total of 11 stations were surveyed. PV images were not collected in the former Mill Pond.
2. SPI and PV images were collected in the harbor by deploying the SPI-PV camera system from a research vessel with digital GPS unit for location control. Images were collected at 89 locations.

Three images were attempted at each sampled location. The captured images were processed and reviewed by Integral staff for several parameters, including sediment texture and composition, presence and abundance of wood debris, prism penetration depth and surface boundary roughness, apparent redox potential discontinuity (aRPD) depth, organic loading, infaunal successional stage, and presence of other biological features.

Images represent the upper 21 cm of sediment based on penetration depths. Wood debris (ranging from very small splinters to chips and large chunks) are present in the vicinity of the former overwater structures, historical wharf, and within the former Mill Pond. Benthic habitat quality does not appear to be obviously impaired in areas with wood debris.

Benthic habitats vary across the Study Area, but the variations seem to be correlated with substrate texture rather than seasons (e.g., seasonal hypoxia would be revealed in SPI images by buried, relict aRPDs). The former Mill Pond appears to be an area of high organic loading and high sediment oxygen demand. The SPI-PV Survey is included as Appendix F. Additional assessment of the benthic community in relationship to wood debris is provided in Section 6.3.

4.2.1.3 Shoreline and Habitat Survey

The Shoreline and Habitat Survey was conducted in 2021 during Phase 1 of the RI. The purpose of the Shoreline and Habitat Survey was to characterize habitat and substrate along the shoreline and littoral areas to support the RI/FS.

The survey was comprised of three parts:

- A desktop review
- A habitat characterization and substrate inventory conducted by a Professional Wetland Scientist
- A shoreline type classification, which was completed using this guidance:
    - Cowardin's classification of wetlands and deepwater habitats of the United States (Bailey et al., 1993; Cowardin et al., 1979).
    - Dethier's marine and estuarine habitat classification system for Washington State, which was further refined in the 2001 ShoreZone Inventory (Dethier et al., 1990).

The field components of the survey were conducted at low tide. During the visual assessment, slopes were recorded along each transect, and observations were made regarding substrate types,

vegetation coverage, and the presence of avian, terrestrial, and aquatic fauna. Classification of the shoreline into types was completed based on the two guidance documents noted above.

Six representative shoreline types were identified, including: Hardpan, Mixed Coarse, Sandflat, Mudflat, Mud/Sandflat, and Marsh–Spit/Berm. The Shoreline and Habitat Survey Field Report is included as Appendix G and provides a discussion of the habitats and substrates associated with each shoreline type along with details of the methods and equipment used to perform this survey.

4.2.1.4 Shoreline Structures and Seeps Survey

A visual shoreline inspection survey was conducted at low tide to identify the presence/absence of seeps and record locations of structures around the Study Area. Accessible features visible above the waterline were photographed, and upstream and downstream views of the shoreline were photographed to document typical shoreline conditions and potential access constraints for future sampling, remedial design, and construction.

Remnant structures were observed associated with the former Mill operations in the Inner Harbor and upland areas (e.g., brick fragments, concrete rubble). The location of the observed structures is reported in Figure 4-2a. Ten seeps, the unnamed creek on the west side of the Mill Pond, and one outfall were observed, and locations were recorded on a map (Figures 4-2b). The Shoreline Seeps and Structures Survey report is included as Appendix H.

4.2.1.5 Slag Survey

Spot concentrations of slag (large and small) were observed along the northern shoreline of the Inner Harbor during the site walk, shoreline survey, and site sampling. A semi-quantitative shoreline slag survey was described in the Work Plan Addendum approved by Ecology (Geosyntec, 2023a; Ecology, 2023) and completed as part of the Phase 2 RI to assess abundance of slag embedded in the beach substrate along the northern shoreline. Additionally, Phase 2 soil and sediment samples (discussed in more detail below) collected in the upland and the Inner Harbor along the northern shoreline were field screened to evaluate the presence of slag debris.

Percent surface coverage of slag was generally below 10% across the Study Area as shown in Figure 4-3. There were two primary areas where slag was observed in the Study Area: (1) in proximity of the former blacksmith and machine shops (on the eastern portion of the Inner Harbor shoreline); and (2) adjacent to the pedestrian bridge and riprap area (on the western portion of the Inner Harbor shoreline). The slag observed in these two areas had distinctive features that may indicate different origins. The Slag Survey Summary report is included as Appendix I.

4.2.1.6 Probing and Wood debris Evaluation

Wood debris was identified during historical and current Site investigation activities. As noted in Section 4.1.2, Anchor conducted a diver survey in 2008 to estimate the extent of wood debris. More recently, locations of wood debris were observed during the Shoreline Seeps and Structures Survey (discussed in Appendix H),[18] and elevated percentages of surficial wood debris were also documented in the Inner Harbor area during the SPI-PV Survey (Appendix F).

[18] Wood debris identification was not an objective of the Shoreline Seeps and Structures Survey, but observations were made when wood debris was encountered.

A transect probing survey was conducted during Phase 1 field investigations to evaluate the presence of soft sediments and the extent of wood debris. The survey was conducted from a small vessel along three transects in the Mill Pond, Inner Harbor, and Outer Harbor. A measuring rod was used to probe the soft sediment substrate.

Soft sediment thickness was greatest in the northern portion of the Mill Pond (thickness of more than 3 ft) and was generally greater in the Mill Pond compared to the Inner Harbor (thickness of 1 to 2 ft). Soft sediment thickness was less along the shoreline and increased in deeper portions of the Outer Harbor (maximum thickness observed is 2 to 3 ft).

In general, wood debris was observed at the sediment surface in subtidal and intertidal areas of the Mill Pond and Inner Harbor, corresponding to the footprint of former overwater Mill structures and the former wharf. Abundant wood debris was observed at depth in the northern upland area within the footprint of former Mill structures. Very little wood debris was observed in discrete sampling locations along the southern shoreline or in the southern upland area. This indicates that the presence of wood debris in soil and sediment in the Study Area is strongly associated with historical structures.

The Probing and Wood Debris Evaluation report is included as Appendix J.

4.2.1.7 Timber Piling Mapping and Sampling

The presence of timber piles was noted during exploratory Site visits performed prior to initiating RI field activities. Construction of buildings and overwater structures at the Mill dates to before the twentieth century before creosote was used for the preservation of wood materials. However, since some piles were installed after the Mill burned down when creosote was potentially in use, an evaluation was performed to inspect and map timber piles and collect samples from the surface of the pile to determine if the piles were treated with creosote.

Timber piles in the Study Area are distributed along the northern shoreline in the former Mill Pond and the Inner Harbor, and some of the piles in the Inner Harbor are submerged. The distribution and structure of timber piles varies, and most timber piles are located along the eastern shoreline of the former Mill Pond and the shoreline in front of the Powerhouse. The degree of timber pile weathering and exposure above the mudline also differed based on mudline elevation and presumed age of the piles. The abundance and density of timber piles were considered together with visual characteristics, and five sampling areas were identified.

The Timber Pile Mapping and Sampling report is attached as Appendix K.

4.2.2 Timber Pile Sampling

Pile scrape samples were collected for PAH analysis from five areas, including four shoreline areas (located in the former Mill Pond and Inner Harbor) and one submerged area within the Inner Harbor. Sample analyses showed that (1) PAH concentrations on the surface of Study Area piles were considerably lower than creosote reference samples, (2) PAH profiles did not resemble creosote signatures, and (3) differences between PAH datasets for the Study Area and reference samples were statistically significant (98.8% confidence level). The findings indicate the Study Area piles were not treated with creosote.

Sample results are presented in the Timber Pile Mapping and Sampling report, included as Appendix K.

4.2.3 Asbestos-Containing Material Inspection and Abatement

Suspected asbestos-containing material (ACM) were visually identified along the southern shore of the Mill Pond and along the northern shoreline of the Inner Harbor during a Site walk conducted on April 2, 2021.

Samples were collected of a fibrous, white, papery material (likely roofing insulation) identified within a block of soil (sand/gravel) and demolition debris along the southern shore of the Mill Pond, and samples were collected of fiber-wrapped rubber hose scattered on the northern shoreline of the Inner Harbor. The presence of asbestos was confirmed in the samples collected near the Mill Pond, but not in the samples collected near the Inner Harbor.

A site-wide inspection was subsequently conducted by an Asbestos Hazard Emergency Response Act (AHERA)-certified asbestos inspector, G2 Consultants, to evaluate the potential presence of other suspected ACM, include suspected ACM associated with former Study Area building materials, collect soil samples, and conduct abatement in the area where ACM was confirmed. The inspection did not identify additional ACM at the Site and ACM was not identified in soil samples surrounding the area where asbestos was detected. Within the area of confirmed ACM, the portion of the material visible in the block of soil was removed (to be tested), and the abatement work limited airborne dispersion, therefore reducing the risk of exposure to asbestos, by confining the ACM in a solid matrix (liquid glue).

Suspected ACM was not encountered by field staff during the RI sampling activities, indicating that the presence of ACM is limited at the Site. The Asbestos Inspection and Sampling Report is provided in Appendix L.

4.2.4 Soil Sampling and Analysis

During the three phases of RI investigation work, 188 surface and subsurface soil samples were collected from 52 locations throughout Blakely Harbor Park and surrounding properties. Target sampling locations included areas of historical operations (e.g., oil house, hog fuel/refuse burner, foundry) and areas where historical sampling activities identified COPCs exceeding preliminary screening levels (GeoEngineers, 2019; Shannon & Wilson, 1992a, 1992b). The RI soil sampling program included the following:

- Hand auger soil sampling (referred to as Surface or Shallow Soil Sampling in Work Plan documents). Soil samples were collected by hand augering to a maximum depth of less than 3 ft bgs. Samples were collected at 39 locations in the north and south upland areas and in proximity to the perimeter of the Blakely Harbor Park property line. A total of 83 surface soils samples were collected (73 primary samples and 10 field duplicates).
- Drill rig soil borings (referred to as Subsurface Soil Sampling in Work Plan documents). Soil samples were collected by using direct-push drilling to a maximum depth of 25.5 ft bgs at 26 locations within the footprint of former Mill buildings, in the north upland, and in the south upland. A total of 105 soil samples were collected (94 primary samples and 11 field duplicates) from ground surface to depths of 24 ft bgs.

Field and QC samples are summarized in Table 4-4, and details of the sampling programs and procedure are included in Appendix D.

Soil samples were analyzed for metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc), TPH, PAHs, phenols and phthalates, and dioxin and furans. Soil boring logs are provided in Appendix C.

4.2.5 Groundwater Sampling and Analysis

Site groundwater was not sampled during previous investigations, so the RI sampling program was developed to assess potential groundwater impacts first from temporary and then from permanent sampling points. Groundwater was first monitored in five temporary wells located within the footprint of former Mill buildings in the north upland and along the shoreline in proximity of potential historical and ongoing sources of contamination. Based on the information from the temporary wells, 4 permanent groundwater monitoring wells were installed and sampled quarterly over a one-year period to evaluate seasonal variability and potential impacts on water quality parameters. One field duplicate was collected during each sampling event, including the initial sampling event from the temporary wells.

Field and QC samples are summarized in Table 4-4, and details of the sampling programs and procedure are included in Appendix D.

Groundwater samples were analyzed for dissolved and total metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc), PAHs, phenols and phthalates, and dioxin and furans. Conventional parameters including ammonia, sulfide, total solids, and dissolved solids were also analyzed. In addition, field parameters were measured prior to sampling.

4.2.6 Sediment Sampling and Analysis

During the three phases of the RI investigation work, 148 surface and subsurface sediment samples were collected from 57 locations in the Inner and Outer Harbor, the Mill Pond, and the unnamed creek. Surface sediment grab samples were collocated with sediment cores at 10 locations to assess sediment quality and physical characteristics throughout the sediment column at surface and depth. The RI sediment sampling program included the following:

- Surface sediment grab samples collected to a depth of 10 cm bml at 43 sampling locations. A total of 48 surface sediment samples were collected (43 primary samples and 5 field duplicates).
- Sediment cores advanced to a target depth of 10 ft bml at 24 locations. A total of 100 sediment core samples were collected (91 primary samples and 9 field duplicates) to depths ranging from 2 to 10 ft bml.

Field and QC samples are summarized in Table 4-4, and details of the sampling programs and procedure are included in Appendix D.

Sediment samples were analyzed for metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc), PAHs, phenols and phthalates, and dioxin and furans. Surface sediments were also analyzed for conventional parameters with the potential to impact aquatic life including ammonia,

sulfide, simultaneously extracted metals, and acid sulfides. In addition, bioassay testing was performed on 20 surface sediment samples.

4.2.7 Inadvertent Discovery Plan

Archaeological monitoring was conducted as outlined in the Work Plan (Geosyntec, 2022), Work Plan Addendum (Geosyntec, 2023a), and FCR-001 (Geosyntec, 2023c).

An archaeological excavation permit (per RCW 27.53) was obtained from DAHP prior to ground disturbing activities conducted within the boundaries of archaeological site 45KP110. A licensed archaeologist was on-site during upland sampling and on-call during in-water sampling. No historical or culturally relevant artifacts were found during RI field activities.

4.2.8 Field Quality Assurance

A record of all field surveys and procedures was maintained, which included sampling locations, sample depths, sampling methods, sample handling procedures, preservation methods, and storage procedures. Dates and times of collection, preservation methods, and storage procedures were recorded in daily field logs or sampling logs, along with notable field circumstances affecting sampling procedures. Visual assessments of wood debris and other substrate conditions were documented in the designated field forms per the Work Plan. A summary of these records is included in Appendix D.

Field QA/QC samples were collected in accordance with the sampling programs detailed in the Work Plan (Geosyntec, 2022), the Work Plan Addendum (Geosyntec, 2023a), and FCR-001 (Geosyntec, 2023c). Field QA/QC samples included the following:

- Field duplicates were collected to assess variability within samples. Field duplicates (collected as field splits of homogenized sample material) were collected from at least 5% of the samples. A total of 40 field duplicates were collected during the RI sampling program (Table 4-4).
- Equipment rinsate blanks were collected to assess inadvertent introduction of chemical contaminants during sampling and analytical activities. Rinsate blanks consisted of aqueous sampling equipment rinsates generated once for each sampling event (the methodology is described in Appendix D). Analytical parameters tested in rinsate blanks varied per matrix and sampling event. A total of 17 rinsate blanks were collected during the RI sampling programs (Table 4-4).

Analytical results of field duplicates and rinsate blanks were utilized in the data quality evaluation discussed in Section 6.5.

4.2.9 Investigation-Derived Waste Disposal

Investigation-derived waste generated during the field effort consisted of decontamination and rinsate water, soil and sediment cuttings, and solid waste (e.g., disposable one-time-use sampling materials). The investigation-derived waste generated from the upland and sediment sampling events were temporarily stored in labeled 55-gallon drums, securely staged in the Blakely Harbor Park parking lot, and once the disposal profile was approved by the landfill, they were transported

off-site for disposal as nonhazardous waste to Arlington, Oregon. Drum inventory and disposal receipts are provided in Attachment D-4. Solid waste was disposed in municipal trash dumpsters.

4.2.10 Modifications and Deviations from Work Plan

Deviations from the Work Plan and Work Plan Addendum involved modifications to proposed sampling locations, sample acceptance criteria, and number of samples collected and submitted for analysis. These field deviations did not affect data quality and usability. Deviations were as follows:

- In the SPI-PV survey: Nine[19] of the 10 proposed sampling locations were surveyed, and images were collected at two additional stations not included in the original scope.[20]
- During the Phase 1 surface soil sampling:
    - Four sampling locations (HA-01, HA-04, HA-08, and HA-12) were moved more than 10 ft from proposed locations because of limited access due to heavy and dense vegetation.
    - A sample was not collected at the deepest sample interval at location HA-07 due to refusal by hard substrate.
    - The Work Plan initially specified that samples collected from 1 to 2 ft bgs would be held in archive, but these samples were analyzed immediately after collection to meet analytical hold times.
    - During the Phase 1 surface sediment sampling, multiple grab subsamples were collected and composited at Mill Pond intertidal locations SG-03 and SG-04 because of poor recoveries associated with limited capacity of the sampling method (ponar).
- During the Phase 1 sediment coring:
    - Cores were not collected at locations SC-16 and SC-17 because of limited boat access to proposed location and hard substrate limited recovery during attempts at nearby locations.
    - A core was collected at an alternative sampling location more than 50 ft from proposed location SC-12 because of limited boat access and refusal due to hard substrate. The collected samples were considered useable for horizontal and vertical delineation of nature and extent.
    - Cores were collected at multiple locations where acceptability criteria were not fulfilled because of shallow refusal and/or poor core recovery (SC-04, SC-05, SC-07, SC-12, SC-14, SC-24, SC-27, SC-32, SC-34, and SC-38).

[19] Planned station (Station 128) was not safely accessible for the field staff because of muddy, soft substrate and overlying water.
[20] Two additional stations (Stations 133 and 134) were added by the field team to collect additional images of wood debris observed in surface sediments at those locations.

- During the timber pile sampling:
    - Deeper sample material was not available for archive sample collection because of limited penetration through the timber piles.
    - A 4-point composite instead of a 5-point composite was collected in area PS-05, which included submerged piles within the Inner Harbor; the divers could not collect the sample because of access limitations.
- During the Phase 2 surface soil sampling, a sample was not collected at the deepest sample interval at multiple locations (HA-33, HA-34, and HA-36) where refusal was encountered before the target depth was reached because of hard substrate.
- During the Phase 2 surface sediment sampling, a sample was collected at an alternative location moved about 93 ft from the proposed sampling location because of poor recoveries and hard sediment substrate.
- During the Phase 2 sediment coring:
    - Cores were not collected at locations SC-16 and SC-50 due to limited boat access to the proposed locations and hard substrate limiting recovery during attempts at nearby locations.
    - Cores were collected at SC-17, SC-49, SC-51, SC-52, and SC-53 despite the acceptability criteria not being fulfilled due to both refusal before target depth and poor core recovery.
- During the Phase 2 sampling, 10 water samples, including 5 equipment blanks and 5 groundwater samples, were re-analyzed for dioxin/furans due to laboratory blank contamination.
- During Phase 3 surface soil sampling:
    - One alternative location (HA-50b) was sampled after multiple sampling attempts encountered refusal at location HA-50.
    - Refusal was encountered at multiple locations before the target depth was reached (HA-37, HA-46, HA-50b, and HA-51).

Additional details on deviations from the Work Plan and Work Plan Addendum are provided in Appendix D.

5. SITE SCREENING LEVELS, COPCS, AND COCS

The following sections discuss the Site SLs and the SL refinement process. A statistical approach and Study Area data were used to select refined SLs. This section also discusses the identification of Site COPCs and the use of the refined SLs to identify Site COCs. The process discussed in the following sections is depicted in Figure 5-1.

5.1 Screening Levels

Preliminary screening levels were first presented in the Work Plan and further developed in the Work Plan Addendum to incorporate additional risk-based screening levels and updated Ecology values. The sources and selection of Site SLs were presented in Appendix B to the Work Plan Addendum, and these values are further refined in this section. In summary, the soil and groundwater SLs are the lowest applicable value among risk-based direct contact/ingestion (MTCA Method A/B) or soil leaching-based values (soil only). If the lowest applicable SLs were below natural background (NB), then the NB value was selected as the SL if available.

For the selection of sediment SLs, if a chemical is classified as bioaccumulative, then NB was selected as the SL if available. If no NB value was available, then the lowest risk-based value was selected as the SL. For non-bioaccumulative COPCs, the lowest risk-based value was selected as the SL.

The RI data set was screened against the most conservative screening criteria for each media and the data summary tables and figures were submitted to Ecology in 2024 (Geosyntec, 2024). Geosyntec reviewed the RI data set in relation to the initial conceptual site model (CSM) presented in the Work Plan to determine if the SLs should be further refined. Additionally, the practical quantitation limits (PQLs) were reviewed to determine the average PQL, and if the average PQL was greater than the SL, the SL was revised to the average PQL. As discussed in more detail in Section 6.1, empirical evidence confirms that soil SLs should not be based on the protection of groundwater. Metals and dioxins/furans were the only COPCs detected in Site groundwater, indicating that PAHs, phenols, and phthalates are not migrating into groundwater. Metals and dioxins/furans (based on total 2,3,7,8-tetrachlorodibenzo-p-dioxin [TCDD] TEQs) were detected in groundwater but were below the refined SL. Metals and dioxins/furans are discussed further in Section 6.1.2. Based on these results, the migration to groundwater pathway is incomplete, so the soil SL was further refined by excluding values based on the migration to groundwater pathway. The refined soil SLs are presented in Table 5-1. For groundwater and sediment, the exposure pathways previously identified in the Work Plan are complete, but the SLs were refined considering the average PQL (sediment and groundwater) and applicable or relevant and appropriate requirements (ARARs) (groundwater only). The refined SLs for groundwater and sediment are presented in Table 5-2 and Table 5-3a and 5-3b,[21] respectively.

[21] For sediment, the selected refined SLs are the same as the preliminary SLs, except for 2,4-dimethylphenol. The average PQL for 2,4-dimethylphenol is greater than the preliminary SLs. A refined screening table for sediment is not presented due to no change in the identified initial COPCs and refined COPCs with the one exception.

5.2 COPCs

The COPCs identified in the Work Plan are those chemicals that have the potential to be present at the Site based on review of previous investigations, detection in multiple environmental media, SL exceedances, and historical operations. In addition, Ecology requested that certain chemicals be added as COPCs because of their presence in certain media or more data was needed to verify historical results. In summary, the COPCs for the Site included the following chemicals:

- **Soil:** metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc), PAHs (including total carcinogenic PAHs [cPAHs] individually and based on TEQs), phenols, dioxins/furans individually and based on TEQs, TPH, and phthalates
- **Groundwater:** metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc), PAHs (including total cPAH TEQs), phenols, dioxins/furans (including total TCDD TEQs), TPH, and phthalates for protection of sediments

Sediment: wood debris indicators,[22] metals (SMS metals: arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc), PAHs (including total cPAH TEQs), phenols, dioxins/furans (including total TCDD TEQs), and phthalates

Additional details pertaining to the identification of COPCs were provided in the Work Plan.

After completing RI data collection, the COPCs were further evaluated based on detection frequencies (DF), frequency of exceedance (FOE), and exceedance factors (EFs) for the RI data. The maximum detected concentration of each analyte from each medium was compared to the SLs and if the maximum detected concentration exceeded the SL, then summary statistics for the COPC were reviewed (Tables 5-4, 5-5, and 5-6 for soil, groundwater, and sediment, respectively). If the DF or FOE was greater than 5%, the COPC was identified as a COC. If the DF and EF were less than 5%, the COPC concentrations that exceed the SL were either not widely distributed or were localized to smaller discrete areas. In addition, the COCs with DF and FOE less than 5% were not major contributors to risk in the risk screening and although considered for determination of the RI boundary. Those COPCs with a maximum detected concentration greater than the SL and a DF and EF greater than 5% were selected as COCs and carried forward for additional review in the RI (Tables 5-7, 5-8, and 5-9).

5.2.1 Development of Total cPAH TEQs

The total cPAH TEQ was calculated for each sample in accordance with Ecology Implementation Memorandum Number 10 (Ecology, 2015a). A toxicity equivalency factor (TEF) was applied to individual cPAHs, then summed to calculate total cPAH TEQs.[23] For individual cPAHs that were

[22] Wood debris indicators (i.e., TOC, TVS, total sulfides, ammonia, dissolved oxygen, and pH) are not included in the preliminary and refined screening process because there are no risk-based SLs available for these parameters. Instead, they are discussed in more detail in Section 6.2.

[23] Since benzo(a)pyrene concentrations detected in soil samples exceeded the preliminary SL, the development of the cPAHs utilizing the relative mobility factor (RMF) was not performed. The TEF and RMF for benzo(a)pyrene is 1; therefore, the cPAH TEQs with the TEF and RMF applied would also exceed the preliminary SL that is based on leaching to groundwater.

not detected in a sample, the TEF was applied to one-half the method detection limit (MDL)/PQL and included in the summation (see details in Appendix P). For those instances where individual cPAHs were not detected in a sample, no total cPAH TEQ was calculated and the maximum MDL/PQL of the individual chemicals was selected to represent the sample and qualified as not detected.

5.2.2 Development of Total TCDD TEQs for Dioxins/Furans

For dioxins/furans, total TCDD TEQs were calculated in accordance with Ecology Implementation Memorandum Number 11 (Ecology, 2015b) and Number 13 (Ecology, 2016). Development of the total TCDD TEQs concentrations within a sample incorporate a TEF specific to each congener and then summed to calculate the total TCDD TEQ for each sample. Both mammalian and avian-based TEQs were calculated, and the mammalian-based TEQ was sufficiently protective of avian receptors. Therefore, the mammalian TEQs were used in the screening processes. For individual congeners that were not detected in a sample, the TEF was applied to one-half the MDL/PQL and included in the summation. For those instances where all individual congeners were not detected in a sample, the maximum MDL/PQL was selected to represent the sample and qualified as not detected (see details in Appendix P).

5.2.3 Organic Carbon Normalization of Sediment Results

Before sediment analytical results were compared to the SLs, non-polar organic chemicals were converted to an OC-normalized concentration using the TOC concentration within a sample for comparison to SMS marine criteria (benthic Sediment Cleanup Objectives [SCOs]). OC-normalization accounts for the bioavailability of organics in sediment, but this relationship is best suited for sediment samples within a "normal" TOC range of 0.5% up to 3.5%. For those samples with a TOC greater than 3.5% or less than 0.5% (Ecology, 2021), the OC-normalized concentration for non-polar contaminants was presented; however, dry weight (dw) concentrations were compared to the relevant SL (i.e., Apparent Effects Thresholds [AETs] or NB) for identification of COCs.

5.3 COCs

The results of the analysis from Section 5.2 are presented in Tables 5-7, 5-8, and 5-9 for soil, groundwater, and sediment, respectively. The following COCs were identified:

- **Soil:** metals (arsenic, chromium, copper, lead, mercury, and zinc), TPH (diesel range organics [DRO] and heavy oils), PAHs (except for anthracene and beta-chloronaphthalene), phthalates (bis[2-ethylhezy]phthalate and di-n-butyl phthalate), and dioxins/furans
- **Groundwater:** dioxins/furans (individually and based on the TEQs)
- **Sediment:** metals (SMS metals: arsenic, cadmium, lead, and mercury), PAHs (phenanthrene, benzo[g,h,i]perylene, chrysene, fluoranthene, indeno[1,2,3-c,d]pyrene, pyrene), total cPAH based on the TEQ, organics/phenols (phenol), phthalates (butyl benzyl phthalate), and dioxins/furans (individually and based on the TEQ)

The COC concentrations were compared to the refined SLs to identify the final list of COCs. The final COCs are presented in Tables 5-10 and 5-11 for soil and groundwater, respectively, and Table 5-9 for sediment,[24] and are as follows:

- **Soil:** metals (arsenic, chromium, copper, lead, mercury, and zinc), TPHs, total cPAH based on the TEQ, and dioxins/furans (individually and based on the TEQ)[25]
- **Groundwater:** No COCs above refined SLs
- **Sediment:** metals (SMS metals: arsenic, cadmium, lead, and mercury), PAHs (phenanthrene, benzo[g,h,i]perylene, chrysene, fluoranthene, indeno[1,2,3-c,d]pyrene, pyrene), total cPAH based on the TEQ, organics/phenols (phenol), phthalates (butyl benzyl phthalate), and dioxins/furans (individually and based on the TEQ)

The COCs for each media are retained for further analysis in the RI, including an analysis of the nature and extent of contamination (Section 6) and evaluation in the risk screening for receptor-specific risk evaluation (Section 7).

[24] Table 5-9 summarizes the sediment screening using the preliminary SLs, and the refined SLs were unchanged except for one chemical that did not impact the results of the screening, so Table 5-9 applies for both preliminary and refined SLs.
[25] As part of the site-specific Terrestrial Ecological Evaluation (TEE) process, the identification of COCs was inclusive of identification of chemicals of ecological concern for which risk was characterized in Section 7.5.

6. NATURE AND EXTENT OF CONTAMINATION

The results of the RI sampling effort were used to determine the nature and extent of contamination in soil, groundwater, and sediment. This section presents the horizontal and vertical extent of COCs, interpolates the spatial distribution of COCs, and identifies the RI boundary based on review of perimeter data.

6.1 Nature and Extent of Contamination

Contaminants in soil, groundwater, and sediment have been characterized using the analytical methods summarized in the SAP and QAPP, Appendix A to the RI/FS Work Plan (Geosyntec, 2022). Overall, data quality objectives have been met (Sections 6.4 and 6.5), and the nature and extent of contamination in soil, groundwater, and sediment have been sufficiently delineated for the RI. Additional data may be collected after the remedial action is selected to inform the remedial design.

In this section, the nature and extent of Site contamination is discussed for each medium and portion of the Study Area. For soil, this discussion is separated into the north upland area and the south upland area. Groundwater is treated as a single area, and sediment is discussed for three areas: the Inner Harbor, the Outer Harbor, and the Mill Pond. The following sections discuss the methods used to evaluate the nature and extent of contamination in soil, groundwater, and sediment, and the results. cPAHs and dioxins/furans are discussed as calculated total cPAH TEQ (based on benzo[a]pyrene) and total TCDD TEQ, respectively.

Generally, contamination is associated with the former Mill footprint, building debris, and fill materials present from ground surface to approximately 8 to 14 ft bgs in soil and 1 to 4 ft bml in sediment. Soil borings drilled through the fill units reached native soil at about 9 to 17 ft bgs, and sediment cores reached native material at 2 to 4 ft bml, with corresponding chemical concentrations below SLs at these deeper depths in native material. Groundwater data were below refined SLs.

6.1.1 Soil Results

The extent of COCs in soil was evaluated using a combination of concentration mapping, statistical analysis, and distribution comparisons. Soil COC concentration maps are shown in Figures 6-1 through 6-11. Statistical analysis was performed for a subset of chemicals that had either a high FOE compared to the refined SL or exceeded SLs over a large area of the upland. The statistical analyses[26] are provided in Section 7 for select COCs: lead, copper, total cPAH TEQ, and total TCDD TEQ. Distribution comparisons were not developed for other COCs since they fall within the footprints of more wide-spread COCs (primarily total cPAH TEQ). Instead, the average concentrations of the perimeter samples were compared to the next closest samples (next-in

[26] The perimeter sample locations selected for comparison to the remaining north upland area data include HA-38, HA-39, HA-40, HA-41, HA-44, and HA-52 (12 samples total). The perimeter sample locations selected for comparison to the remaining south upland area data include HA-36 HA-42, HA-43, and HA-47 (seven samples total).

samples).[27] The concentration distributions in soil for the COCs are discussed in the following sections.

6.1.1.1 Metals

The highest concentrations of metals were detected in the locations associated with the historical structures on the north upland area peninsula and south of Northeast Blakely Avenue, especially near the former foundry where slag piles were observed. Concentrations decreased moving farther north, east, and west. Concentrations for each metal varied with depth, with higher concentrations located in subsurface soil between 2 ft and 6 ft bgs; however, elevated concentrations of arsenic, copper, and lead were detected above the refined SLs in both surface and subsurface soil near the former sawmill, machine shop, and slag piles. Below are descriptions of metal concentrations found in the Study Area:

- Arsenic was detected in 159 soil samples with 50% exceeding the NB-based on the refined SL (7 mg/kg). Two samples at the northern perimeter and five at the southern perimeter had concentrations that exceeded the refined SL with EFs between approximately 1 and 2. Arsenic in four borings (SB-17, SB-20, SB-22, and SB-23) exceeded the refined SL with an EF less than 2. Due to the low EFs, horizontal and vertical delineation has been achieved for arsenic in Site soil, with one exception. Arsenic was detected in the deepest sample from location HA-13 (north upland area) at a concentration of 43.3 mg/kg. The concentrations in samples collected in the surrounding locations were below the refined SL, including those at depth; therefore, the area around HA-13 is considered delineated vertically. The exceedance at HA-13 is relatively small and localized.
- Chromium was detected in 159 soil samples with 14% exceeding the plant-based refined SL (48 mg/kg). Sample concentrations at the perimeter and at depth were below the refined SL with five exceptions:
    - Concentrations in HA-35 exceeded the refined SL, but no additional samples were collected to the east of these exceedances because the ground surface was altered during residential property development. As a result, the boundary of the residential development is considered the RI boundary in this area.
    - Concentrations in HA-38, HA-46, and HA-52 exceeded the refined SL with EFs less than 2.
    - A result from one boring (SB-18) exceeded the refined SL at depth with an EF less than 2.
    - Due to the low EFs, horizontal and vertical delineation has been achieved for chromium in Site soil. Soil samples collected as part of the Phase 1 and Phase 2 investigations were analyzed for hexavalent chromium, and while it was not detected in these samples, the data were rejected due to expiration of the hold time. However, the results are considered suitable for determining the absence of hexavalent chromium based on the following lines of evidence: (1) hexavalent

[27] The next closest sample locations (i.e., step-in samples) include HA-07, HA-31, HA-32, HA-33, HA-34, and HA-51 (nine samples total)

chromium was not detected; and (2) the predominant form of chromium in Site soil is trivalent.

- Copper was detected in 154 soil samples, with 66% exceeding the NB-based refined SL (50 mg/kg). Concentrations from perimeter samples and at depth were below the refined SL, with five exceptions:
    - Copper was detected above the refined SL in samples from HA-16, HA-35, and HA-49, but no additional samples were collected to the east of these exceedances because the ground surface was altered during residential property development. As a result, the boundary of the residential development is considered the RI boundary in this area.
    - Copper concentrations in HA-02 and HA-52 also exceeded the refined SL, with EFs less than 2. Copper results from multiple borings exceeded the refined SL at depth and had EFs between 1 and 2. Based on the low EFs, the horizontal and vertical delineation has been achieved for copper in Site soil.
- Lead was detected in 159 soil samples, with 45% exceeding the plant-based refined SL (50 mg/kg). Two samples (HA-02 and HA-42) at the southern perimeter exceeded the refined SL with EFs between 1 and 4. Eastern perimeter sample concentrations were below the refined SL except at HA-16, HA35, and HA-49. No additional samples were collected to the east of these exceedances because the ground surface was altered during residential property development. As a result, the boundary of the residential development is considered the RI boundary in the southeastern area of the Site. The deepest sample from SB-22 exceeded the refined SL with an EF of approximately 2. Therefore, based on the low EFs, horizontal and vertical delineation has been achieved for lead in Site soil.
- Mercury was detected in 129 out of 147 Study Area soil samples, with 25% exceeding the soil biota-based refined SL (0.1 mg/kg). One northern perimeter sample concentration exceeded the refined SL (HA-40) with an EF of 2.2. The greatest exceedance was at HA-02, near the former steam dry kilns/lumber shed/planing Mill in the south upland area, with a concentration of 22 mg/kg at 1 to 2 ft bgs. Since other soil borings showed declining concentrations when native soil was encountered (9 to 17 ft) and adjacent borings did not exceed the refined SL, horizontal and vertical delineation has been achieved for mercury in Site soil.
- Zinc was detected in 154 soil samples with 59% exceeding the plant-based refined SL (86 mg/kg). Five samples from the northern perimeter (HA-38, HA-39, HA-40, HA-44, and HA-52) and three from the southern perimeter (HA-02, HA-42, and HA-46) had concentrations that exceeded the refined SL, with EFs between 1 and 2. In addition, concentrations in HA-16, HA-35, and HA-49 exceeded the refined SL, but no additional samples were collected to the east of this exceedances because the ground surface was altered during residential property development. As a result, the boundary of the residential development is considered the RI boundary in this area. Zinc was detected in multiple soil borings above the refined SL with EFs between 1 and 2. One exception was SB-22, with an EF of 10, but nearby locations at similar depths were below the refined SL. Based on the low EFs, horizontal and vertical delineation has been achieved for zinc in Site soil.

6.1.1.2 Polycyclic Aromatic Hydrocarbons

The highest concentrations of PAHs were detected in the areas associated with the historical structures located on the north upland area peninsula and south of Northeast Blakely Avenue. Concentrations in the south upland area decreased in samples farther from the historical structures. Concentrations for PAHs varied based on depth, but the highest concentrations were detected in subsurface soil at depths ranging from 2 ft to 6 ft bgs. Except for boring SB-22, the deepest samples from each boring were below refined SLs. Overall, concentrations for PAHs were delineated horizontally and vertically in Site soil based on comparison to the refined SLs.

Concentrations above the total cPAH TEQ were detected in 141 out of 159 Study Area samples, with 35% exceeding the refined SL (100 micrograms per kilogram [µg/kg]), including samples collected along the southern (HA-02 and HA-46) and eastern (HA-15) perimeters and at depth (SB-22). The EFs for HA-02 and HA-15 were between 1 and 2. Decreases in concentrations nearby at HA-46 and SB-22 at similar depths indicate the exceedances are relatively localized. Therefore, horizontal and vertical delineation is considered complete for total cPAHs in Site soil.

6.1.1.3 Other Organics

TPHs (i.e., diesel range organics and lube oil range) were identified as COCs (Section 5). Diesel and lube oil range TPH concentrations exceeded the soil biota-based refined SL (200 mg/kg) in 11 and 28 out of 142 samples, respectively. The samples with the highest EFs were located in the northern upland area at SB-19 (0-2 and 2-6 ft bgs) and SB-24 (0-4 ft bgs). Samples with exceedances were bounded spatially by results below the SL. Therefore, delineation has been achieved for TPHs.

Phthalate and phenol concentrations in soil were either below SLs or had low DF and/or FOE (i.e., less than 5%). Therefore, delineation has been achieved for these chemical classes.

6.1.1.4 Dioxins/Furans

The highest concentrations of dioxins/furans based on the total TCDD TEQ were detected in the footprint of and north of the former sawmill on the north upland area peninsula, south of Northeast Blakely Avenue. Concentrations decreased moving farther north and generally correspond to the same concentration gradients as PAHs and metals (highest concentrations observed near the former hog fuel burner, foundry, and primary mill structure). The highest concentrations of dioxins/furans based on the total TCDD TEQ were in subsurface soil (4 to 12 ft bgs), but generally concentrations decreased with depth. Overall, concentrations of dioxins/furans based on the total TCDD TEQ are delineated horizontally and vertically in Site soil.

The total TCDD TEQ exceeded the NB-based refined SL (5.21 ng/kg) in 50% of soil samples. Results from perimeter samples were above the refined SL with EFs less than 2 except for HA-16, HA-35, and HA-49 (25.6, 26.6, and 19.9 ng/kg, respectively). No additional samples were collected to the east of these exceedances because the ground surface to the east was altered during residential property development. As a result, the boundary of the residential development is considered the RI boundary in this area. One boring (SB-22) at depth exceeded the refined SL but decreases in sample concentrations nearby SB-22 at similar depths indicate the exceedances are relatively localized. Therefore, horizontal and vertical delineation in Site soil is considered complete for dioxins/furans based on the total TCDD TEQ.

6.1.2 Groundwater Results

Between September 2020 and August 2021, 26 groundwater samples, including five duplicates, were collected during Phases 1, 2, and 3 of the RI. Grab samples were collected from four temporary wells in 2021; four permanent groundwater monitoring wells were installed on the north upland area and sampled over four consecutive quarters in 2022 and 2023.

Total and dissolved metals were detected in all monitoring events, and metals concentrations were below the refined SLs except total chromium. While dissolved phase (filtered) chromium concentrations were less than the refined SL, one total chromium concentration exceeded the refined SL at well GW-27 in unfiltered groundwater samples. This suggests chromium was sorbed to solids present in the unfiltered groundwater samples.

PAHs were not detected in groundwater samples, and the MDLs/PQLs were below the refined SL except for total cPAH TEQ (one MDL/PQL exceeded the refined SL). Given that PAHs were not detected and MDLs/PQLs were below the refined SLs (with one exception for total cPAH TEQ), it is unlikely that PAHs are present in Site groundwater. Therefore, the migration to groundwater exposure pathway for PAHs is incomplete.

Other organic classes of contaminants (i.e., semi-volatiles, phenols, petroleum hydrocarbons, and phthalates) were not detected in groundwater with the exception of one detection each of TPHs, bis(2-ethyhexyl)phthalate, and diethyl phthalate. The detected concentration and MDLs/PQLs for non-detected analytes were all below refined SLs. Total TCDD TEQ concentrations were below the refined SL.

The results indicate there are no impacts to groundwater above the refined SLs.

6.1.3 Sediment Results

The extent of COCs in sediment was evaluated using a combination of concentration mapping and distribution comparison. Sediment COC concentration distributions are shown in Figures 6-1 through 6-11. Average concentrations at the eastern perimeter samples[28] were compared to the next-in samples[29] for the distribution comparison. The concentration distributions in sediment for the COCs are discussed in the following sections.

6.1.3.1 Metals

The highest concentrations of metals were detected in the locations associated with the historical wharf structure in the Inner Harbor, near the former sawmill and former machine shop structures in the north upland area. Concentrations in the Inner Harbor decrease moving farther south and east from the former wharf near the northern peninsula. Concentrations detected in the Mill Pond and Outer Harbor were lower than in the Inner Harbor. Metals concentrations in the Inner Harbor near the northern peninsula were greatest in subsurface sediment between 3 to 6 ft bml; metals concentrations in the Mill Pond and Outer Harbor were greatest in surface sediment (i.e., top 10 cm) and decreased with depth. Overall, concentrations for metals are delineated horizontally and

[28] The selected perimeter sediment samples included were BH2-30, BH2-33, BH2-35, BH2-39, BH2-40, SG-55, SG-56, and SG-57.
[29] The next closest sediment (step-in) samples included were BH2-34, BH2-38, SG-28, SG-30, SG-37, SG-42, SG-53, and SG-54.

vertically in Site sediment based on comparison to the refined SLs. Additional discussion of the individual metals follows:

- Arsenic was detected in 180 sediment samples, with 28% exceeding the NB-based refined SL (11 mg/kg). These exceedances were bounded by samples below the refined SL with the exception of SC-21 and SG-43. The two deepest sample at SC-21 were preceded by samples below the refined SL, and their EFs were less than 2. SG-43 had a slight exceedance (11.6 mg/kg) of the refined SL (11 mg/kg) with an EF of 1.1.
- Cadmium was detected in 180 sediment samples, with 19% exceeding the NB-based refined SL (0.8 mg/kg). At SG-56 in the northeast Outer Harbor, the parent sample concentration was above the refined SL, but the concentration in the duplicate was below the refined SL. The concentration of the deepest sample in SC-11 exceeded the refined SL, but this sample was collected from shallower depth and nearby samples were below the refined SL.
- Lead was detected in 180 sediment samples, with 58% above the NB-based refined SL (21 mg/kg). Lead concentrations exceeded the refined SL in two surface sediment samples collected at the eastern perimeter of the Outer Harbor, with EFs of 8 for the SG-56 sample and 1.1 for the SG-57 sample.
- Mercury was detected in 180 sediment samples, with 24% exceeding the NB-based refined SL (0.2 mg/kg). Mercury concentrations in samples from location SG-56 in the northeast Outer Harbor were above the refined SL; the primary sample had an EF of 3 and the duplicate sample had an EF of 1.4.

6.1.3.2 Polycyclic Aromatic Hydrocarbons

The highest concentrations of low molecular weight (LMW) and high molecular weight (HMW) PAHs in sediment were detected in the Inner Harbor near the former sawmill and former machine shop structures. Concentrations in the Inner Harbor decreased moving farther from the former wharf near the northern peninsula. Concentrations in the Mill Pond and Outer Harbor were lower than the Inner Harbor. Concentrations of LMW and HMW PAHs in the Inner Harbor near the northern peninsula were greatest in surface sediment with sharp decreases in concentrations below surface sediment (top 10 cm).

Total cPAH TEQ exceeded the NB-based refined SL (21 µg/kg) in 69% of samples. Concentrations were greater in the northern half of the Mill Pond, Inner Harbor, or Outer Harbor (i.e., closer to historical structures). Total cPAH TEQ concentrations were greatest in surface sediment with relatively high concentrations in the top 3 ft bml near the northern peninsula in the Inner Harbor and sharp decreases in concentrations with depth. Total cPAH TEQ concentrations in the Mill Pond and Outer Harbor were greatest in surface sediment and sharply decreased with depth.

6.1.3.3 Other Organics

Other organic chemical classes with identified COCs, including phenols and phthalates, had lower DFs, including a 71% DF for phenol and 17% DF of butyl benzyl phthalate. The FOEs of these COCs in these chemical classes were low but were above 5% (ranging between 6 and 10%). The highest concentrations of phenol and butyl benzyl phthalate (indicators for other chemicals in these classes) were sporadically detected in the Inner Harbor near the former sawmill structure but

concentrations generally decreased in samples farther out in the harbor. Spatial distribution patterns were generally similar to other COCs with highest concentrations above revised SLs in the upper 3 ft of sediment. Exceedances were spatially delineated both horizontally and vertically with one exception. The intertidal core (SC-11) located closest inshore had 2-methylphenol and benzoic acid exceedances in the bottom sample at 8 to 10 ft depth. Surrounding borings achieved vertical delineation. Therefore, for RI purposes, delineation has been achieved for these COCs.

6.1.3.4 Dioxins/Furans

Total TCDD TEQ exceeded the NB-based refined SL (5.4 ng/kg) in 49% of sediment samples. The highest total TCDD TEQ concentrations were located south of the former sawmill structure at locations SG-09 and SC-34. Inner Harbor concentrations decreased to the southeast, and concentrations in the Mill Pond and Outer Harbor were lower than the Inner Harbor. Total TCDD TEQs in the Inner Harbor were higher from surface sediment to approximately 6 ft bml. The two highest concentrations were at depth (SC-14 and SC-34) located just outside the former wharf footprint near the edge of the Inner Harbor, but concentrations decreased significantly below the top 3 ft bml. Overall, exceedances were bounded by samples below the refined SL; therefore, horizontal and vertical delineation was achieved.

6.2 Extent of Wood Debris

Large volumes of wood debris can cause increased biological growth, resulting in decreased dissolved oxygen and the increased production of sulfide, ammonia, and phenols, which can impact sediment and surface water quality (Ecology, 2013b). Because of the large volume of wood debris in the Study Area (e.g., logs, pulp fibers, bark, ash, saw dust, dimensional lumber), the RI included a systematic field effort to map and quantify the wood debris. The survey scope, results, and conclusions are discussed in detail in Appendix J.

Abundant wood debris was observed at the sediment surface and near-surface in subtidal and intertidal areas of the Mill Pond and Inner Harbor, corresponding to the footprint of former overwater Mill structures and the former wharf (Appendix J, Figure J-4). In addition, wood debris was observed at depth in the north upland area within the footprint of former Mill structures as shown in Figure J-5 (Appendix J). Historical test pits advanced in the intertidal area observed large dimensional lumber, wood fragments, fibers, pilings, sawdust, and wood debris up to 6 ft bgs along the eastern shoreline of the north upland peninsula (Shannon & Wilson, 1992a). The vertical extent of wood debris, as the dominant stratigraphic layer with more than 50% wood, was refined during the RI. Wood debris was observed up to 15 ft bgs (SB-17). Brick fragments were also sometimes present. This wood fill layer extends offshore about 300 ft towards the east to water depths of about –16 ft MLLW (Anchor, 2009; supplemented with RI data).

Very little wood debris was observed in discrete sample locations along the southern shoreline, the south upland area, and the Outer Harbor. This indicates that wood debris in soil and sediment was present at locations associated with former historical structures and log rafting areas.

6.3 Assessment of Benthic Infauna Impairment

Multiple points were measured during the SPI and PV survey to evaluate whether wood debris in Blakely Harbor sediment affects the quality of the benthic habitat and the associated infaunal community. As described in Section 4.2.1, the SPI and PV survey collected information on the

successional stage of the benthic infauna, sediment grain size, extent of wood debris, apparent redox potential discontinuity (aRPD), number of methane voids, and presence of sulfur oxidizing bacteria to determine if there were impairments on the benthic community related to these substrate conditions. Key findings were as follows:

- **Benthic Infauna Successional Stage**: Wood debris was not statistically related to successional stage. Stations with higher wood debris did not show a lower successional stage and instead demonstrated an average successional stage of 2.5 (i.e., the maximum successional stage is 3; Figure 6-12a; Appendix F). Higher successional stages are generally equated with healthier and more stable benthic communities.
- **aRPD Depth**: There was no evidence of benthic infaunal impairment based on aRPD depth (depth at which anoxic reducing conditions are observed. A deeper aRPD means more oxygen). Higher aRPD was found at stations with medium and medium-high volumes of wood debris (Figure 6-12b).
- **Methane Voids**: A qualitative comparison showed no differences in the number of methane voids at stations with wood debris compared to those without (Figure 6-12c).
- **Sulfur-Oxidizing Bacteria**: Only one SPI station (112-A) out of 198 total stations assessed showed sulfur-oxidizing bacterial colonies (*Beggiatoa*), indicating that harbor-wide, oxygen was not limiting colonization or health of benthic organisms.

Multiple lines of evidence suggest that the benthic community, as measured by SPI-PV imaging, is not impaired due to wood debris. The successional stage, aRPD depths, and methane voids are not correlated with wood debris. Additionally, the absence of *Beggiatoa* bacteria supports the conclusion that wood debris does not smother the benthos. These findings are comparable to those found in the Western Port Angeles Harbor Study Area (WPAHG, 2020) where high-order infaunal successional stage was present in all areas, including those with high wood debris.

6.4 Evaluation of Benthic Toxicity

Bioassay testing was conducted to assess surface sediment quality and potential toxicity to benthic organisms. A total of 20 surface sediment samples were submitted for three marine bioassay tests, including at least two acute effect tests and one chronic test, as required to evaluate biological criteria in marine sediments (Ecology, 2021). Bioassay testing was performed at 14 locations during Phase 1 and at six additional locations during Phase 2. Locations were selected to help define the RI boundary and provide data for spatial bounding and defining sediment management areas, which will be helpful in evaluating remedial alternatives. Rationale for bioassay testing, results of relevant chemical and physical parameters at selected sampling locations, and bioassay results are summarized in Table 6-1. TOC, grain size, and wood debris were evaluated along with the chemistry and the bioassay results, as summarized in Table 6-2.

Bioassay testing was performed because physical and chemical parameters were identified that could potentially be toxic to benthic organisms (Ecology, 2013a). These bioassay triggers included the following:

- Significant volumes of wood debris observed during field screening

- Elevated concentrations of either sulfide or ammonia
- Detected chemical exceedances of refined SLs based on benthic SCO/Contaminant Screening Level (CSL)

In summary, bioassay testing was performed at sampling locations for multiple purposes: (1) evaluate chemical SMS exceedances; (2) provide additional information on the biological impacts associated with wood debris, if any; (3) refine the extent of adversely affected areas; and (4) help define the RI boundary. The bioassay testing methods, results, and the overall implication for evaluating sediment quality and potential toxicity for benthic organisms are discussed below.

6.4.1 Bioassay Testing

The following marine sediment bioassay tests were performed:

- Polychaetae (*Neanthes arenaceodentata*) worm chronic growth and survival tests
- Amphipod (*Eohaustorius estuaries*) acute survival test
- Larval (*Mytilus galloprovincialis*) acute development test

Tests were conducted according to the SMS guidance and as detailed in the Work Plan and Work Plan Addendum. Bioassay results were compared to SMS biological criteria, which include both numeric and statistical thresholds. Statistical significance was assessed by comparison to reference samples selected to provide a representative range of percent fine particles in tested sediments and negative control samples.

Laboratory reports that detail bioassay testing methods and results are included in Appendix N. A robust data quality review was conducted to confirm that quality assurance and control requirements for marine sediment toxicity tests were met. A detailed summary is provided in Section 6.5; results showed that data met the project DQOs and are acceptable for unqualified use in the RI.

6.4.1.1 Phase 1 Bioassay Testing

Bioassay tests were performed on 14 Phase 1 Study Area surface sediment samples and two reference samples with different percentages of fine sediment (12% and 48%, respectively). Total percent fines among Phase 1 bioassay samples ranged between 11.3% and 57% with a median of 18%. Most bioassay samples were compared to the reference sample with 12% fines, and three samples (SG-05, SG-06, and SG-33) were compared to the reference sample with 48% fines. The samples were also compared to a negative control test performed using clean sand.

Exceedances of the SCO and CSL biological criteria were reported for the polychaetae test in one Phase 1 sample (SG-05 Mill Pond), and two exceedances of the SCO were initially observed for the larval development test in two Phase 1 samples (SG-31 and SG-33) when compared to the reference but not when compared to the negative sand control. The negative sand control is an acceptable endpoint for comparing Site results, especially when the organisms performed exceptionally well in the native reference substrate (based on laboratory report in Appendix N).

6.4.1.2 Phase 2 Bioassay Testing

Bioassay tests were performed in 2023 on six Phase 2 sediment samples and two reference samples with different percentages of fine sediment content (10% and 36%, respectively). Total percent fines among the Phase 2 bioassay samples ranged between 4% and 32% with a median of 26%. Four bioassay samples were compared to the reference sample with 32% fines, and two (SG-10A and SG-49) were compared to the reference sample with 10% fines. No exceedances of either the SCO or CSL biological criteria were detected in Phase 2 sediment samples.

6.4.2 Bioassay Results

Phase 1 bioassay results indicated exceedances of CSL biological criteria at one location (SG-05). Additional tests performed during Phase 2 sampling to confirm these results indicated no exceedances of either the SCO or CSL biological criteria at locations proximal to SG-05.

Sampling station SG-05 was located in the Mill Pond, and bioassay test results indicate one exceedance of the CSL biological criteria for the polychaetae test. SG-05 exceeded the chemical CSL for mercury, but other benchmarks that can contribute to toxicity, including wood debris, sulfide, and ammonia, were not elevated at SG-05. The worms used in the polychaetae test sometimes show adverse effects from physical sediment substrate type such as shell fragments, which might explain the failure. The Phase 2 bioassay results indicate no toxicity at locations adjacent to and surrounding SG-05 (SG-46, SG-47, and SG-48). Because adverse biological effects in the vicinity of SG-05 could not be confirmed in the 2023 tests, benthic toxicity at location SG-05 in 2022 is considered to be an isolated hit and limited to a small area (less than 50 ft).

Results of bioassay testing indicate the Site surface sediment provide a healthy environment for the benthic community with only one potential circumscribed exception in the Mill Pond.

6.5 Data Quality Summary: Chemistry

Samples collected during the RI were reviewed by Geosyntec chemists using Level IIA, Level IIB, and Level IV data validation, in accordance with EPA National Functional Guidelines for Data Review (EPA, 2020a, 2020b, 2020c). The laboratory reports are provided in Appendix N, and the data quality review reports are included in Appendix O. An evaluation of data usability compared to project specific QAPP criteria is also provided in Appendix O.

Overall, the field and laboratory QC sample frequency met the requirements listed in Table 10 of the QAPP and supports the DQOs:

- The sample count, holding time, preservation requirements, and requested analyses were verified against Table 5 of the QAPP, the chains-of-custody, and sample login information. Several chain-of-custody discrepancies were identified in the data validation reports (DVRs) presented in Appendix O. Field duplicates are discussed in Section 6.5.1.
- The QAPP-specified holding times were met for the sample analyses, with the exceptions discussed in the DVRs. Additionally, the samples were received at the laboratories within the QAPP-specified acceptance criteria except for a few laboratory-caused delays. For the minority of samples outside of the criteria, the samples are listed in the DVRs and do not impact the usability of the data (discussed in Section 6.5.3).

- Qualifications that were applied due to holding time exceedances and improper sample preservation are discussed in the DVRs presented in Appendix O and summarized below.

6.5.1 Field Duplicates

Field duplicate pairs were collected with the sample sets, and laboratory replicates were also analyzed. For compounds with a result showing no detection but a result greater than the MDL or RL, the RPD was considered noncalculable. For compounds with both an estimated concentration greater than the MDL and less than the RL and a concentration greater than the RL, the RPD was considered noncalculable. Qualifications were also applied to concentrations with RPDs greater than the specified acceptance criteria. Qualifications applied to the data based on field duplicate and laboratory duplicate assessment were J qualifications as estimated and UJ qualifications as estimated less than the MDLs. None of the data were rejected based on field duplicate and laboratory replicate assessment.

6.5.2 Qualifications

The following qualifications were applied to the data due to surrogate exceedances, matrix spike/matrix spike duplicate (MS/MSD) exceedances, internal standard exceedances, and laboratory control sample/laboratory control sample duplicate (LCS/LCSD) exceedances:

- J qualified as estimated
- J- qualified as estimated with low bias
- J+ qualified as estimated with high bias
- UJ qualified as estimated less than the MDL

There were several instances where results showing no detections were R-qualified as rejected due to surrogate exceedances, MS/MSD recovery exceedances, internal standard exceedances, and/or LCS/LCSD recovery exceedances. Further details of these instances can be found in the DVRs.

Qualifications applied to the data due to isotope dilution standard exceedances were J-qualified as estimated. None of the data were rejected due to isotope dilution standard exceedances.

Qualifications applied to the data due to exceedances during the initial calibration verification (ICV) and/or the continuing calibration verification (CCV), were J qualified as estimated and UJ qualified as estimated less than the MDL. None of the data were rejected due to ICV/CCV exceedances.

6.5.3 Chemistry Summary

Most of the data that were assessed are considered usable based on the information provided and per the referenced validation guidance. The completeness percentage was greater than 95% and surpassed the completeness goal of 90% for most parameters. A few exceptions are noted below within subsets of percent completeness for each analyte:

- Sixteen sediment results showing no detections of total sulfide and six results showing no detections of acid volatile sulfide (AVS) were R-qualified as rejected due to holding time

exceedances. Therefore, the analytical completeness for the wet chemistry sulfide results is 79.2%.

- The hexavalent chromium data reported in the soil dataset are not considered usable for supporting project objectives. Nineteen results showing no detections of hexavalent chromium were R-qualified as rejected due to holding time exceedances. Therefore, the analytical completeness for the hexavalent chromium results is 0%.
- For soil, sediment, and groundwater samples, the field and laboratory QC sample frequency met the requirements for the project and supports the DQOs. The sample counts, holding time, preservation requirements, and requested analyses were verified against the chain-of-custody and sample login information. Several chain-of-custody notation discrepancies were identified and itemized in the DVRs presented in Appendix O but did not affect data quality. The QAPP-specified holding times were met for the sample analyses, with the exceptions discussed in the DVRs resulting in rejected data. Qualifications that were applied due to holding time and temperature exceedances are discussed in the DVRs presented in Appendix O. The sample-specific quantified results were compared to the project-specific PQLs, as outlined in the QAPP. The MDLs met the project-specific PQLs. Elevated results showing no detections were reported for some of the data because of sample dilutions due to either matrix interference or high target compound concentrations. In these cases, on a sample-specific basis, the PQLs for individual compounds showing no detections may not meet the project-specific PQLs.
- No evidence of an overall directional bias was observed based on associated field and/or laboratory QC exceedances, although some qualifications applied to the data may limit their usability. In summary, five EPA 8270E benzoic acid results and two EPA 8270E SIM benzoic acid results showing no detections were rejected due to low MS/MSD pair recoveries. Nineteen hexavalent chromium results, five total sulfide results, and six AVS results showing no detections were rejected due to holding time exceedances. Rejected data are not considered usable. Other qualified data should be used within the limitation of the qualification.

6.6 Data Quality Summary: Bioassays

Bioassay test data were reviewed to determine if test conditions were followed, test acceptability criteria were met, and reference toxicant tests met both control acceptability requirements. The bioassay laboratory reports from EcoAnalyst are provided in Appendix N, and the data quality review reports by Geosyntec are included in Appendix O. Specific results were as follows:

- **Polychaete growth and survival test**. The tests met their acceptability criteria with mean control survival for polychaetes of more than 90% and a mean individual growth rate of at least 0.38 milligrams per individual per day. The median effective concentration (EC50) in each ammonium chloride reference toxicity test fell within two standard deviations of the mean of the previous laboratory tests for survival and growth. With the exception of ammonia in the Phase 1 testing, water quality parameters (temperature, salinity, dissolved oxygen, pH, sulfide) were within acceptable limits and other test conditions were met with only minor deviations. Ammonia concentrations were above the purging trigger in the

overlying water of samples SG-33 and SG-39 on Day 20 (0.537 and 0.513 milligrams per liter [mg/L], compared to purging trigger of 0.46 mg/L); however, they were both below the no observed effect concentration value derived from the concurrent ammonia reference-toxicant test (1.51 mg/L), indicating that ammonia did not confound the test results.

- **Amphipod survival test.** The tests met the acceptability criteria with mean control survival of more than 80%. The EC50 in each ammonium chloride reference toxicity test fell within two standard deviations of the mean of the previous laboratory tests for survival. Water quality parameters (temperature, salinity, dissolved oxygen, pH, and sulfide) were within acceptable limits for all samples and other test conditions were met with only minor deviations.
- **Larval bivalve development test**. The tests met the acceptability criteria with mean control normal survivorship for bivalves of more than 70%. The EC50 in each ammonium chloride reference toxicity test fell within two standard deviations of the mean of the previous laboratory tests for survival. Water quality parameters (temperature, salinity, dissolved oxygen, pH, and sulfide) were within acceptable limits for all samples and other test conditions were met with only minor deviations.

These findings indicate that the data are valid for use in the RI/FS without any qualifications.

6.7 RI Boundary Determination

The RI data set was used to determine the nature and extent of contamination in soil, groundwater, and sediment. The RI boundary was developed using the perimeter contaminant concentrations while also considering surrounding ambient concentrations, native conditions, and physical, regulatory, and legal constraints. The initial RI boundary was drawn considering the following:

- Mapping the extent of refined SL exceedances of COCs, including copper, lead, total cPAH TEQ, and total TCDD TEQ.
- Evaluating property boundaries and other landmarks (e.g., roads), including historical land use areas and site operations as well as properties with prior redevelopment activities.
- Evaluating benthic toxicity passes.
- Mapping the RI perimeter and step-out samples.

The perimeter and/or step-out samples were used to establish the boundary line of ambient concentrations. This boundary line is shown on Figure 6-13.

The area of contamination within this boundary is used to perform the risk evaluation, calculate spatially weighted average concentrations (SWACs), interpolate concentration gradients, and develop cleanup levels and points of compliance. The risk screening (Section 7) will identify areas of unacceptable risk that will require remedial evaluation in the FS. This footprint becomes the final RI boundary that is carried forward into the FS.

6.8 Interpolated Distribution of COCs

Inverse distance weighting (IDW) is a deterministic method preferred by Ecology for spatial interpolation of datasets used to evaluate soil and sediment chemistry, both area-wide and Site-wide. When the IDW interpolation is conducted, values (e.g., concentrations) are assigned to a location by calculating a weighted average of the known values at nearby sample locations.

Using the RI dataset, a range of IDW settings and scenario combinations were evaluated to select the best fit IDW settings that minimize error among COCs. The same IDW parameterization will be used for all COC interpolations. The selected IDW settings for interpolating soil and sediment data include the following:

- Data transformation: logarithmic
- Power: 3
- Search radius: 200 ft
- Minimum/maximum number of nearest neighbors: 2/8

In 2020, IDW interpolations were conducted using the following settings:

- Data transformation: none
- Power: 2
- Search radius: 200 ft
- Minimum/maximum number of nearest neighbors: 3/5

The IDW parameters used in 2020 were based on a much smaller dataset (GeoEngineers, 2019), and the RI dataset (2023) is considerably larger with improved spatial coverage.

For this RI evaluation, four different datasets were used for IDW interpolation using the 2023 dataset: surface soil data (0 to 6 ft), subsurface soil (more than 6 ft), surface sediment (0 to 10 cm), and subsurface sediment (more than 10 cm depth). For the next step, the concentration gradient maps were stacked together (surface soil and surface sediment together) for a wholistic view of surface conditions. A few perimeter samples were used as needed to provide adequate spatial coverage. Results of the IDW analysis are presented in Figures 6-14a through 6-29b. From these interpolations, surface SWACs will be derived in Section 7 to assess exposure risks.

6.9 Nature and Extent Summary

COCs with elevated concentrations above refined SLs are associated with: (1) fill material in both surface and subsurface soil and sediment samples, (2) slag piles along the Inner Harbor shoreline, and (3) the former wharf structure and northern shoreline. COCs are generally below NB in the southern portion of the Mill Pond and southern portion of the Inner Harbor and most of the Outer Harbor. While wood debris covers a much larger area than the former wharf structure, the footprint of the SCO/CSL sediment exceedances is much smaller. Of the 20 bioassays, 19 passed (SG-05 in the Mill Pond did not pass), indicating the wood debris is not toxic to benthic biota. The nature

and extent of COCs exceeding the refined SLs are discussed in more detail in the following sections.

Soil and sediment sample results compared to refined SL for select COCs are summarized by depth in Figures 6-1 through 6-11, and COC interpolations are presented in Figures 6-14a through 6-29b. The extent of wood debris and bioassay results are shown in Figure 6-30a and 6-30b.

6.9.1 North Upland

COC concentrations in the north upland area that exceed refined SLs are not contiguous both horizontally and with depth. Higher concentrations are present in the former Mill footprint, decreasing to the north and east towards the northern perimeter samples (Section 7). Although somewhat sporadic, the depth of contamination ranged from a shallow depth of 2 ft bgs up to 6 ft bgs (in fill material) in most areas, and fill material included wood and building debris. COC exceedances were detected up to 12 ft bgs in one boring, SB-22, near the northwest corner of the former sawmill. Fill material was encountered in SB-22 to the maximum boring depth (12 ft bgs), and surrounding borings provided delineation. Metals (arsenic, lead, copper, cadmium), total cPAH TEQ, and the total TCDD TEQ were greater than refined SLs in boring SB-21, near the slag piles and in the former foundry/machine shop area. Elevated copper and lead exceedances were present in this area between 2–3 ft and 6–8 ft bgs. Arsenic and cadmium in two locations and mercury at one location were detected at elevated concentrations with exceedances up to 7 ft bgs.

Cadmium, chromium, copper, total cPAH TEQ, and total TCDD TEQ detected near the former mill structures were at or below NB in upland perimeter samples. Zinc was up to two times the NB concentration.

Higher lead concentrations were detected at a sampling location in the northeast corner of the Park property (HA-35) where building debris (i.e., ceramic and brick fragments) was observed.

6.9.2 South Upland

In the south upland area, metals, the total cPAH TEQ, and the total TCDD TEQ concentrations were above refined SLs near the former planing mill and kiln structures, where small pieces of charcoal and asbestos were observed. Depths of exceedances extended from ground surface to 2 or 3 ft bgs, which was the bottom depth of the six hand auger borings. One soil boring, SB-38, located on the southern side of the pedestrian bridge, was drilled to 20 ft bgs. Arsenic and zinc (16–18 ft bgs) and total cPAHs TEQ (14–16 ft bgs) concentrations were elevated at depths, but not consistently elevated in sample intervals from the ground surface to 20 ft bgs. Arsenic and total cPAH TEQ concentrations were below refined SLs in the maximum sample depth intervals at SB-38 and HA-37.

6.9.3 Mill Pond

COCs were detected at higher concentrations in subsurface sediment (below 10 cm) in the Mill Pond compared to surface sediment and appear to be associated with wood debris in subsurface sediment. COCs were generally higher in the northern portion of the Mill Pond, with the highest detections located within a low area where the stream discharges (near sample location SG-05). North of this area, sediment appears to accumulate behind the upland peninsula, and mudflats were exposed at low tides. The southern portion of the Mill Pond is mostly intertidal and less

contaminated than as compared to the northern Mill Pond. The greatest concentrations of COCs were detected in the top 2 ft bml and were vertically delineated with the exception of arsenic at two locations (SC-05 and SC-07). In these locations, arsenic exceeded refined SLs in the bottom interval (3.8–6.5 and 4.4–6.8 ft bml, respectively), the depths where both cores hit refusal as shown in Figure 6-1.

Metals, total cPAH TEQ, and total TCDD TEQ concentrations were consistently detected near or below NB in the southern portion of the Mill Pond and the creek sediment samples, except lead, which was above background but less than the SCO. In the northern portion of the Mill Pond, higher metals concentrations, in particular mercury, were detected in a cluster of samples at and surrounding SG-05, where the single bioassay failed (SG-05). However, lead, mercury, and other metals concentrations were lower (less than SCO), and bioassay samples passed in the three surrounding locations.

6.9.4 Inner Harbor

The highest COC concentrations were detected in the Inner Harbor in both surface and shallow subsurface sediment with exceedances of the refined SL up to 6.5 ft bml (deepest at SC-24 and SC-34 locations), and up to 10 ft bml in the high intertidal area (SC-11 to bottom of core). The highest metals concentrations and exceedances were often observed in the top core interval from 0 to 1.5 ft bml. Observed exceedances above the refined SLs were often associated with the presence of wood debris in subsurface sediment and slag piles. COC concentrations were generally higher in northern portion of the Inner Harbor, particularly along former wharf structure and closer to the former foundry.

Metals and total TCDD TEQ concentrations at two locations (SG-08 and SG-13) were consistently below NB in sediment samples in the southern portion of the Inner Harbor near the private intertidal tax lots, except lead and mercury. Metals and total TCDD TEQ concentrations at two locations (SG-08 and SG-13) were consistently below NB in sediment samples in the southern portion of the Inner Harbor near the private intertidal tax lots, except lead and mercury. Lead is present in nearshore Inner Harbor at sample depths ranging from 0 to 3 ft bgs, with sporadic sample locations above NB extending beyond the wharf footprint. The highest lead concentrations above the refined SLs were detected near slag piles and westward along the shoreline. The highest mercury concentrations (above the refined SLs) were detected along the edges of the wharf structure at depths ranging from the surface (few locations) up to 4 to 6 ft bml and did not appear collocated with the slag piles. The total cPAH TEQ concentrations were above refined SLs in surface sediment along the southern portion of the Inner Harbor and were less than NB concentrations in core samples. All sediment bioassays in the Inner Harbor passed.

In the northern portion of the Inner Harbor, some metals concentrations were below NB (chromium), and sporadic detections (arsenic, cadmium, zinc) were mostly in surface sediment with a few locations up to 4 ft bml. Copper concentrations were more frequently above NB ranging from surface up to 8 ft bml along the former wharf structure. Total cPAH TEQ and total TCDD TEQ concentrations were above refined SLs in surface sediment and core samples up to 6.5 ft bml.

6.9.5 Outer Harbor

RI sampling was focused on the northern portion of the Outer Harbor, and COC concentrations were mostly below NB for arsenic, cadmium, chromium, and zinc, total cPAH (based on the TEQ), SVOCs (phenols, phthalates), and dioxins/furans (using the total TCDD TEQ).

Results from the primary/duplicate pair were different from each other at one surface sediment sample (SG-56) located in the northeast Outer Harbor, likely due to sorption onto soil particulates or small metal-oxide compounds (i.e., "nugget effect"). Metals, PAHs, total cPAH TEQ, and total TCDD TEQ concentrations were below and above NB concentrations and other screening criteria in this primary/duplicate pair. Samples to the west of SG-56 had generally lower concentrations or were below NB concentrations, and the COC exceedances at SG-56 were isolated or sporadic.

A few metals (copper, lead, mercury) and total cPAH TEQ concentrations were above NB and sporadically above the SCO (metals) or human health criteria (total cPAH TEQ) in surface sediment, with declining concentrations away from the wharf footprint to the east and southeast and declining with depth. Total cPAH TEQ and mercury concentrations were above refined SLs in surface sediment samples along the northern shoreline, but not at consistent exceedance ratios. Three samples (SG-41, SG-54, and SG-56) located along the northern shoreline had high mercury concentrations; however, the locations with high mercury concentrations were not continuous as they were adjacent to sample results below NB concentrations or refined SLs. Total cPAH TEQ concentrations were above 10 times NB (0.21 mg/kg) but less than the refined SL for sediment (120 mg/kg) along the northern shoreline and the outermost sample to the northeast (SG-56). Total cPAH TEQ and mercury concentrations were below the refined SLs in subsurface sediment samples. All sediment benthic bioassays in the Outer Harbor passed.

7. CONCEPTUAL SITE MODEL AND RISK EVALUATION

The CSM summarizes potential historical and current contaminant sources, fate and transport mechanisms, potential receptors, and exposure pathways. A depiction of the current CSM for the Site is shown in Figure 7-1. The Site CSM provides the basis for developing remedial alternatives in the FS. Guidance on how to develop a CSM is provided in Ecology's Sediment Cleanup User's Manual (SCUM) guidance (Ecology 2021).

7.1 Contaminant Sources

The upland area and marine embayment at Blakely Harbor are currently used as a recreational park. Historical industrial activities in the Study Area are described in Section 2.3, and their potential contribution to the distribution of COCs at the Site is summarized in Section 7.1.1. Potential offsite sources and current secondary sources of Site contamination are discussed in Section 7.1.2.

7.1.1 Historical Sources from Site Operations

Historical on-Site activities that may have resulted in spills and releases of hazardous substances to upland soil from historical Mill operations included the machine shop, powerhouse, blacksmith shop, oil house, hog fuel/refuse burner, foundry, steam dry kilns, planing mill, and warehouse facilities. Activities that may have resulted in spills and releases directly to sediment include overwater activities such as use of machinery and ships for debarking/rafting logs and loading/unloading materials onto ships at the wharf. In addition, burnt materials resulting from the fires that destroyed the Mill structures in 1888 and 1907 were deposited on Site surface soil and sediment and represent a potential source of hazardous substances. ACM (former roofing material) was identified within a piece of demolition debris along the southern shoreline near the former planing mill (see Appendix L and Section 4.2.3). ACM found at the Site was mitigated and is not considered an ongoing source of contamination.

Former Mill operations conducted from 1863 to 1923, when the Mill shutdown, were likely sources of metals, organic compounds like PAHs and TPH, and dioxins/furans. In addition, wood debris was likely deposited in upland and in-water areas during Mill operations and log rafting. Wood debris, pilings, lumbered wood, foundry bricks, and other construction debris may have been used as fill material during reconstruction or expansion of the Mill after the 1888 and 1907 fires. Former Mill operations and their potential impact on contaminant distribution at the Site are discussed below.

7.1.1.1 Foundry and Blacksmith Operations

Metals such as copper, chromium, lead, mercury, and zinc were common in alloys used in historical foundry and blacksmithing operations at the time the Mill was operational. During the RI field investigation, slag piles were observed along the Inner Harbor shoreline in proximity of the former foundry and blacksmith shops (described in Appendix I and summarized in Section 4.2.1). Slag is formed during the cooling of melted ferrous metals and alloys, and the piles observed at the Site may be from melted metal mixtures released and cooled on the shoreline. The slag piles may be broken down by natural processes and become a secondary source of COCs, as discussed in the Sections 7.1.2 and 7.2. Elevated concentrations of metals in soil and sediment proximal to

the former foundry, blacksmith shop, and slag piles on the shoreline may have been released from these former activities.

7.1.1.2 Fuel Supply Lines and Timber Pilings

Diesel and petroleum-derived products were commonly used as fuel for operations in mills and vessel transport during this time period, as well as wood preservative products. TPH and PAHs may have been released during historical operations in both soil and sediments.

Wood structures are often preserved with materials such as creosote, which can result in releases of PAHs and other organic compounds into soil and sediment. Coal-tar creosote, the most common type of creosote, was commercially introduced in 1838 and was produced in the Wyckoff facility that began operations in Eagle Harbor in 1905. The Mill burnt down for a second time in 1907 and was reconstructed in 1909. Therefore, the potential use of creosoted timber pilings and wood during reconstruction and Mill operations was investigated during the RI, with a focused study summarized in Appendix K and Section 4.2.2. Scrape samples from Study Area timber piles were tested, and samples did not contain elevated concentrations of PAHs. Furthermore, the signature of the low PAH concentrations detected in the scrape samples was significantly different than PAH signatures typical of creosote as reported in literature (Appendix K). These results confirmed that Mill structures were not likely treated, and timber pilings present at the Site are not treated with creosote.

7.1.1.3 Refuse Burners and On-Site Fires

The Mill operated two refuse burners (hog fuel burners) during routine operations as a source of energy, and wood debris available from Mill operations was likely the fuel used in the burners. In addition, the Mill was destroyed in 1888 and 1907 by two documented fires and rebuilt. The use of hog fuel burners and the two historical Mill fires likely resulted in localized areas of combustion byproducts.

Elevated concentrations of dioxin/furans present in both soil and sediments in proximity to the former smokestacks or the former Mill structures likely the result of historical refuse burner operations and the fires that burnt down the Mill.

7.1.1.4 Wood Milling Operations and Wood Debris

In 1882, Mill production was 200,000 board ft per day, and the Mill that was rebuilt in 1909 had a maximum output of 500,000 board ft per day (Price 1989). Historical industrial operations produced wood debris including saw dust, dimensional lumber, pulp fibers, wood chips, logs, and bark some of which were observed during RI investigations (Appendix J).

Wood debris was found in subsurface soil and sediment in the north upland and the Inner Harbor areas within the former Mill footprint (Figure 6-30). Log rafting (log booming) occurred in the Mill Pond and in the portion of the Inner Harbor adjacent to the former Mill. Observed wood fragments (e.g., bark, dimensional lumber, wood chips) were likely dislodged and sloughed off during log rafting and settled into surface sediment. In some instances, wood debris has been shown to contribute to impairment of sediment and surface water quality by generating a toxic environment for benthic species. However, the results of the RI investigation show that benthic toxicity is not collocated with high wood debris content in surface sediment (Figure 6-30). At some sites, abundant wood debris in surface sediment has increased the biological oxygen demand

(BOD) due to increased microbial activity in carbon rich environments; this resulted in oxygen depletion and increasing concentration of sulfide and ammonia due to biological activity under suboxic and anoxic conditions. Sulfide and ammonia were quantified in surface sediment, and results were not consistently elevated in areas with high wood debris content indicating the wood debris detected at the Site has not increased microbial activity and raised BOD. Based on the bioassay and correlation analysis, the wood debris is not considered a COC.

7.1.1.5 Reconstruction and Shoreline Reshaping

Based upon our understanding of historical Site operations, the northern and southern shorelines at the Site were likely dredged and reshaped to extend the shoreline, build new Mill structures, and increase berthing depths for vessel traffic and mooring. Historical maps show that the Mill Pond area and the shoreline between the Mill Pond and the Inner Harbor were reshaped when the Mill was first built in 1863 and after the two subsequent historic fires (United States Coast Survey, 1856; United States Coast and Geodetic Survey, 1884; Port Blakely Mill Company, 1917; ERIS, 2019b; Geosyntec, 2019). RI findings of wood fill layers or lenses in the upland area to depths up to 15 ft bgs (see Figure 7-1 and cross-section series Figure 3-3) including near the shoreline suggest wood debris could have been used as fill material . Bricks/brick fragments also were observed in soil and sediment within the fill layer (Appendices C and D) indicating building debris could have also been used as fill material during reconstruction following the Mill fires. The fill layers in the upland area are collocated with some slag piles along the Inner Harbor and elevated concentrations of metals and organic compounds in soil and Inner Harbor sediments, although metals and organic compounds, when detected, were not present in groundwater above refined SLs (potential for leaching is further discussed in Section 7.2).

7.1.2 Current Potential Sources

Potential offsite sources and secondary sources of Site contamination are from sources in the vicinity of the Site as well as airborne releases that have traveled long distances. There is one unknown outfall and six natural streams from offsite upland areas that discharge to the Site marine embayment. The unknown outfall is an unclassified pipeline according to data retrieved from Kitsap County and assessed during a survey conducted in 2022 (Figure 7-2). The largest stream at the Site is located near the westernmost end of the Mill Pond and called the “unnamed creek.” Other smaller streams are located near the southwest of the Mill Pond, in the north upland area, and in private properties within the Outer Harbor northern and southern shorelines. Sediment samples collected within the unnamed creek and in proximity of other natural discharges indicated no areas with high concentrations of contaminants, except near one outfall (i.e., surface sediment sample SG-25). At SG-25, detected concentrations of COCs did not exceed natural background or refined screening levels, with the exception of cPAHs. Otherwise, streams and outfall discharges do not appear to be a contributing source of contamination to the Site.

Other anthropogenic sources may also have contributed to ambient concentrations. EPA has identified combustion emissions as a primary category of dioxin sources to the environment, with loadings decreasing over time as a result of environmental regulation on emissions (EPA, 2006). TCDD and 1,2,3,7,8-pentachlorodibenzo-p-dioxin (PeCDD) are present in combustion emissions globally and can come from a variety of regional sources that are not easily distinguishable at low levels (regional background), including incineration of municipal solid waste, sewage sludge,

hazardous wastes, and fuel (*e.g.*, coal, wood, petroleum), as well as uncontrolled burning (*e.g.,* forest fires, brush fires, open burning of wastes) (EPA, 2006).

Historical deposition of airborne arsenic and lead released from the former Asarco Smelter located in Tacoma, Washington, may have been transported to Bainbridge Island and the Site, based on historical wind patterns. The Site is within the 20 mg/kg zone mapped from the historic Tacoma Smelter Plume (Pacific Groundwater Group and TeraStat, Inc., 2005). [30]Between 2000 and 2004, Kitsap County collected surface soil samples of an Extended Footprint Study, and arsenic was detected in surface soil samples with concentrations (31 and 33 mg/kg) above regulatory screening levels (MTCA Method A 20 mg/kg) and NB (7 mg/kg).

7.2 Fate and Transport Pathways

Fate and transport pathways govern the distribution and transformation of COCs in environmental media. Fate describes the transformation processes that can change the concentration of a COC through time, such as adsorption, biodegradation, precipitation, dissolution, and advection. The transport pathways represent the physical and/or chemical processes resulting in contaminant migration from the point of release or source area to the impacted media. Transport pathways can mobilize contaminants from source areas of release (or hot spots) and transport them between or within environmental media by various mechanisms. Transport pathways at the Site include the following:[31]

- Erosion of surface soil from overland runoff and deposition into sediment.
- Atmospheric Deposition.
- Redistribution of sediment via erosion.
- Upward migration from subsurface sediment into surface sediment.
- Natural attenuation, which is the decrease of COC over time due to the cumulative effect of transformation (fate) and transport processes. COCs can undergo a variety of transformation and transport processes including those listed above.

The primary fate and transport pathways and their areas of interest at the Site are described in detail in the following subsections.

7.2.1 Erosion of Surface Soil

Surface soil particles, including associated contaminants, can be eroded by tidal action and suspended by overland runoff during storm events and inundation during high tides. Slag piles, bricks, and wood debris present on the shoreline can be eroded by wave action and physical and chemical weathering into more mobile, smaller fragments over time. Mobilized particles can migrate towards lower elevation areas and deposit into intertidal and subtidal areas. While areas

[30] Weather data prior to 1945 could not be found. Wind frequencies and velocities from the Air Weather Service, Data Control unit, U.S. Weather Bureau for the Central Puget Sound Region, and Seattle-Tacoma Airport are summarized in Figures 3-9 and 3-10 and Tables 3-4 and 3-5 (Brown and Caldwell, 1958).
[31] Since COCs in soil are not present in groundwater above refined SLs, the soil to groundwater and groundwater to surface water pathways are not considered complete transport pathways for the Site.

of large-scale soil erosion were not observed, smaller scale is likely occurring along the northern shoreline in the Mill Pond and Inner Harbor. Steeper slopes along the northern portion of upland area near the Mill Pond could particularly be vulnerable to erosion at higher tides. erosion (and/or weathering) and redistribution of slag debris could result in transport of small particles away from the areas where large slag piles were observed (Figure 4-3).

7.2.2 Atmospheric Deposition

There are no current airborne releases of contaminants at the Site, but historical emissions were likely during Mill operations. Airborne release of contaminants can occur through volatilization during combustion or foundry processes, and/or distribution of contaminated particles generated from or associated with operations (e.g., dust and/or burning). Volatile or gas compounds and/or particles can be transported by wind over short and long distances and deposited directly to surface soil, surface water, and surface sediment. Non-point sources of low-level contaminants from urban activities such as car emissions, industrial operations, and street dust may be transported to the Site and may also contribute background levels of chemicals present at the Site.

7.2.3 Redistribution of Sediment via Erosion

Redistribution of sediment via erosion occurs when the shear stress applied by wave action and tidal currents can mobilize nearshore sediment or debris and transport them to a different location. Slag deposits, brick, and wood debris found exposed along the shoreline appear stable but would be vulnerable to redistribution from currents and tides. Recreational vessel traffic (temporary mooring, anchoring, propeller wash) is limited to seasonal use of the park and is not considered to be significantly affecting the shoreline and substrate stability. Evidence of redistribution of sediment via erosion in different areas of the Site include:

- The thickness of unconsolidated sediment was higher in general in the Mill Pond (thickness up to 4 ft) compared to the Inner Harbor (thickness of 1 to 2 ft) as shown in Figure 3 (Appendix J), suggesting Mill Pond is a depositional environment. Transport of sediment from the Inner Harbor to the Mill Pond is possible during high tides or storm events, although likely limited by the small size of the channel connecting the Mill Pond to the Inner Harbor.
- Fine-grained sediments were not abundant in the Inner Harbor shoreline adjacent to the North and South Upland areas. The observance of small grains of slag with fragments of wood debris in nearshore sediment indicate some erosion of and migration from the slag piles observed along the northern shoreline (see Appendix I for additional detail).

The RI bathymetric survey data collected in 2020 was compared to the bathymetry survey data from a 2009 NOAA survey to map elevation changes at the Site (Figure 7-3). Figure 7-3 provides an approximate estimate for bathymetric elevation changes where there is suitable data overlap as the Mill Pond was not covered during 2009 survey. Based on this comparison, over the past 11 years (where there is overlapping data coverage), sediment bed elevation changes have been minimal (+ or – 0.5 ft) over most of the Site, with few small erosional areas (elevation loss) corresponding to the location of floating docks and likely main vessel activity. The southern shoreline shows small areas that appear to have more sediment deposition, such as sediment particle load coming from the Mill Pond and unnamed creek or other non-point sediment loads.

Redistribution of sediment via erosion is considered a transport pathway at the Site.

7.2.4 Upward Migration from Subsurface Sediment

Multiple processes (physical or biological) may mobilize contaminants from subsurface sediment to surface sediment and promote vertical migration through the sediment column. In both the Inner and Outer Harbor, elevated COC concentrations were mostly found in surface sediment samples (collected between 0-10 cm bml) with few exceptions (Table 5-6).

Vertical COC distribution in Site sediment was assessed to understand the importance of potential vertical mixing pathways, and the potential for higher concentrations in the subsurface to migrate to surface sediment. Concentrations of five COCs (arsenic, mercury, lead, total cPAH based on the TEQ, and total TCDD based on the TEQ) were plotted to visualize data distribution between surface and subsurface sediment using a non-parametric hypothesis test[32] (Wilcoxon) to evaluate if differences between datasets were statistically significant. The Figure 7-4 series shows distribution of the five COCs.

Results indicate that there are no statistically significant differences between maximum concentrations of arsenic, mercury, and total TCDD based on the TEQ in surface and subsurface sediments (Figure 7-4a, 7-4b, and 7-4e, respectively). The concentrations of lead were higher in subsurface sediment and significantly different than surface sediment (Figure 7-4c), which appears to be localized to Inner Harbor locations where shoreline core intervals were characterized mainly as fill (Figure 3-3d). The total cPAH based on the TEQ concentrations were higher in surface sediment and significantly different than subsurface sediment (Figure 7-4d). Overall, results showed that higher COC concentrations are mainly located in surface sediment, as there are no significant differences in COC concentrations between surface and subsurface; this indicates that surface-subsurface sediment is equilibrated.

Vertical mixing and upward migration of sediment particles can be promoted by bioturbation, where the movements of benthic organisms disturb the sediment bed. The SPI/PV survey (Appendix F) showed that successional stage 3 infauna populations are distributed across the Mill Pond and the Inner Harbor Northern shoreline. Stage 3 suggests bed stability and limited physical disturbance and sediment resuspension, but it also may indicate biological activity by deep-dwelling, head-down deposit feeders can occur. SPI survey results noted distinctive feeding voids and aerated burrows in the Mill Pond and the Inner Harbor Northern shoreline, which may indicate that shallow mixing due to bioturbation is extending across the surface sediment depth. Vertical mixing due to bioturbation is considered a transport pathway at the Site.

7.2.5 Natural Attenuation

Natural attenuation processes can decrease the overall mass of contaminants in environmental media, and include biodegradation, adsorption, chemical reactions like precipitation, dilution, and dispersion. Physicochemical characteristics of contaminants govern natural attenuation processes and are discussed in detail in the following sections.

[32] Non-parametric test assesses differences between medians instead of means (evaluated by using parametric tests) and are appropriate for small datasets that do not fit a particular distribution.

Organic COCs include PAHs, dioxin and furans, and SVOCs (phenols, chlorinated organics, and phthalates) and inorganic COCs include metals like arsenic, copper, lead, mercury, and zinc. Attenuation of organic compounds can occur via adsorption or biodegradation, while attenuation of metals can occur by precipitation and adsorption on soil or sediment due to surface interactions with the minerals or partitioning into organic matter.

- Adsorption is a reversible process and plays an important role in the fate and transport of organic contaminants because adsorption delays the release of organic contaminants in the environment and is critical for evaluating overall decay rate of a compound (half-life). This process is likely to occur at the Site, but the variability of sediment organic carbon content and grain size will impact the magnitude and significance of it.
- Biodegradation occurs when thermodynamic conditions are favorable to development of a microbial community capable of oxidizing (breaking down) organic contaminants with consequent reduction of a terminal electron acceptor. However, the significance of this process is linked to the magnitude of biodegradation rates. Biodegradation rates will vary within oxic, suboxic, and anoxic environments; with the process being faster in presence of oxygen and slower when different terminal electron acceptors are present (nitrate in suboxic environments and sulfate or carbon dioxide in anoxic environments). Biodegradation rates for LMW organic compounds are on the order of days in oxic environments and months in anoxic environments, while biodegradation rates for HMW organic compounds are in the order of years in oxic environments and decades in anoxic environments. Therefore, biodegradation can represent an important transport process for LMW organic compounds.
- Precipitation of metals will occur when redox conditions, concentrations of chelating agents, and ionic strength of groundwater or sediment porewater are favorable to formation of complexes with dissolved metals. This process can occur in saturated soil or in shallow and undisturbed sediment where redox conditions are stable and not altered by tidal currents or wake actions. Significant redox changes in the upland were not observed in Study Area soils (e.g., significant iron oxidation changes or evidence of metals/sulfides) and groundwater field parameters. In sediment, the aRPD was observed using the SPI/PV survey. Results indicated the aRPD in sediment ranges between 0.5 and 3.6 cm with an average of 1.9 cm across the Study Area (128 stations). Speciation of metals sensitive to redox changes like arsenic and mercury could occur in surface and subsurface sediments, but not enough significant field observations were collected to conclude this could be an important process contributing to natural attenuation.

The rate of natural attenuation was evaluated by comparing concentrations of five COCs (arsenic, mercury, lead, total cPAH based on the TEQ, and total TCDD based on the TEQ) in surface sediment collected in 2019 and 2021-2023. A non-parametric hypothesis test (Wilcoxon) was used to evaluate concentration changes through a time range (2019 to 2023). The dataset distributions for the five selected COCs are shown in the Figure 7-5 series. Arsenic and total cPAH TEQ concentrations were lower in surface sediment collected in 2021-2023 and significantly different than surface sediment collected in 2019 (Figure 7-5a and 7-5d). There were no statistically significant differences between concentrations of mercury, lead, and total TCDD based on the TEQ in surface sediments over the 2-to-4-year time-difference (Figures 7-5b, 7-5c, and 7-5e,

respectively). Despite a small timeframe compared to the time that has passed since the Mill was shut down, statistical evidence indicates that natural attenuation of arsenic and cPAH has been occurring at the Site, while other COCs are more stable or have already achieved ambient concentrations.

Natural attenuation is the result of cumulative contribution of on-Site chemical and physical processes including adsorption, biodegradation, precipitation, and mixing or transport of particles. Temporal comparison of COC concentrations showed that natural attenuation is occurring at the Site.

7.3 Potential Receptors and Exposure Pathways

Potential human receptors at the Site include recreational and tribal users of the upland, intertidal, and subtidal areas, and construction workers. Receptors and exposure pathways are summarized in Figures 7-6a and 7-6b. Typical recreational activities include hiking and wildlife viewing in the upland area and wading, swimming, fishing, and shellfish harvesting in the intertidal or subtidal areas. On-water recreational activities, such as kayaking and boating, may occur, but the potential for contact with sediment is expected to be minimal. Construction workers, if working in the upland areas of the Site, are potential human receptors. The human health exposure pathways that are considered complete are as follows:

Soil

- Dermal contact and incidental ingestion pathways for recreational users in the upland soil areas. These pathways are considered complete for construction workers, although they would have a shorter exposure duration.

Sediment

- Dermal contact and incidental ingestion pathways for recreational and Tribal users in both intertidal and Site-wide sediment. The exposure scenarios include beach play, clam digging, and net-fishing. These scenarios are also considered protective of recreational kayakers that launch their boats from the shoreline.
- Indirect exposures (shellfish and fish consumption) for recreational and Tribal fish/shellfish consumers due to bioaccumulation of contaminants.[33]

Potentially exposed ecological receptors in the uplands include terrestrial vascular plants, invertebrate communities, and herbivorous, omnivorous, and invertivorous wildlife following the site-specific TEE process (WAC 173-340-7490). Larger herbivorous and carnivorous wildlife are not expected to spend significant time foraging at the Site due to their large home ranges. In the intertidal and subtidal sediment areas, potentially exposed ecological receptors include the benthic invertebrate community, fish, marine mammals, and aquatic-life dependent wildlife. The ecological exposure pathways that are considered complete are as follows:

[33] Tribal and recreational consumers would have different consumption rates; however, they are included together because the exposure pathway is the same.

Soil

- Direct contact (ingestion, dermal contact) for terrestrial invertebrates and vascular plant communities.
- Incidental ingestion during foraging for terrestrial birds and mammals. Direct contact to surface soils is complete, but insignificant due to the presence of fur and feathers.
- Ingestion of plants or invertebrates (i.e., earthworms) for herbivorous, omnivorous, and invertivorous wildlife (e.g., shrew, vole, and American robin) due to bioaccumulation. Large terrestrial herbivore (e.g., deer) and carnivore exposure via bioaccumulation is complete; however, due to their large home ranges, exposure is limited, and the pathway is considered insignificant.

Sediment

- Direct contact (ingestion, dermal contact) for benthic invertebrates.
- Indirect exposures (shellfish and fish consumption) for aquatic-life dependent marine mammals (e.g., northern sea otter and harbor seal) and birds (e.g., spotted sandpiper and osprey) due to bioaccumulation.
- Direct contact (ingestion, dermal contact) to surface water for fish, however there are not screening values available for this pathway. Incidental ingestion of surface water for wildlife receptors is complete but insignificant due to saline water not being an appropriate potable water source. This pathway is discussed qualitatively.

The sediment bioaccumulation pathway for human and ecological receptors was evaluated by comparison of surface sediment data to bioaccumulative SCOs (i.e., NB or PQL SLs).

7.4 Human Health Risk Evaluation

The following sections discuss the risk screening performed for the complete human health exposure pathways. A summary of results is presented in Table 7-1a and 7-1b. For media-receptor pairs with an excess lifetime cancer risk (ELCR) greater than $1x10^{-6}$ or a hazard quotient (HQ) greater than 1 were identified as COCs that exceed Ecology's risk threshold. Cumulative risk was also considered for direct contact pathways (see Section 7.4.3).

7.4.1 Direct Contact in Soil and Sediment

The direct contact pathways were evaluated for COCs identified in Section 5.3. The maximum detected concentration was compared to direct contact SLs. If the maximum was below the SL or the FOE was less than 5%, the COCs contribution to risk is insignificant. If a COC was retained, then an IDW-based SWAC was developed (see methods in Section 6.7) for appropriate spatial scales and results were compared to the cancer and noncancer direct contact SLs. The SL comparison included the following:

- Upland - The maximum and SWAC from the top 15 ft of soil was compared to MTCA method B direct contact SLs (Table 7-2).

- Intertidal sediment - The maximum and SWAC from the top 2 ft was compared to the beach play (Table 7-3) and clamming (Table 7-4) direct contact SLs.
- Intertidal/subtidal sediment (site-wide) - The maximum and SWAC from the top 10 cm was compared to the net-fishing direct contact SLs (Table 7-5).

Results of the screening identified the following:

- Upland Soil area – Arsenic, total cPAH based on the TEQ, and total TCDD based on the TEQ were retained as soil COCs with risks exceeding the acceptable individual chemical threshold ($1x10^{-6}$) or for cumulative risk ($1x10^{-5}$) (see Section 7.4.3). The SWAC for lead (179 mg/kg) was below the MTCA Method A value for unrestricted site use (250 mg/kg).
- Intertidal sediment – Arsenic and total cPAH based on the TEQ were retained as sediment COCs because SWACs exceeded cancer SLs. The total cPAH TEQ SWAC did not exceed $1x10^{-6}$ for the beach play scenario. Total TCDD TEQ SWAC was below SLs.
- Intertidal/subtidal sediment – Arsenic and total cPAH based on the TEQ were retained as sediment COC with risks because SWACs exceeded cancer SLs, while the total TCDD TEQ SWAC was below SLs.

7.4.2 Human Heath Bioaccumulation

Surface sediment data (0 to 10 cm) for bioaccumulative COCs were compared to the bioaccumulative SCO (i.e., natural background or the average PQL) to determine risk related to human consumption of shellfish and fish consumption for recreational and Tribal fish/shellfish consumers. If the maximum detected concentration of the bioaccumulative COC was below the SL, or the FOE was less than 5%, then the risk is considered insignificant. For COCs that were retained, IDW SWACs (see methods in Section 6.7) were developed and compared to the bioaccumulation SLs (Table 7-6)[34]. Lead, four HPAHs (benzo[g,h,i]perylene, fluoranthene, indeno[1,2,3-cd]pyrene, and pyrene), total cPAH based on the TEQ, and total TCDD TEQ SWACs exceeded their respective bioaccumulative SL. Arsenic, cadmium, and mercury SWACs were below their respective SL.

7.4.3 Cumulative Risk

The determination of whether a COC was present above an acceptable risk threshold included the consideration of the cumulative risk for a receptor in accordance with MTCA. The calculation of cumulative risk was conducted for human populations and not ecological communities due to the uncertainty related to combining risk estimates for ecological populations (e.g., toxicity values for one contaminant may not be applicable to another species). Therefore, the cumulative risk was calculated for human cancer and noncancer endpoints for soil and sediment.

The acceptable cumulative cancer risk when there are multiple hazardous substances and/or pathways is identified in WAC 173-340-700 as $1x10^{-5}$. Therefore, if the cumulative ELCR for a receptor-media pair exceeded $1x10^{-5}$, those COCs with an individual ELCR equal to or exceeding

[34] Benzo(g,h,i)perylene, fluoranthene, and pyrene are identified as bioaccumulative. The average PQL was selected for comparison.

$1x10^{-6}$ were identified as exceeding Ecology's risk threshold. For noncancer endpoints, hazard quotients were summed to develop a target organ hazard index (HI). A summary of the cumulative cancer and noncancer risks follows:

- Direct contact for soil exposure: the cumulative ELCR was $2x10^{-5}$; therefore, arsenic, total cPAH based on the TEQ, and total TCDD based on the TEQ were identified as COCs above Ecology's threshold. There were no target organ HIs greater than 1.
- Direct contact for beach play intertidal sediment exposure: the cumulative ELCR was $7x10^{-6}$; therefore, only those COCs with individual ELCRs greater than $1x10^{-6}$ were identified as COCs above Ecology's threshold. There were no target organ HIs greater than 1.
- Direct contact for clamming intertidal sediment exposure: the cumulative ELCR was $2x10^{-5}$; therefore, arsenic, total cPAH based on the TEQ, and total TCDD based one the TEQ were identified as COCs above Ecology's threshold. There were no target organ HIs greater than 1.
- Direct contact for net fishing surface sediment exposure – the cumulative ELCR was $7x10^{-6}$; therefore, only those COCs with individual ELCRs greater than $1x10^{-6}$ were identified as COCs above Ecology's threshold. There were no target organ HIs greater than 1.

An extensive quantification of risk related to Site sediments would also include the contribution related to the bioaccumulation pathway and consumption of biota. The screening of sediment concentrations to bioaccumulation SCOs contextualizes risk for this pathway, but it could not be combined with direct contact estimates due to being NB- or PQL-based (i.e., a target risk or hazard is not used in the SL derivation). It is likely that cumulative risk related to exposure to the Site is underestimated via quantification of the direct contact pathways only. However, the method used to estimate risk follows Option 1 discussed in Chapter 9 of SCUM (Ecology, 2021). Therefore, the cumulative risk was used to identify those COCs that exceed Ecology's risk threshold and will have cleanup levels developed (see Section 9) for evaluation in the FS.

7.5 Ecological Evaluation

The following sections discuss the risk screening performed for the complete ecological exposure pathways, and the results of the TEE utilizing the table lookup method using SL from WAC 173-340-7490 Table 749-3. Results are summarized in Tables 7-1a and 7-1b.

7.5.1 Soil Terrestrial Ecological Evaluation

The direct contact pathways were evaluated for COCs identified in Section 5.3. An initial screening compared the maximum detected concentration to direct contact/bioaccumulation SLs. If the maximum was below the SL or the FOE was less than 5%, then the COCs contribution to risk is considered insignificant. If a COC was retained, then an IDW-based SWAC was developed for comparison to area-based SLs. The maximum detected concentration and SWAC from the top 6 ft bgs were compared to SLs.

Copper, lead, zinc, and total TCDD based on the TEQ were retained as COCs above acceptable risk thresholds. Arsenic, chromium, mercury, and DRO SWACs were below their respective SLs,

or their hazard quotients did not exceed 1 and were not retained as COCs above acceptable risk thresholds (Table 7-7).

7.5.2 Sediment Benthic

Benthic risk was evaluated on a point-by point-basis with surface sediment data chemistry (0 to 10 cm bml) compared to dw or OC-normalized benthic SCOs. Summary statistics, DF, and FOEs are provided in Table 7-8.

Among the 89 surface sediment samples, lead, mercury, five HPAHs, phenanthrene, phenol, and butyl benzyl phthalate were detected above the benthic SCO with greater than 5% FOE (except lead, at 4% FOE). As discussed in Section 6.3, bioassay results indicated one CSL exceedance of biological criteria (SG-05) in the Mill Pond, and mercury was the only COC that exceeded the benthic SCO. Bioassay results from locations surrounding SG-05 (within 25 ft) did not exceed the SCO or CSL biological criteria. Overall, results of bioassay testing showed the surface sediment at the Site as being a healthy environment for the benthic community with one exception in the Mill Pond. However, those COCs that exceeded the benthic SCO were identified as exceeding an acceptable risk threshold. Mercury was identified as a COC that exceeds an acceptable risk threshold based on the exceedance of the benthic SCO and the bioassay result that exceeded the CSL at SG-05.

7.5.3 Sediment Wildlife Bioaccumulation

Surface sediment data (0 to 10 cm bml) for bioaccumulative COCs were compared to the bioaccumulative SCO (i.e., NB) for aquatic-life-dependent wildlife and marine mammals (e.g., northern sea otter and harbor seal) and birds (spotted sandpiper and osprey). If the maximum detected concentration of the bioaccumulative COC was below the SL, or the FOE was less than 5%, then the risk is considered insignificant. For COCs that were retained, IDW SWACs (see methods in Section 6.7) were developed and compared to the bioaccumulation SLs (Table 7-6). Lead, four HPAHs (benzo(g,h,i)perylene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene), and total TCDD TEQ SWACs exceeded their respective bioaccumulative SL. Arsenic, cadmium, and mercury SWACs were below their respective SL.

7.6 Evaluation of Wood Debris and Indicators

Results of the RI field activities showed that wood debris is present in surface sediment of the Mill Pond and Inner Harbor areas and in subsurface soil and sediment in the north Upland and the Inner Harbor areas, in the location of former Mill buildings (Appendix J). Bioassay testing conducted at multiple sampling stations with varying abundance of wood debris (between 0 and 80% by volume) indicate no direct correlation between toxicity to the benthic community and the physical presence of wood debris (Figure 6-30). Only one sediment sample failed bioassay tests but abundance of wood debris at this sample was below 20% by volume (Table 6-1 and Section 6-3).

Although results of bioassay testing in the Study Area indicate no correlation between presence of wood debris and toxicity to the benthic community, a deeper analysis was conducted to assess the potential secondary impacts of wood debris on the aquatic environment. The following subsections discuss indicators of wood debris decomposition, correlation of wood debris with dissolved oxygen and redox potential discontinuity in surface sediment, and collocation with identified COCs.

7.6.1 Indicators of Wood Debris Decomposition

Conventional analytes including TOC, TVS, oxygen, ammonia, and sulfides in bulk and porewater sediments were measured to assess impact from decomposition by-products associated with wood debris. Summary statistics including minimum and maximum, median, and averages for these indicator parameters for Mill Pond, Inner Harbor, and Outer Harbor sediments are reported in Table 7-9a, and values for discrete samples are listed in Table 7-9b.

- TOC measured in bulk sediment samples was higher in the Mill Pond, where the average was 5.1% compared to 3.9% in the Inner Harbor, and closer to the Puget Sound average of 2% TOC in the Outer Harbor. The maximum ranged up to 20.7% in Inner Harbor sediments.
- TVS measured in bulk sediment was also higher in the Mill Pond where the average was 9.0% compared to 6.9% in the Inner Harbor, and 5.4% in the Outer Harbor. TVS percentages ranged up to 29.9% in Inner Harbor sediments.
- Average ammonia and sulfide concentrations were higher in the Outer Harbor with 11.4 and 363 mg/kg respectively, compared to averages of 8.6 and 276 mg/kg in the Mill Pond, and 6.1 and 167 mg/kg in the Inner Harbor. However, no consistent spatial trend was observed across the Study Area. In addition, the RPD, which indicates the depth to which sediment become anoxic, and was measured during the SPI/PV survey (Appendix F). The average aRPD was higher in the Inner Harbor (2.4 cm) compared to the Outer Harbor (1.9 cm). Measurements in the Mill Pond were not conclusive due to technical difficulties in camera deployment.
- Dissolved oxygen was measured ex-situ in sediment porewater prior to conducting the bioassay tests and values were found to be within normal ranges (between 6 and 8 mg/L). Ammonia and sulfide were also measured ex-situ in sediment porewater prior to bioassay testing and were analyzed in surface sediment during the tests. Total ammonia in porewater ranged between 1.09 and 26.9 mg/L, while total sulfide ranged between 0.02 and 5.22 mg/L. Concentrations did not appear to be positively correlated with bioassay results. A summary of dissolved oxygen, ammonia and sulfide measurements for bioassay testing is reported in Appendix N-4.

7.6.2 Correlation between Wood Debris and other Analytes

A statistical analysis was conducted to assess the correlation between indicators of wood debris decay and selected Site COCs. The presence of organic compounds like phenol can be associated with decomposition of wood debris (Ecology, 2013a). Results of this analysis are reported in Table 7-10.

There is no strong correlation between wood debris percentage and any of the wood debris parameters. There is a moderate correlation between wood debris and concentrations of ammonia, sulfide, TOC, TVS, and phenol, and a weak correlation with cPAH based on the TEQ and total PAHs in bulk sediment samples. Consequently, a significant positive correlation was not identified to support a link of causality between the presence of wood debris and the Site COCs. A correlation analysis was also conducted between wood debris and TCDD based on the TEQ, but it was not statistically significant (Table 7-10).

7.6.3 Overlap Analysis with Areas with Sediment Exceedances

An overlap analysis was performed for total cPAHs and total TCDD, comparing the concentrations of these chemicals to the percentage of wood debris observed during field activities (e.g., chemistry sampling, SPI collection). Total cPAHs based on the TEQ and total TCDD based on the TEQ were selected because both have extensive footprints above refined SLs. The results for soil are presented on Figure 7-7a and 7-7b and for sediment are presented on Figure 7-8a and 7-8b.

The overlap of total TCDD TEQ concentrations to wood debris in soil is greater than for total cPAH TEQ concentrations; however, the overall overlap with wood debris was similar. The overlap of wood debris over 50%, and 75% and total cPAH TEQ concentrations above 100 µg/kg (MTCA method A) was 58%, and 78%, respectively. The overlap of wood debris over 50% and 75% and total TCDD TEQ concentrations above 13 ng/kg (MTCA Method B cancer SL) was 75%, and 89%, respectively. The comparison of the overlap analysis for soil indicates a positive correlation between wood debris percentage and concentrations of total cPAH TEQ and total TCDD TEQ.

The overlap of total cPAH TEQ concentrations to wood debris in sediment is greater than for the total TCDD TEQ concentrations; however, the overall overlap with wood debris was similar. The overlap of wood debris over 50% and 75% and total cPAH TEQ concentrations above 0.21 µg/kg (100xNB) was 85% and 87%, respectively. The overlap of wood debris over 50% and 75% and total TCDD TEQ concentrations above 4 ng/kg (NB-based SL) was 83%, and 84%, respectively. The comparison of the overlap analysis for sediment indicates a positive correlation between wood debris percentage and concentrations of total cPAH TEQ and total TCDD TEQ.

7.7 Summary of Site Risks

A summary of the human health and ecological direct contact/bioaccumulation risks in soil and sediment is as follows. While risk is identified for some COCs above Ecology's risk thresholds, no interim actions are required, and the park can remain open for public use.

Soil

Human health: Arsenic, total cPAH TEQ, and total TCDD TEQ concentrations exceed applicable direct contact SLs and risk exceeds acceptable thresholds. Total cPAH based on the TEQ had the greatest SWAC EF with the maximum concentration in the top 2 ft of soil, collocated with the maximum arsenic soil concentration, near the observed slag piles. The maximum total TCDD TEQ concentration (SB-22 from 4 to 6 ft bgs) was located west of the former Mill.

Ecological: Copper, lead, zinc, and total TCDD TEQ concentrations exceed applicable direct contact/bioaccumulation SLs and risk exceeds acceptable thresholds. Lead had the greatest SWAC EF with the maximum concentration in the top 2 ft, collocated with the maximum copper and zinc concentrations, located near the center of the former Mill.

Sediment

Benthic: Multiple chemicals exceed their dw or OC normalized SCOs, but the bioassay results for the locations tested did not show toxicity. Some chemicals were identified as COCs where bioassay testing was not conducted. Overall, the bioassay results that passed indicate that surface sediment

at the Site is a healthy environment for the benthic community with one exception in the Mill Pond (location SG-05).

Human health (direct contact): Arsenic and total cPAHs TEQ concentrations exceed applicable direct contact (clamming and net fishing) SLs and risk exceeds acceptable thresholds. The greatest SWAC exceedance factor was for arsenic, with the maximum concentration in the top 2 ft of sediment near the observed slag piles. The maximum total cPAH TEQ concentration was located near the former western lumber shed at 0 to10 cm bml.

Human health and ecological seafood ingestion: Lead, total cPAH TEQs, and total TCDD TEQ concentrations exceed bioaccumulative NB-based SCOs. The greatest SWAC EF was for total cPAH based on the TEQ, with the maximum concentration near the former western lumber shed at 0 to 10 cm bml.

7.8 Uncertainty

Uncertainties are inherent in the RI based on assumptions that are often intentionally conservative to ensure protectiveness when evaluating site risks. This section discusses the uncertainties related to assumptions made in the RI process and how they could impact conclusions.

7.8.1 Historical Data

The RI dataset includes historical data collected within the past 10 years as well as samples collected during the RI (see Section 4). In collaboration with Ecology, data collected more than 10 years ago were excluded from the RI dataset for mapping the RI boundary and evaluating Site risks. While these older data may provide value when evaluating time trends, the older data were considered less reliable (e.g., higher detection limits, less field documentation).

7.8.2 Method Detection Limits

The MDLs/PQLs for the analytical methods of the RI dataset were compared to refined SLs. For sediment and soil (Table 5-9 and Table 5-10, respectively), the majority of MDLs/PQLs were below their respective refined SL or the FOE was less than 5%. For groundwater, some COPCs had high FOEs (COCs were not among them); specifically, benzo(a)pyrene (and total cPAH based on the TEQ), 4,6-dinitro-2-methylphenol, pentachlorophenol, and TCDD (and total TCDD based on the TEQ). When compared to the refined SLs, no MDLs/PQLs exceeded except for total cPAH based on the TEQ in one sample. Overall, the MDLs/PQLs did not impact the identification of COCs, development of the RI boundary, or characterization of Site risk.

7.8.3 Unrestricted Land Use Assumptions

Unrestricted (residential) land use-based SLs were used for identification of COCs, the RI boundary, and evaluation of Site risk. These unrestricted SLs overestimate calculated risk for exposure to soil and groundwater because they assume greater exposure than the current site use as a recreational area. Further, the groundwater SLs assume potable use, which is unlikely for the Site and surrounding area due to saline conditions. For sediment, the exposure assumptions for human health assume use of the Site for a majority of an individual's life (70 years), which is not the case because the Site is used for recreational purposes.

7.8.4 Assumptions for Bioaccumulative COCs in Sediment

Evaluation of the sediment bioaccumulation risk using NB- or PQL-based SCOs may be conservative for subsistence-level seafood consumption because it does not consider the variability of consumption patterns, age, food sources, etc. that are considered in a more quantitative food web model. Further, ambient conditions may result in sediment concentrations exceeding NB-based SLs. Therefore, identification of bioaccumulation COCs above acceptable risk thresholds based on NB- or PQL-based SLs could identify COCs that are associated with ambient conditions.

Shellfish and fish tissue data were not collected for direct evaluation of risk to human and ecological receptors. SLs based on Tribal user consumption of fish and shellfish from the Site were not developed and the NB-based SCOs were used for screening. The use of NB-based SCOs likely overestimates potential risk. Further, recreational consumption of fish and shellfish from the Site is likely less than Tribal consumption, which would result in overestimation of risk for recreational receptors.

Ecological receptors that could be exposed to COCs that bioaccumulate through the food web are also likely overestimated by comparison to NB- or PQL-based bioaccumulation SCOs. It is unlikely that the receptors obtain their entire diet from the Site and use of the bioaccumulative SCOs would overestimate risk to these receptors, especially if regional background is greater than natural background. In addition, NB-based SLs may under or overestimate risk for exposure to sediment due to other potential ambient non-point sources of contaminants (discussed in Section 7.1.1). For the purposes of the RI and to streamline evaluating the risks, NB-based SCOs are used for evaluating bioaccumulative risk, while recognizing there is some uncertainty.

7.8.5 Depth of Contamination

No exceedances of MTCA screening levels were detected in the deepest samples from soil borings, with the exception of location SB-22 at 12 ft bgs. Multiple analytes in the deepest soil samples were below the applicable MTCA values but were above the surface soil NB. The surrounding information from nearby borings was used to evaluate the depth of contamination in the area of SB-22, which was delineated in most of the upland soil borings.

The depth of contamination was fully delineated in 18 of 25 sediment cores. Exceedances of applicable sediment criteria were found in the deepest sample interval in the remaining seven cores, including three cores were driven to 10 ft target depth in the northern shoreline of the Inner Harbor, and four cores were not driven to the full planned depth (deepest sample at 4.4 ft bml) because of refusal (rocks or wood substructures). A list of exceedances at depth is reported in Table 7-11.

Soil, groundwater, and sediment media are considered delineated for purposes of the RI/FS. Additional sampling may be needed to more fully delineate the extent of exceedances at depth in soil and sediments at the Site as part of the future remedial design.

7.8.6 Consideration of Background

NB was used as the SMS bioaccumulative SCO during the risk screening to evaluate nature and extent of contamination for bioaccumulative COCs. The SMS rule also incorporates the concept of regional background (CSL) that considers concentrations of hazardous substance from regional

diffuse sources such as stormwater runoff and atmospheric deposition (Ecology, 2021) that contribute low levels of concentrations of hazardous substances to the Site. These ambient values provide context when evaluating concentrations of COCs at the Site and their risks. For sediment, the regional background is considered a CSL for bioaccumulative compounds and, if available, will be used to identify a sediment cleanup level (WAC 173-204-560[4]).

As discussed in Section 7.1.1, one example of regional inputs is the historical deposition of airborne arsenic and lead released from the former Asarco Smelter, upwind of the Site. For samples collected within the Blakely Harbor area, average arsenic concentrations ranged from 8.2 mg/kg in surface soil (2- to 6-inch bgs) with maximum values up to 30.7 and 32.5 mg/kg and average lead concentrations ranged from 45.4 mg/kg in surface soil (0 to 2 inches bgs) with maximum values up to 198 and 132 mg/kg (PgG and TeraStat, 2005). These results are above the MTCA Method A value of 20 mg/kg and NB value of 7 mg/kg for arsenic and above the NB value of 24 for lead.

7.8.7 Surface Water

The soil-to-groundwater pathway is not complete based on groundwater results, and therefore the groundwater-to-surface water pathway also is considered not complete. Moreover, sediment data screening and bioassay results suggest that risks related to aquatic receptors is low (see Section 6.3). Seeps are present along the shoreline (Figure 7-2), and the presence of some bacteria at the groundwater/surface water interface (seeps) can provide indications of water conditions Previous investigations at the Site observed the presence of Beggiatoa bacteria, a large sulfur-reducing bacteria that could have been associated with the multiple seeps located in the wood debris field along the northern shoreline of the Inner Harbor. Limited observations indicative of Beggiatoa bacteria were observed during the shoreline habitat survey (Appendix G). In addition, presence of Beggiatoa bacteria was not observed during the SPI/PV survey(Appendix F, Table 3-3 of Attachment F-1). Due to the incomplete pathway, low potential risk of Site COCs to surface water receptors, and lack of benthic toxicity, no further evaluation of surface water is necessary and cleanup standards for surface water will not be developed.

7.9 Conceptual Site Model Summary

The CSM is presented in Figure 7-1. Historical operations at the Site impacted soil and sediments within the RI boundary. The presence of fill in the subsurface reflects historical construction activities along the waterfront, conducted to expand the shoreline and accommodate the historical structures. Wood debris, bricks, pilings, and slag are remnants of former structures that were deposited or embedded within Site soil and sediment. However, timber pilings were not treated with creosote or hazardous preservatives containing PAH, and therefore, are not considered a potential source of contamination or a risk to human health and the environment. The historical activities have impacted soil in the upland and along the shoreline and sediment in the Inner Harbor, with a range of COCs including metals (arsenic, chromium, copper, lead, mercury, zinc), PAHs, and dioxins/furans.

Transport pathways can mobilize COCs from impacted areas and further distribute them in the upland, Mill Pond, and Harbor. Based on empirical groundwater data, transport of COCs from soil to groundwater is not a transport pathway at the Site.

Potential human health receptors include recreational and Tribal users of the Site for hiking and wildlife viewing in the upland area and wading, swimming, fishing, and shellfish harvesting in intertidal and/or subtidal sediment, who could be exposed to contaminants via direct contact or ingestion of media. Ecological terrestrial plant and invertebrate communities and herbivorous, omnivorous, and invertivores wildlife are receptors in the upland area that could be exposed to contaminated soil, while the benthic invertebrate community, fish, marine mammals, and aquatic-life dependent wildlife could interact with contaminated sediment.

A summary of the CSM finding for COCs that exceeded an acceptable threshold is provided in Table 7-12. The overlap of areas with COC concentrations exceeding risk thresholds, slag piles, and wood debris are shown on Figure 7-9.

8. PROPOSED CLEANUP STANDARDS

This section outlines proposed cleanup standards, which establish the basis for developing cleanup action requirements and evaluating remedial alternatives in the FS. Cleanup standards consist of two elements, the cleanup level (CUL) and the point of compliance (POC). The CUL is the concentrations of a hazardous substance in a particular media that is determined to be protective of human health and the environment under specified exposure conditions. The CUL is established by considering applicable or relevant and appropriate requirements (ARARs), risk-based screening levels, background, and PQLs. The POC is the point or points where CULs must be attained. POCs are established for each media where there is an exposure pathway. At this Site, the spatial scale is also important to which the cleanup level is applicable (i.e., intertidal area for protection of beach play scenarios).

The following sections identify potential chemical specific ARARs, if available, and proposed cleanup standards for soil and sediment.

Cleanup levels are developed for the following Site-related COCs with risk above acceptable thresholds and include the following:

- Soil: arsenic, copper, lead, zinc, total cPAH based on the TEQ, and total TCDD based on the TEQ
- Sediment: arsenic, lead, mercury, HPAHs, phenol, butyl benzyl phthalate, total cPAH based on the TEQ, and total TCDD based on the TEQ.

A statistical analysis was conducted to evaluate if a significant correlation existed among organic COCs identified in sediments. Results showed that a statistically significant moderate to very strong correlation exists between PAHs, phenol, butyl benzyl phthalate, and total cPAH based on the TEQ (Table 8-1). Therefore, total cPAH based on the TEQ and total HPAH were selected to represent this larger group of chemicals.

In addition to positive correlations among COC concentrations, the footprints of elevated concentrations also show overlap with higher concentrations located near historical Mill activities, and concentrations decrease moving away from this source area. This correlation will be further evaluated in the FS.

8.1 Soil Cleanup Standards

This section identifies CULs and POCs for Site COCs in soil. Each COC may have more than one CUL depending on the pathway it is designed to protect.

8.1.1 Preliminary Soil Cleanup Levels

At this Site, CULs for soil only need consider protection of direct contact; there are no impacts to groundwater and therefore the protection of groundwater as drinking water and the related protection of surface water and sediment as a result of groundwater migration are incomplete pathways. CULs considered risk-based SLs for protection of the direct contact pathway (for human health and ecological receptors) for the COCs that exceeded acceptable risk thresholds (Section 7.5). The CULs were adjusted to the maximum between the risk-based SL, NB (if available), or

additional considerations (see Section 8.1.3). The Selected CULs for soil COCs are presented in Table 8-2.

8.1.2 Points of Compliance for Soil

MTCA requires POCs for specific pathways/receptors, as follows.

- CULs based on human health – the POC is 0 to 15 ft bgs.
- CULs based on ecological receptors – the POC is 0 to 6 ft bgs.

8.1.3 Ecological Cleanup Level Considerations

Three COCs, copper, lead, and zinc, in soil exceeded an acceptable risk for ecological receptors. For these COCs, additional review was performed to evaluate the appropriateness of the SLs as the basis of the CULs.

Copper exceeded the SL for protection of soil biota (see Section 7.5) and was below SLs for protection of plants and wildlife. The soil-biota SL (50 mg/kg) was based on toxicity reference values (TRVs) from Efroymson et al. (1997a) and corresponds to a no-effect value for earthworm cocoon production. NOEC values are considered protective of all individuals (i.e., below the concentration where effects on a single receptor were noted) and is highly conservative as the management endpoint for ecological receptors is the community level. An updated literature review of soil-biota exposure to copper (EPA, 2007a) provides a more robust soil-invertebrate based risk-based threshold for copper. EPA (2007a) identified a SL protective of soil-biota communities at 80 mg/kg, which reflects the geometric mean of 10% effect concentrations (EC10) or maximum acceptable toxicant concentration from 10 studies capturing potential effects to six species. The soil SWAC (78.9 mg/kg) is below this SL indicating that effects at the community level are not anticipated; however, the soil-biota based SL for copper was selected as the CUL.

Lead and zinc exceeded SLs for plants and wildlife (see Section 7.5). Healthy flora is present across the Site based on field observations, especially along the perimeters where detected concentrations of both lead and zinc were above the plant based SL. The lead SL for plants is 50 mg/kg, and the zinc SL for plants is 86 mg/kg, both derived from Efroymson et al. (1997b). Efroymson et al. also specifically noted, "*If chemical concentrations reported in field soils that support vigorous and diverse plant communities exceed one or more of the benchmarks presented in this report or if a benchmark is exceeded by background soil concentrations, it is generally safe to assume that the benchmark is a poor measure of risk to the plant community at that site.*" Additionally, an updated literature review of plant exposure to lead (EPA, 2005) and zinc (EPA, 2007b) identified SLs protective of plant communities at 120 and 160 mg/kg for lead and zinc, respectively. The soil SWACs (177 and 166 mg/kg for lead and zinc, respectively) are in the range of these more recent SLs, and field observations support a robust plant community, therefore, plant community impacts are not anticipated. However, the plant-based SLs for lead and zinc were selected as the CUL.

8.2 Groundwater Cleanup Standards

CULs for groundwater consider protection of drinking water and protection of surface water and sediment. However, there were no COCs identified in groundwater (see Section 5.3) and the

migration to groundwater pathway is incomplete. Therefore, no cleanup standards were proposed for Site groundwater.

8.3 Sediment Cleanup Standards

Results of the RI showed that Site sediments contain COCs at concentrations that can pose a risk to human health and the environment. Therefore, establishing cleanup standards is required to protect these risks.

No proposed cleanup standard was developed for COCs that did not exceed acceptable risk thresholds or for other analytes that were not shown to be toxic. This section proposes CULs for sediment COCs (Section 7.9). and POCs for receptor-specific pathways.

8.3.1 Preliminary Sediment Cleanup Levels

As described in the SMS, the default CUL is set as the SCO, which is selected as the highest of the following three levels:

- The lowest risk-based concentration protective of benthic organisms, human health (direct contact, bioaccumulation, 10^{-5} risk), or ecological receptors (bioaccumulation);
- NB; or
- PQLs.

Sediment CULs are initially established at the SCO and may be adjusted up to, but no higher than the CSL. The CSL is established as the highest of one of the following:

- The lowest risk-based concentration protective of benthic organisms, human health (direct contact, bioaccumulation, 10^{-5} risk), or ecological receptors (bioaccumulation);
- Regional background, if it has been established; or
- PQLs.

Adjustment of the SCO to the CSL can occur based on an evaluation of technical possibility and net adverse environmental impact (WAC 173-204-560[2][a][ii]). The SCUM guidance (Ecology, 2021) details how to determine whether it is technically possible to attain the SCO based on site-specific factors, including, but not limited to, the ability to:

- Achieve the SCO using available cleanup technologies, and
- Maintain the SCO after cleanup construction

Site-wide CULs consider human and ecological receptors, benthic, direct contact, bioaccumulative exposure pathways, and spatial areas (intertidal, site-wide, subtidal). Sediment CULs for these receptors and COCs are listed in Table 8-3.

An evaluation of technical practicality can be conducted in the FS to determine if the SCO can be maintained after cleanup or if the CUL needs to be adjusted. This evaluation is based on considerations such as source control and ambient concentrations representative of ongoing diffuse

sources not associated with the Site history that cannot be reliably contained or managed. Additional adjustments of the proposed CULs, especially for PAHs, will be discussed in the FS.

8.3.2 Points of Compliance for Sediment

Sediment POCs address multiple exposure pathways and receptors based on the current or expected use of specific areas of the Site. Multiple POCs can be identified:

- Site-wide POC depth is 0 to 10 cm bml for Site-wide exposure pathways (benthic, human/ecological seafood consumption (bioaccumulative), human health direct contact net-fishing).
- Intertidal POC depth is the 0 to 45 cm bml for the human health beach play and clamming direct contact pathway.

The POC is established on a point-basis for benthic protection and an area SWAC-basis for protection of human and ecological health. The SMS says the CULs must be met at these depths after the restoration (natural recovery) time period (typically, 10 years after cleanup). Recovery time estimates will be evaluated in the FS.

9. RI CONCLUSIONS

This RI Report provides an analysis of Study Area data to define the nature and extent of contamination. It includes an analysis of physical, chemical, and biological data to determine the relevant transport and exposure pathways resulting in risks to human health and the environment. While the RI identifies risk above Ecology's stringent risk thresholds for some COCs, no interim actions are required, and the park can remain open for public use. This RI Report presents the CSM, which is a conceptual summary of sources, pathways, receptors, and risk and provides a foundational understanding of Site characteristics so that remedial alternatives can be developed in the FS. The RI collected sufficient soil, groundwater, and sediment data to evaluate alternatives in the FS.

10. REFERENCES

Associated Earth Sciences, Inc. (AESI). 2000. *Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report,* Oddfellows Short Plat, Bainbridge Island, Washington. July.

AESI. 2001. *Halls Hill Road Shoulder Failure – Bainbridge Island, Washington*. April.

Anchor Environmental LLC (Anchor). 2009. *Intertidal Sampling and Analysis Report Blakely Harbor Park.* Anchor Environmental, LLC. Prepared for City of Bainbridge Island. January.

Bailey, A., K. Ward, and T. Manning. 1993. *A Field Guide for Characterizing Habitats using A Marine and Estuarine Habitat Classification System for Washington State*. Washington Department of Natural Resources Division of Aquatic Lands.

Brown and Caldwell. 1958. *Metropolitan Seattle Sewerage and Drainage Survey*. March. https://books.google.com/books?id=TzQ3AQAAIAAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

Burgner, R.L., J.T. Light, L. Margolis, T. Okazaki, A. Tautz, and S. Ito, 1992. *Distribution and origins of steelhead trout (Oncorhynchus mykiss) in offshore waters of the North Pacific Ocean*. International North Pacific Fisheries Commission, Bulletin 51. 91 pp.

Carlsson, L.E. 1992. *Port Blakely Mills & Mill Town, Historic Buildings and Cultural Resources Survey.* Prepared for the Port Blakley Mill Company. On file at the Bainbridge Library, Office of Archaeology and Historic Preservation. April.

Cowardin, L.M., F.C. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States.* Report No. FWS/OBS-79/31. U.S. Fish and Wildlife Service.

Dethier, M.N. 1990. *A Marine and Estuarine Habitat Classification System for Washington State*. Washington Natural Heritage Program, Department of Natural Resources, Olympia.

U.S. Department of the Interior (DOI), 1999. *Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for Bull Trout in the Coterminous United States; Final Rule*. 64 FR No 210. November 1, 1999.

Ecological Land Service. 2021. *Wildlife Study, North Grand Forest Bainbridge Island, Washington*. Prepared for: Bainbridge Island Metropolitan Parks and Recreation District. April 30.

Efroymson, R. A., Will, M. E., and Suter II, G. W. 1997a. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision.* ES/ER/TM-126/R2. November.

Efroymson, R. A., Will, M. E., Suter II, G. W., and Wooten, A. C. 1997b. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision.* ES/ER/TM-85/R3. November.

Environmental Risk Information Services (ERIS). 2019a. *Fire Insurance Map Research Results.* April.

ERIS. 2019b. *Historical Aerial Report*. April.

Federal Register. 1992. *Determination of Threatened Status for the Washington, Oregon, and California Population of the Marbled Murrelet; Final Rule*. Federal Register Volume 57 Number 191. Pages 45328-45337. October 1.

GeoEngineers. 2019. *Surface Soil and Sediment Data Report*, Former Port Blakely Mill Site. Bainbridge Island, Washington. August.

Geosyntec Consultants, Inc. (Geosyntec). 2019. *Internal Memorandum: Creosote production on Bainbridge Island and potential association/non-association with Blakely Harbor*. May.

Geosyntec. 2020a. *Bathymetric and Lidar Survey Field Sampling Plan Blakely Harbor Park Site*. Prepared by Geosyntec Consultants, Inc. on behalf of Port Blakely Tree Farms for submittal to the Washington State Department of Ecology. September.

Geosyntec. 2020b. *Sediment Profile Imaging Field Sampling Plan Blakely Harbor Park Site*. Prepared by Geosyntec Consultants, Inc. on behalf of Port Blakely Tree Farms for submittal to the Washington State Department of Ecology. September.

Geosyntec. 2022. *Final Remedial Investigation/Feasibility Study Work Plan Blakely Harbor Park Site*. Prepared by Geosyntec Consultants, Inc. on behalf of Port Blakely Tree Farms for submittal to the Washington State Department of Ecology. January 31.

Geosyntec. 2023a. *Final Remedial Investigation/Feasibility Study Work Plan/ Sampling and Analysis Plan Addendum Blakely Harbor Park Site*. Prepared by Geosyntec Consultants, Inc. on behalf of Port Blakely Tree Farms for submittal to the Washington State Department of Ecology. April 19.

Geosyntec. 2023b. *Phase 2 Data Gaps Evaluation Memorandum*. Prepared by Geosyntec Consultants, Inc. on behalf of Port Blakely Tree Farms for submittal to the Washington State Department of Ecology. October 6.

Geosyntec. 2023c. *Field Change Request FCR-001*. Prepared by Geosyntec Consultants, Inc. on behalf of Port Blakely Tree Farms for submittal to the Washington State Department of Ecology. November 28.

Geosyntec. 2024. Soil, Groundwater, Surface and Subsurface Sediment Data Summary Tables (Tables 1, 2, 3a, 3b) for the Blakely Harbor Park Site. Prepared by Geosyntec Consultants, Inc. on behalf of Port Blakely Tree Farms for submittal to the Washington State Department of Ecology. March 21.

Germano & Associates, Inc. 2012. *2011 Long Term Benthic Monitoring and Bioaccumulation Survey in Sawmill Cove, AK.*

Herrera Environmental Consultants (Herrera). 2011. *Addendum to Summary of Science Report.* Prepared for City of Bainbridge Island Planning & Community Development. Prepared by Herrera. January.

Huppert, D.D., A. Moore, and K. Dyson. 2009. *Impacts of climate change on the coasts of Washington State.*

Kendall, D., and T. Michelsen. 1997. *Management of Wood Waste under Dredged Material Management Programs (DMMP) and the Sediment Management Standards (SMS) Cleanup Program*. Seattle District, ACOE, and Washington Department of Ecology.

Larson, L.L. and D.E. Lewarch. 1995. *The Archaeology of West Point, Seattle, Washington: 4,000 Years of Hunter-Fisher-Gatherer Land Use in the Puget Sound*. Volume 1, Part 1. Larson Anthropological/Archaeological Services, Seattle, Washington.

Leidos and NewFields. 2019. *Blakely Harbor Park Sediment Investigation,* Draft Data Report. Prepared for the Washington State Department of Ecology, Toxics Cleanup Program, Lacy, Washington. October.

Lewarch, D. 1995. State of Washington archaeological site form for 45KP110. Department of Archaeology and Historic Preservation, Olympia.

McPhail, J.D. and C.B. Murray, 1979. *The Early Life-history and Ecology of Dolly Varden (Salvelinus malma) in the upper Arrow Lakes.* University of British Columbia, Department of Zoology and Institute of Animal Resources, Vancouver, B.C.

Mote, P., A.K. Snover, S. Capalbo, S.D. Eigenbrode, P. Glick, L. Littell, R. Raymondi, and S. Reeder. 2014. Chapter 21: Northwest. Pages 487-513 in *Climate Change Impacts in the United States: The Third National Climate Assessment.* Melillo, J.M., T.C. Richmond, G.W. Yohe (eds). U.S. Global Change Research Program.

National Oceanic and Atmospheric Association (NOAA). 2009. *Descriptive Hydrographic Report – Approaches to Elliot Bay – Skiff Point to Alki Point, Washington*. April.

National Marine Fisheries Service (NMFS), 2005. *Status review update for Puget Sound Steelhead. Prepared by the 2005 Puget Sound Steelhead*. Biological Review Team, National Marine Fisheries Service, Northwest Fisheries Science Center. July 26, 2005. 112 pp.

Pacific Groundwater Group and TeraStat Inc, 2005. *Tacoma Smelter Plume Project Extended Footprint Study*. Prepared for the Washington State Department of Ecology, Olympia, WA. July.

Port Blakely Mill Company. 1917. Map: History of the Mill.

Port Blakely Mill Company. 2019. Port Blakely Mill Company Accession, company records. Manuscripts and Archives Division of the University of Washington Library. Reviewed site files in 2019. April and May.

Pratt, K.L., 1992. *A review of bull trout life history.* In: Howell, P.J.; Buchanan, D.B., eds. Proceedings of the Gearhart Mountain bull trout workshop. 1992 August; Gearhart Mountain, OR. Corvallis, OR: Oregon Chapter of the American Fisheries Society: 5-9.

Price, A. Jr. 1989. *Port Blakely, the Community Captain Renton Built.* Seattle, Washington. Port Blakely Books. Seattle, Washington. January.

Shannon & Wilson Inc. (Shannon & Wilson). 1991. *Project Status Report Environmental Site Assessment Old Blakey Mill Site,* Bainbridge Island, Washington. March.

Shannon & Wilson. 1992a. *Focused Environmental Site Assessment Report Old Mill Site*, Port Blakey Harbor Bainbridge Island, Washington. August.

Shannon & Wilson. 1992b. *Project Status Report II Environmental Site Assessment*, Old Port Blakely Mill Bainbridge Island, Washington. September.

Snover, A.K., G.S. Mauger, L.C. Whitely Binder, M. Krosby, and I. Tohver. 2013. *Climate change impacts and adaptation in Washington state: Technical summaries for decision makers*. State of Knowledge Report prepared for the Washington State Department of Ecology. Climate Impacts Group, University of Washington, Seattle, Washington. 130 p.

Suquamish Tribe. 2021. *History and Culture*. https://suquamish.nsn.us/home/about-us/history-culture/

United States Coast and Geodetic Survey. 1884. Map: Blakely Harbor.

United States Coast Survey. 1856. Map: Reconnaissance of Blakely Harbor, Washington.

EPA. *Ecological Soil Screening Levels for Lead Interim Final.* Office of Solid Waste and Emergency Response. OSWER Directive 9285.7-70. March.

EPA. 2007a. *Ecological Soil Screening Levels for Copper Interim Final*. Office of Solid Waste and Emergency Response. OSWER Directive 9285.7-68. February.

EPA. 2007b. *Ecological Soil Screening Levels for Zinc Interim Final*. Office of Solid Waste and Emergency Response. OSWER Directive 9285.7-73. June.

EPA. 2020a. *National Functional Guidelines for High Resolutions Superfund Methods Data Review,* EPA-542-R-20-007. November.

EPA. 2020b. *National Functional Guidelines for Inorganic Superfund Methods Data Review*, EPA 542-R-20-006. November.

EPA. 2020c. *National Functional Guidelines for Organic Superfund Methods Data Review,* EPA 540-R-20-005. November.

EPA. 2024. Environmental Justice Screening and Mapping Tool. https://www.epa.gov/ejscreen.

United States Geological Survey (USGS). 2005. *Preliminary Geologic Map of Bainbridge Island, Washington.* October.

U.S. Department of the Interior, Fish and Wildlife Service (USFWS). 1997. *Recovery Plan for the Threatened Marbled Murrelet (Brachyramphus marmoratus) in Washington, Oregon, and California*. U.S. Fish and Wildlife Service, Portland, Oregon. September 24.

USGS. 2011. *Conceptual model and Numerical Simulation of the Groundwater-Flow System of Bainbridge Island, Washington*. March.

Ecology. 2013a. *Sediment Management Standards.* Chapter 173-204 WAC. Publication No. 13-09-055. Revised February 2013. Effective September 2013.

Ecology. 2013b. Identifying, Assessing, and Remediating Wood Waste in Marine and Freshwater Environments. Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards, Chapter 173-204 WAC. Publication No. 09-09-044. September 2013.

Ecology, 2015a. *Evaluating the Human Health Toxicity of Carcinogenic PAHs (cPAHs) Using Toxicity Equivalency Factors (TEFs) Implementation Memorandum #10*. Publication No. 15-09-049. April 2015.

Ecology, 2015b. *Dioxins, Furans, and Dioxin-Like PCB Congeners: Addressing Non-Detects and Establishing PQLs for Ecological Risk Assessments in Upland Soil Implementation Memorandum #11*. Publication No. 15-09-048. July 2015.

Ecology, 2016. *Dioxins, Furans, and Dioxin-Like PCB Congeners: Ecological Risk Calculation Methodology for Upland Soil Implementation Memorandum No. 13*. Publication No. 16-09-044. July 2016.

Ecology. 2020c. Washington State Water Quality Atlas. https://fortress.wa.gov/ecy/waterqualityatlas/map.aspx

Ecology. 2021. *Sediment Cleanup User's Manual II (SCUM II) Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards*, Chapter 173-204 WAC. Revision 3. Washington State Department of Ecology, Toxics Cleanup Program, Olympia, WA. Publication No. 12-09-057. First Issued 1991. Re-issued March 2015. Revised December 2021.

Ecology. 2023. *Sustainable Remediation, Climate Change Resiliency and Green Remediation*, Publication 17-09-052. Revised January 2023.

Ecology. 2024. *Implementation Memo No. 25: Identifying Likely Vulnerable Populations and Overburdened Communities Under the Cleanup Regulations*. Publication 24-09-044. January.

Ecology and Port Blakely Tree Farms (Limited Partnership). 2020. Agreed Order No. DE 16944. Issued by the State of Washington, Department of Ecology. June 24.

Washington Department of Fish and Wildlife (WDFW). 2020. *WDFW Comments on Blakely Harbor Cleanup and Draft Agreed Order*. March.

Washington State Department of Health (DOH). 2022. Environmental Health Disparities Map (Version 2.0). July 28. https://fortress.wa.gov/doh/wtnibl/WTNIBL/

Washington Department of Natural Resources (WA DNR). 2017. *Eelgrass abundance and depth distribution on Bainbridge Island.* https://geodataservices.wdfw.wa.gov/hp/phs/. Updated June 2017.

Waterman, T., V. Hilvert, J. Miller, and Z. Zahir. 2001. *Puget Sound Geography*. Lushootseed Press: Federal Way, Washington.

TABLES

FIGURES

Table 1-1. Project Contact Information

Role	Name	Firm	Address	Phone	Email
Ecology Project Coordinator	Rachel McDermott	Washington State Department of Ecology Toxics Cleanup Program	300 Desmond Drive Lacey, Washington, 98504-7600	(564) 223-9481	rachel.mcdermott@ecy.wa.gov
Port Blakely Technical Advisor (Primary Project Consultant)	Anne Fitzpatrick, LHG WA	Geosyntec Consultants, Inc.	520 Pike Street, Suite 2600 Seattle, Washington, 98101	(206) 496-1461	afitzpatrick@geosyntec.com
Port Blakely Project Coordinator	Cindy Bartlett, LG WA	Geosyntec Consultants, Inc.	920 SW Sixth Avenue, Suite 600 Portland, Oregon, 97204	(503) 505-4145	cbartlett@geosyntec.com
President of US Forestry for Port Blakely Tree Farms	Mike Warjone	Port Blakely Tree Farms	8133 River Dr SE Olympia, Washington, 98501	(360) 596-9417	mwarjone@portblakely.com
Wildlife Biologist for Port Blakely Tree Farms	Hansen Leif	Port Blakely Tree Farms	--	--	lhansen@portblakely.com
Legal Counsel for Port Blakely Tree Farms	Lynn Tadlock Manolopoulos	Davis Wright Tremaine LLP	929 108th Avenue NE, Suite 1500, Bellevue Washington 98004	(425) 646-6146	lynnmanolopoulos@DWT.com
Property Owner	Dan Hamlin	Bainbridge Island Metro Park & Recreation District	11700 Meadowmeer Cir NE, Bainbridge Island, Washington, 98110	(206) -245-7385	dan@bipark.org

Acronyms:
-- = currently not available

Table 4-1. Site History and Timeline

Year(s)	Activity at Blakely Harbor Park
1863	First sawmill constructed on the Site with a capacity of 30,000 board feet per day (bd ft/day)[a]
1872-1885	Twice-daily steamship trips to Seattle via the steamship *Success*[b]
1881	Hall Brothers moved shipbuilding operations from Port Ludlow to the northeastern end of Blakely Harbor[a]
1882	The Mill significantly enlarged, and capacity increased to 200,000 bd ft/day[b]
1888	First sawmill burned down and expanded following a rebuild in the same year; capacity increased to 300,000 bd ft/day[a]
1903	Hall Brothers relocated their operations to Eagle Harbor[a]
	Port Blakely Mill Company, a California Corporation is sold to Skinner and Eddy[a]
1907	The Second sawmill capacity reached 500,000 bd ft/day before it burned down;[b] reports indicate that the plant was ~50% destroyed[a]
1909	Third sawmill constructed and capacity decreased to 300,000 bd ft/day[b]
1911	Northwest fisheries fleet began anchoring in Blakely Harbor during the offseason[b]
1916-1923	Port Blakely Mill Company leased the facility to the Dominion Mill Company[a]
1923	The Mill is closed;[a] property remained in the possession of the Port Blakely Mill Company
1924	The Mill is dismantled[a]
1924-1937	Nine daily auto service ferry trips to Seattle via the steamships *Liberty*, *Kitsap* and *Bainbridge*[b]
1942-1958	American Tug Boat stored logs on the south side of the harbor; duration of log storage is unknown, but log booms are visible in the 1951 aerial image of Blakely Harbor[c,d]
1943-1944	U.S. Army Transportation Corps anchored approximately 15 barges in Blakely Harbor; these were removed due to complaints from American Tug Boat Company[e]
1968	Three narrow structures of unknown origin protruded into the harbor from the northern spit as seen in an aerial photograph from 1968[f]
1986	Port Blakely Mill Company, a Washington Corporation, is converted to Port Blakely Tree Farms Limited Partnership to reflect the company's focus on forestry[g]
1990-1991	Shannon & Wilson initial sampling/reporting as part of an Environmental Site Assessment for Port Blakely Tree Farms[h]
1992	Shannon & Wilson follow up sampling/reporting as part of an Environmental Site Assessment for Port Blakely Tree Farms[i,j].
1999	Part of the Property is sold and transferred to BI Parks[g]
2001	Remainder of the Property is sold and transferred to BI Parks[g]
2008	Anchor Environmental sampling as part of a shoreline restoration investigation for the City of Bainbridge Island[k]
2019	Leidos and NewFields and GeoEngineers, on behalf of Ecology, conduct soil and sediment sampling to characterize historical sawmill impact[l,m]

Table 4-1. Site History and Timeline

Year(s)	Activity at Blakely Harbor Park
2020	Washington State Department of Ecology (Ecology) and Port Blakely Tree Farms (Limited Partnership) signed an Agreed Order[n]
2020-2024	Geosyntec Remedial Investigation[o,p]

Footnotes:

a. Banham, R. 2011. A True and Lasting Legacy The History of Port Blakely Companies and the Family Behind It. Georgia: Bookhouse Publishing.

b. Price, A. 1990. Port Blakely, The Community Captain Renton Built. Publisher Unknown.

c. University of Washington. 2019a. Numerous Correspondence Letters between Port Blakely Mill Co. and American Tug Boat Company in 1942 and 1943. University of Washington Archives for Port Blakely.

d. University of Washington. 2019b. Port Blakely Mill Company letter to District Engineer of the U.S. Engineers Office, November 12, 1943.

e. University of Washington. 2019c. Newman, A.F. Major, Transportation Corps. Letter to James G. Eddy of Port Blakely Mill Co. June 5, 1944.

f. ERIS. 2019a. U.S. Geological Survey, 1968. Aerial Photograph of Port Blakely Harbor Port Blakely Harbor WA. Approx. Center: 47.59441 / -122.5099. Scale 1 inch to 1000 feet.

g. ERIS. 2019b. First American Title Insurance Company, 2019. Recorded Document Guarantee. Guarantee Number 5002800-0001133e. February 5.

h. Shannon & Wilson Inc. 1991. Project Status Report, Environmental Site Assessment, Old Blakey Mill Site, Bainbridge Island, Washington. March.

i. Shannon & Wilson, Inc.1992a. Focused Environmental Site Assessment Report, Old Mill Site, Port Blakey Harbor, Bainbridge Island, Washington. August.

j. Shannon & Wilson, Inc.1992b. Project Status Report II, Environmental Site Assessment, Old Port Blakely Mill, Bainbridge Island, Washington. September.

k. Anchor Environmental, LLC. 2009. Intertidal Sampling and Analysis Report, Blakely Harbor Park. Data was collected in 2008 and reported in 2009. Prepared for City of Bainbridge Island. January.

l. GeoEngineers. 2019. Surface Soil and Sediment Data Report. Former Port Blakely Mill Site, Bainbridge Island, Washington. Prepared for Washington State Department of Ecology. August.

m. Leidos and NewFields. 2019. Blakely Harbor Park Sediment Investigation, Final Data Report. Prepared for Washington State Department of Ecology, Toxics Cleanup Program. October.

n. Washington State Department of Ecology (Ecology) and Port Blakely Tree Farms (Limited Partnership). 2020. Agreed Order No. DE 16944. Issued by the State of Washington, Department of Ecology. June 24.

o. Geosyntec Consultants, Inc. 2022. Final Remedial Investigation/Feasibility Study Work Plan, Blakely Harbor Park Site. Prepared by Geosyntec Consultants, Inc. on behalf of Port Blakely Tree Farms for submittal to the Washington State Department of Ecology. January 31.

p. Geosyntec Consultants, Inc. 2023. Final Remedial Investigation/Feasibility Study Work Plan/ Sampling and Analysis Plan Addendum, Blakely Harbor Park Site. Prepared by Geosyntec Consultants, Inc. on behalf of Port Blakely Tree Farms for submittal to the Washington State Department of Ecology. April 19.

Table 4-2. Summary of RI Field Activities

Date	Study Element	Data Quality Objective
Phase 1 Investigations		
2020	Bathymetric Survey	Map elevations and water depths
2020	Sediment Profile Imaging and Plan View Survey	Determine condition (physical and biological characteristics) of surface sediment substrate
2021	Shoreline Structures and Habitat Survey	Evaluate physical (presence of seeps and structures), seeps, and biological (habitat distribution) shoreline condition
2021	Soft Sediment Probing and Wood Debris Survey	Using divers, evaluate sediment substrate conditions, in particular extent of wood debris
2021	Timber Pile Survey and Sampling	Evaluate if timber pilings in the Study Area were treated with creosote
2021	Surface Sediment Sampling	Define horizontal extent of concentrations of constituents of potential concern in surface sediment
2021	Bioassay Testing of Surface Sediment	Assess potential toxicity (chronic and acute) of benthic environments in surface sediment
2021	Sediment coring	Define vertical extent of concentrations of constituents of potential concern in sediment
2021	Surface and Subsurface Soil Sampling	Define extent of concentrations of COPCs in upland soil
2021	Groundwater Sampling	Evaluate presence of COPCs in groundwater along the shoreline in temporary wells
Phase 2 Investigations		
2022	Slag Survey	Evaluate visual extent of foundry slag debris along the shoreline
2022	Surface Sediment Sampling and Sediment Coring	Fill Phase 1 RI data gaps and refine extent of concentrations of COPCs in surface sediment
2022	Bioassay Testing of Surface Sediment	Assess potential benthic toxicity of surface sediment in samples with wood debris and/or preliminary SL exceedances
2022	Surface and Subsurface Soil Sampling	Fill Phase 1 RI data gaps and refine extent of concentrations of COPCs in upland soil
2022	Quarterly Groundwater Sampling	Install permanent wells to confirm Phase 1 results, collect 4 rounds of samples to assess potential seasonal COPC variability in groundwater
Phase 3 Investigations		
2023	Surface Sediment Sampling	Fill Phase 2 RI data gaps and refine horizontal extent of concentrations of constituents of potential concern in surface sediment
2023	Surface Soil Sampling	Fill Phase 2 RI data gaps and refine horizontal extent of concentrations of constituents of potential concern in upland soil

Acronyms:
COPC = chemical of potential concern; RI =remedial investigation; SL = screening level

Table 4-3. RI Sample Locations and Dates Sampled

Area of Investigation	Date Sampled[a]	Location ID	Confirmed Coordinates[b]		Elevation[c] (ft)	Water Depth[d] (ft)
			Northing	Easting		
Hand Auger Soil Sampling Locations						
North Upland	8/19/2021	HA-01	222458	1224824	17.3	--
South Upland	8/20/2021	HA-02	221689	1225034	--	--
South Upland	8/20/2021	HA-03	221796	1225073	10	--
North Upland	8/20/2021	HA-04	222491	1225269	14	--
North Upland	8/19/2021	HA-05	222197	1225248	11	--
North Upland	8/19/2021	HA-06	222207	1225341	11	--
North Upland	8/24/2021	HA-07	222652	1225412	23	--
North Upland	8/24/2021	HA-08	222364	1225405	11	--
North Upland	8/24/2021	HA-09	222339	1225549	14	--
North Upland	8/24/2021	HA-10	222242	1225661	11	--
North Upland	8/23/2021	HA-11	222561	1225712	--	--
North Upland	8/23/2021	HA-12	222546	1225726	--	--
North Upland	8/23/2021	HA-13	222246	1225832	6	--
North Upland	8/23/2021	HA-14	222308	1225851	19	--
North Upland	8/23/2021	HA-15	222242	1225958	3	--
North Upland	8/23/2021	HA-16	222393	1226041	--	--
North Upland	9/14/2022	HA-31	222609	1224850	28	--
North Upland	9/14/2022	HA-32	222683	1225101	44	--
North Upland	9/15/2022	HA-33	222757	1225564	45	--
North Upland	9/14/2022	HA-34	222661	1225850	45	--
North Upland	9/13/2022	HA-35	222425	1226077	31	--
South Upland	9/13/2022	HA-36	221741	1224871	16	--
South Upland	9/13/2022	HA-37	221720	1225109	15	--
South Upland	10/6/2022	HA-38	223002	1224709	173	--
North Upland	10/6/2022	HA-39	223009	1225161	154	--
North Upland	10/6/2022	HA-40	222978	1225493	119	--
North Upland	10/6/2022	HA-41	222949	1225723	105	--
South Upland	10/6/2022	HA-42	221757	1224585	21	--
South Upland	10/6/2022	HA-43	221693	1224765	23	--
South Upland	9/13/2022	HA-48	222188	1224513	19	--
North Upland	12/13/2023	HA-44	222712	1225987	125	-
North Upland	12/14/2023	HA-45	222431	1225882	36	-
South Upland	12/14/2023	HA-46	221723	1224997	--	-
South Upland	12/13/2023	HA-47	221427	1225203	49	-
North Upland	12/14/2023	HA-49	222352	1226056	20	-
North Upland	12/14/2023	HA-50b	222454	1226273	43	-
North Upland	12/14/2023	HA-51	222515	1226038	49	-
North Upland	12/13/2023	HA-52	223062	1225755	164	-

Table 4-3. RI Sample Locations and Dates Sampled

Area of Investigation	Date Sampled[a]	Location ID	Confirmed Coordinates[b]		Elevation[c] (ft)	Water Depth[d] (ft)
			Northing	Easting		
Soil Boring and Groundwater Sampling Locations [e]						
North Upland	9/15/2021	SB/GW-17	222226	1225173	13	--
North Upland	9/14/2021	SB/GW-18	222101	1225217	15	--
North Upland	9/14/2021	SB/GW-19	222147	1225398	8.4	--
North Upland	9/13/2021	SB/GW-20	222236	1225535	11.4	--
North Upland	9/13/2021	SB/GW-21	222220	1225739	9.7	--
North Upland	9/15/2021	SB-22	222340	1225290	11.5	--
North Upland	9/15/2021	SB-23	222452	1225410	15.7	--
North Upland	10/7/2022	SB/GW-24	222379	1225313	10	--
North Upland	10/7/2022	SB/GW-26	222227	1225397	11	--
North Upland	10/7/2022	SB/GW-27	222253	1225730	9.8	--
North Upland	10/7/2022	SB/GW-29	222432	1225439	14.5	--
North Upland	9/29/2022	SB-25	222155	1225227	10.8	--
North Upland	9/28/2022	SB-28	222469	1225308	13.2	--
North Upland	9/30/2022	SB-30	222252	1225612	9.0	--
South Upland	10/3/2022	SB-38	221838	1225127	10.4	--

Table 4-3. RI Sample Locations and Dates Sampled

Area of Investigation	Date Sampled[a]	Location ID	Confirmed Coordinates[b]		Elevation[c] (ft)	Water Depth[d] (ft)
			Northing	Easting		
Surface Sediment Grab Sampling Locations						
Mill Pond	8/23/2021	SG-01	222388	1224525	--	--
Mill Pond	8/24/2021	SG-02	222355	1224643	--	--
Mill Pond	8/27/2021	SG-03	221871	1224896	2.0	7.0
Mill Pond	8/27/2021	SG-04	222048	1224897	2.8	5.7
Mill Pond	8/26/2021	SG-05	222223	1224969	3.4	6.1
Mill Pond	8/23/2021	SG-06	222479	1225127	--	--
Inner Harbor	8/24/2021	SG-08	221732	1225188	--	--
Inner Harbor	8/24/2021	SG-09	221877	1225162	--	--
Inner Harbor	8/24/2021	SG-10	222006	1225209	--	--
Inner Harbor	8/24/2021	SG-11	222057	1225312	--	--
Inner Harbor	8/23/2021	SG-13	221788	1225354	0.73	7.3
Inner Harbor	8/24/2021	SG-15	221918	1225369	0	5.6
Inner Harbor	8/25/2021	SG-18	221689	1225571	-2	10.9
Inner Harbor	8/25/2021	SG-19	221664	1225750	-1	9.6
Inner Harbor	8/25/2021	SG-22	221891	1225785	-14	16.5
Inner Harbor	8/23/2021	SG-23	222082	1225890	-11	12.5
Inner Harbor	8/25/2021	SG-25	222219	1226009	--	--
Inner Harbor	8/25/2021	SG-26	221764	1225909	-3	4.6
Inner Harbor	8/25/2021	SG-27	221852	1225942	-22	26.8
Outer Harbor	8/25/2021	SG-28	221533	1226124	-21	25.5
Outer Harbor	8/25/2021	SG-30	221593	1226335	-32	37.8
Outer Harbor	8/26/2021	SG-31	221731	1226341	-27	31.4
Outer Harbor	8/25/2021	SG-33	222106	1226405	-4	11.9
Outer Harbor	8/24/2021	SG-35	221930	1226728	-34	33.8
Outer Harbor	8/24/2021	SG-36	222090	1226742	-11	12.8
Outer Harbor	8/26/2021	SG-37	221838	1226943	-39	43.2
Outer Harbor	8/24/2021	SG-39	222155	1226936	-2	5.0
Outer Harbor	8/24/2021	SG-41	222110	1227197	-17	21.5
Outer Harbor	8/24/2021	SG-42	221900	1227426	-44	51.0
Creek	9/22/2022	SG-43	222425	1224283	--	8.2
Creek	9/22/2022	SG-44	222410	1224358	--	7.4
Creek	9/22/2022	SG-45	222406	1224456	--	6.1
Mill Pond	10/13/2022	SG-46	222254	1224903	3.6	6.5
Mill Pond	10/13/2022	SG-47	222255	1225029	3.2	6.0
Mill Pond	10/13/2022	SG-48	222187	1224961	2.9	5.3
Inner Harbor	9/22/2022	SG-10A	222017	1225209	--	7.3
Inner Harbor	9/22/2022	SG-11A	222053	1225303	--	4.2
Inner Harbor	10/12/2022	SG-49	221906	1225324	-0.1	7.2
Outer Harbor	10/11/2022	SG-53	222176	1227507	-3.1	11.8
Outer Harbor	10/13/2022	SG-54	221999	1227685	-37.2	43.5
Outer Harbor	10/13/2022	SG-55	222189	1227774	-5.8	12.3
Outer Harbor	12/14/2023	SG-56	222039	1227975	-25.1	36.1
Outer Harbor	12/14/2023	SG-57	221891	1227831	-46.8	56.8

Table 4-3. RI Sample Locations and Dates Sampled

Area of Investigation	Date Sampled[a]	Location ID	Confirmed Coordinates[b]		Elevation[c] (ft)	Water Depth[d] (ft)
			Northing	Easting		
Sediment Core Sampling Locations						
Mill Pond	9/21/2021	SC-03	221871	1224890	4	1.7
Mill Pond	9/20/2021	SC-04	222054	1224906	2	8.2
Mill Pond	9/21/2021	SC-05	222221	1224950	2	4.5
Mill Pond	9/21/2021	SC-07	222282	1225064	2	6.5
Inner Harbor	9/16/2021	SC-12	222008	1225459	-3	11.7
Inner Harbor	9/16/2021	SC-14	221842	1225461	-1	11.4
Inner Harbor	--	SC-16	--	--	--	--
Inner Harbor	--	SC-17	--	--	--	--
Inner Harbor	9/14/2021	SC-20	221745	1225735	0	10.2
Inner Harbor	9/17/2021	SC-21	221840	1225835	-16	16.4
Inner Harbor	9/14/2021	SC-24	222127	1225944	-6	15.8
Inner Harbor	9/15/2021	SC-26	221744	1225922	-13	16.9
Inner Harbor	9/15/2021	SC-27	221868	1225942	-23	33.2
Outer Harbor	9/16/2021	SC-29	221642	1226135	-26	27.9
Outer Harbor	9/16/2021	SC-32	221923	1226347	-28	32.3
Outer Harbor	9/17/2021	SC-34	222037	1226545	-19	21.0
Outer Harbor	9/13/2021	SC-37	221832	1226943	-40	48.1
Outer Harbor	9/14/2021	SC-38	222032	1226932	-31	37.1
Outer Harbor	9/13/2021	SC-40	221934	1227140	-42	50.7
Inner Harbor	10/5/2022	SC-10A	222027	1225210	7.3	--
Inner Harbor	10/5/2022	SC-11A	222056	1225302	4.2	--
Inner Harbor	10/5/2022	SC-17	222221	1225760	9.0	--
Inner Harbor	10/11/2022	SC-49	221903	1225325	0.04	8.2
Inner Harbor	10/10/2022	SC-51	221988	1225927	-24.3	27.1
Inner Harbor	10/11/2022	SC-52	222088	1226107	-7.3	12.1
Outer Harbor	10/11/2022	SC-53	222180	1227510	-4.1	12.8
Outer Harbor	10/12/2022	SC-54	221999	1227685	-37.6	45.6

Footnotes:

a. Groundwater samples were collected on different dates.
b. Coordinates are reported in feet in the Washington State Plane North, NAVD1983 Datum.
c. Elevation NAVD1983 Datum for upland locations and Mean Lower Low Water for in water locations.
d. Water depth measurements were approximate.
e. Groundwater samples were collected quarterly over a one-year period at monitoring wells SB/GW-24, -26, -27, and -29.

Acronyms:

-- = not recorded; - = not applicable; Comp = Composite; ft = feet; GW = Groundwater; HA = hand auger; ID = identification; PS = Pile Scrape; SB = Sediment Boring; SC = Sediment Coring; SG = Sediment Grabs

Table 4-4. Remedial Investigation Analytical Sample Count

Media	Sampling Location Type	No. Sampling Locations	No. Primary Samples	No. Field Duplicates	No. Rinsate Blanks	No. Total Samples
Soil	Hand Auger	39	73	10	3	188
	Soil Boring	15	94	11	2	
Groundwater	Temporary Wells	5	5	1	1	26
	Monitoring Wells	4	16	4	4	
Sediment	Surface Sediment	43	43	5	3	148
	Sediment Cores	25	91	9	4	

Notes:
1. Number of sampling locations includes locations were samples were collected successfully.
2. Number of field duplicates does not include other quality control samples like mass spike or mass spike duplicates or replicate samples.
3. Number of total samples includes primary and field duplicate samples collected for each media investigated.

Table 5-1. Refined Screening Level Selection: Soil

COPC[a]	Preliminary SL	Refined SL	Basis[b]	Human Health Direct Contact[c]				MTCA Terrestrial TEE T749			Adjustments				
				Method A Unrestricted	Method A Industrial	Method B Cancer	Method B Noncancer	Soil Biota	Plants	Wildlife	Natural Background	Puget Sound Background	Average PQL[d]	Median PQL[d]	QAPP PQL[d]
Metals (mg/kg)															
Arsenic	7	7	Natural Background/	20	20	0.67	24	--	--	7	7	7	0.50	0.25	0.20
Cadmium	1	4	Eco - Plants	2*	2*	--	80	20	4	14	1	1	0.28	0.12	0.10
Chromium	48	48	Natural Background	--	--	--	--	42	42	67	42	48	2.0	1.4	0.5
Chromium (III)	2000	120,000	MTCA Method B NC	2000*	2000*	--	120000	--	--	--	--	--	2.0	1.4	0.5
Chromium (IV)	0.00089	1.4	PQL	19*	19*	0.38	240	--	--	--	--	--	1.4	0.6	
Copper	36	50	Eco - Soil Biota	--	--	--	3200	50	100	217	36	36	1.2	0.6	0.5
Lead	50	50	Eco - Plants	250	1000	--	--	500	50	118	17	24	0.36	0.13	0.10
Mercury	0.07	0.1	Eco - Soil Biota	2*	2*	--	--	0.1	0.3	5.5	0.07	0.07	0.030	0.027	0.025
Zinc	85	86	Eco - Plants	--	--	--	24000	200	86	360	86	85	17	8	4
Petroleum Hydrocarbons (mg/kg)															
Diesel Range Organics (DRO)	200	200	Eco - Soil Biota	2000	2000	--	--	200	--	2,000	--	--	15.6	6.16	--
Lube Oil	200	200	Eco - Soil Biota	--	--	--	--	--	--	--	--	--	31.8	12.4	--
Polycyclic Aromatic Hydrocarbons (µg/kg)															
1-Methylnaphthalene	4.2	34,000	MTCA Method B C	--	--	34,000	5,600,000	--	--	--	--	--	13	5	5
2-Methylnaphthalene	88	320,000	MTCA Method B NC	--	--	--	320,000	--	--	--	--	--	26	20	20
Acenaphthene	160	4,800,000	MTCA Method B NC	--	--	--	4,800,000	--	--	--	--	--	13	5	5
Anthracene	2400	24,000,000	MTCA Method B NC	--	--	--	24,000,000	--	--	--	--	--	16	5	5
Fluorene	80	30,000	Eco - Soil Biota	--	--	--	3,200,000	30,000	--	--	--	--	13	5	5
Naphthalene	240	1,600,000	MTCA Method B NC	5,000*	5,000*	--	1,600,000	--	--	--	--	--	15	5	5
Benzo(a)anthracene	0.057	--	See Total cPAHs TEQ	--	--	--	--	--	--	--	--	--	19	5	5
Benzo(a)pyrene	0.016	100	Method A Res	100	2,000	190	24,000	--	--	12,000	--	--	16	7	5
Benzo(b)fluoranthene	0.096	--	See Total cPAHs TEQ	--	--	--	--	--	--	--	--	--	13	5	5
Benzo(k)fluoranthene	0.94	--	See Total cPAHs TEQ	--	--	--	--	--	--	--	--	--	15	5	5
beta-chloronaphthalene	280	6,400,000	MTCA Method B NC	--	--	--	6,400,000	--	--	--	--	--	25	20	20
Chrysene	2.9	--	See Total cPAHs TEQ	--	--	--	--	--	--	--	--	--	16	5	5
Dibenzo(a,h)anthracene	0.029	--	See Total cPAHs TEQ	--	--	--	--	--	--	--	--	--	16	7	5
Fluoranthene	300	3,200,000	MTCA Method B NC	--	--	--	3,200,000	--	--	--	--	--	16	5	5
Indeno(1,2,3-c,d)pyrene	0.31	--	See Total cPAHs TEQ	--	--	--	--	--	--	--	--	--	19	5	5
Pyrene	550	2,400,000	MTCA Method B NC	--	--	--	2,400,000	--	--	--	--	--	16	5	5
Dibenzofuran	76	80,000	MTCA Method B NC	--	--	--	80,000	--	--	--	--	--	24	20	20
Total cPAHs TEQ (ND = 0)[e]	0.016	100	Method A Res	100	2,000	190	--	--	--	--	--	--	16	7	5
Total cPAHs TEQ (ND = 1/2 MDL/PQL)[e]	0.016	100	Method A Res	100	2,000	190	--	--	--	--	--	--	16	7	5
Phenols (µg/kg)															
2,4,5-Trichlorophenol	1100	4,000	Eco - Plants	--	--	--	8,000,000	9,000	4,000	--	--	--	127	100	100
2,4,6-Trichlorophenol	0.19	10,000	Eco - Soil Biota	--	--	91,000	80,000	10,000	--	--	--	--	127	100	100
2,4-Dichlorophenol	4.3	240,000	MTCA Method B NC	--	--	--	240,000	--	--	--	--	--	127	100	100
2,4-Dimethylphenol	76	1,600,000	MTCA Method B NC	--	--	--	1,600,000	--	--	--	--	--	127	100	100
2,4-Dinitrophenol	9.2	20,000	Eco - Plants	--	--	--	160,000	--	20,000	--	--	--	254	200	200
2-Chlorophenol	11	400,000	MTCA Method B NC	--	--	--	400,000	--	--	--	--	--	25	20	20
2-Methylphenol (o-Cresol)	470	4,000,000	MTCA Method B NC	--	--	--	4,000,000	--	--	--	--	--	32	20	20
4,6-Dinitro-2-methylphenol	1.3	6,400	MTCA Method B NC	--	--	--	6,400	--	--	--	--	--	254	200	200
4-Chloro-3-Methylphenol	28	8,000,000	MTCA Method B NC	--	--	--	8,000,000	--	--	--	--	--	127	100	100
4-Methylphenol (p-Cresol)	940	8,000,000	MTCA Method B NC	--	--	--	8,000,000	--	--	--	--	--	32	20	20
Phenol	2300	30,000	Eco - Soil Biota	--	--	--	24,000,000	30,000	70,000	--	--	--	25	20	20
Pentachlorophenol	0.0018	2,500	MTCA Method B C	--	--	2,500	400,000	6,000	3,000	4,500	--	--	127	100	100

Table 5-1. Refined Screening Level Selection: Soil

COPC[a]	Preliminary SL	Refined SL	Basis[b]	Human Health Direct Contact[c]				MTCA Terrestrial TEE T749			Adjustments				
				Method A Unrestricted	Method A Industrial	Method B Cancer	Method B Noncancer	Soil Biota	Plants	Wildlife	Natural Background	Puget Sound Background	Average PQL[d]	Median PQL[d]	QAPP PQL[d]
Phthalates (µg/kg)															
bis(2-Ethylhexyl)phthalate	5.1	71,000	MTCA Method B C	--	--	71,000	1,600,000	--	--	--	--	--	80	50	50
Butylbenzyl phthalate	0.18	530,000	MTCA Method B C	--	--	530,000	16,000,000	--	--	--	--	--	25	20	20
Diethyl phthalate	74	100,000	Eco - Plants	--	--	--	64,000,000	--	100,000	--	--	--	63	50	20
Dimethyl phthalate	190	200,000	Eco - Soil Biota	--	--	--	--	200,000	--	--	--	--	25	20	20
Di-n-butyl phthalate	15	200,000	Eco - Plants	--	--	--	8,000,000	--	200,000	--	--	--	32	20	20
Di-n-octyl phthalate	23000	800,000	MTCA Method B NC	--	--	--	800,000	--	--	--	--	--	25	20	20
Dioxins and Furans (ng/kg)															
2,3,7,8 Tetrachlorodibenzodioxin (TCDD)	0.0013	13	MTCA Method B C	--	--	13	93	--	--	--	--	--	0.99	0.74	0.80
1,2,3,4,7,8 Hexachlorodibenzodioxin (HxCDD)	9.8	160	MTCA Method B C	--	--	160	--	--	--	--	--	--	4.45	2.4	2.5
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=0)[f]	5.2	5.2	Natural Background	--	--	13	93	--	--	--	5.2	--	0.99	0.74	0.80
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=1/2 MDL/PQL	5.2	5.2	Natural Background	--	--	13	93	--	--	3.15	5.2	--	0.99	0.74	0.80

Footnotes:

a. Preliminary COPCs were identified on the basis of previous detections above preliminary SLs and site use (Geosyntec, 2022; Geosyntec, 2023).

b. SLs based on the migration to groundwater pathway were not considered in the refined SL selection because the migration to groundwater pathway and migration to groundwater and then surface water pathway are determined to be incomplete due to no detections of COPCs or no exceedances of SLs in groundwater. One exception is TCDD TEQ with detections of TCDD TEQ greater than the preliminary screening level. However, the soil SL for TCDD TEQ is based on natural background.

c. The basis of the selected refined SL was the maximum between representative background, the minimum human health direct contact risk-based value, and the average PQL. The sources of the refined SLs include:
Background . Natural Background Soil Metals Concentrations in Washington State, Puget Sound 90th percentile (Ecology, 1994) and Natural Background for Dioxins/Furans in Washington State Soils (Ecology, 2010).
Human Health risk-based values . Washington State Department of Ecology. Cleanup Levels and Risk Calculation (CLARC) Tables (Ecology, 2024)
Ecological risk-based values were referenced from the Model Toxics Control Act (MTCA) Regulation, Chapter 173.340 WAC Table 749.3.

d. PQLs represent the average and median of practical quantitation limits/method detection limits provided by the analytical laboratories for the Phase 1,2,3 remedial investigation soil samples. The PQLs presented in the QAPP (Geosyntec, 2022) are also presented for context. The PQL considered for selection as the refined SL was the average PQL.

e. The petroleum hydrocarbon screening levels apply to the summation of DRO and lube oil.

e. SLs for benzo(a)pyrene are listed for selection of cPAH TEQs refined screening level based on Ecology guidance (Ecology, 2015)

f. SLs for 2,3,7,8 Tetrachlorodibenzodioxin are listed for selection of TCDD TEQs refined SLs based on Ecology guidance (Ecology, 2016)

Acronyms:

-- = not applicable or not available
C = cancer
CAS = chemical abstract service
COPC = chemical of potential concern
COC = chemical of concern
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
NC = noncancer
ND = no detection
ng/kg = nanograms per kilogram
PQL = practical quantitation limit
SL = screening level
TCDD = 2,3,7,8 Tetrachlorodibenzodioxin
TEE = Terrestrial Ecological Evaluation
TEQ = toxicity equivalent
WAC = Washington Administrative Code

References:

Washington Department of Ecology (Ecology). 1994. Natural Background Soil Metals Concentrations in Washington State. Toxics Cleanup Program. Publication #94-115. October.
Ecology. 2010. Technical Memorandum #8 Natural Background for Dioxins/Furans in WA Soils. Toxics Cleanup Program. Publication #10-09-053. August.
Ecology. 2015. *Implementation Memorandum #10: Evaluating the Human Health Toxicity of Carcinogenic PAHs (cPAHs) using Toxicity Equivalency Factors (TEFs)* . Toxics Cleanup Program. Publication # 15-09-049. April.
Ecology. 2016. *Implementation Memorandum #13: Dioxins, Furans, and Dioxin-Like PCB Congeners: Ecological Risk Calculation Methodology for Upland Soil* . Toxics Cleanup Program. Publication # 16-09-044. July.
Ecology. 2024. Cleanup Levels and Risk Calculation Tables. February update. Available at: https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/clarc/data-tables.
Geosyntec Consultants, Inc. (Geosyntec). 2022. *Final Remedial Investigation/Feasibility Study Work Plan Blakely Harbor Park Site* . January.
Geosyntec. 2023. *Final Remedial Investigation/Feasibility Study Work Plan/Sampling and Analysis Plan Addendum* . April.

Table 5-2. Refined Screening Level Selection: Groundwater

COPC[a]	Preliminary SL	Refined SL	Basis[b]	Protection of Human Health and Beneficial Use			Drinking Water Maximum Contaminant Level			Adjustments (May 2024)			
				Method A	Method B Cancer	Method B Noncancer	MCL Goal (MCLG)	Federal MCL	State MCL	Natural Background	Average PQL[c]	Median PQL[c]	QAPP PQL[c]
Metals Total and Dissolved (µg/L)													
Arsenic	8	10	Federal/State MCL	5	0.058	4.8	0	10	10	8	3.1	4.0	0.2
Cadmium	5	5	MTCA Method A/MCL	5	--	8	5	5	5	--	1.5	2.0	0.1
Chromium	50	100	Federal/State MCL	50	--	--	100	100	100	--	6.8	5.0	0.5
Copper	640	1,300	Federal/State MCL	--	--	640	1,300	1,300	1,300	--	7.8	10.0	0.5
Lead	15	15	MTCA Method A/MCL	15	--	--	0	15	15	--	1.7	2.0	0.1
Mercury	2	2	MTCA Method A/MCL	2	--	--	2	2	2	--	0.1	0.1	0.1
Zinc	4800	4,800	MTCA Method B-NC	--	--	4800	--	--	--	--	93	120	4
Petroleum Hydrocarbons (µg/L)													
Diesel Range Organics (DRO)	500	500	MTCA Method A	500	--	--	--	--	--	--	200	200	--
Lube Oil	500	500	MTCA Method A	500	--	--	--	--	--	--	200	200	--
Polycyclic Aromatic Hydrocarbons (µg/L)													
1-Methylnaphthalene	1.5	1.5	MTCA Method B-C	--	1.5	560	--	--	--	--	0.12	0.10	0.10
2-Methylnaphthalene	32	32	MTCA Method B-NC	--	--	32	--	--	--	--	1.1	1.0	1.0
Acenaphthene	480	480	MTCA Method B-NC	--	--	480	--	--	--	--	0.12	0.10	0.10
Anthracene	2400	2,400	MTCA Method B-NC	--	--	2,400	--	--	--	--	0.12	0.10	0.10
Fluorene	320	320	MTCA Method B-NC	--	--	320	--	--	--	--	0.12	0.10	0.10
Naphthalene	160	160	MTCA Method B-NC	160	--	160	--	--	--	--	0.12	0.10	0.10
Benzo(a)anthracene	--	--	See Total cPAHs TEQ	--	--	--	--	--	--	--	0.12	0.10	0.10
Benzo(a)pyrene	0.023	0.20	Federal/State MCL	0.10	0.023	5	0	0.2	0.2	--	0.12	0.10	0.10
Benzo(b)fluoranthene	--	--	See Total cPAHs TEQ	--	--	--	--	--	--	--	0.12	0.10	0.10
Benzo(k)fluoranthene	--	--	See Total cPAHs TEQ	--	--	--	--	--	--	--	0.12	0.10	0.10
beta-chloronaphthalene	640	640	MTCA Method B-NC	--	--	640	--	--	--	--	1.0	0.1	1.0
Chrysene	--	--	See Total cPAHs TEQ	--	--	--	--	--	--	--	0.12	0.10	0.10
Dibenzo(a,h)anthracene	--	--	See Total cPAHs TEQ	--	--	--	--	--	--	--	0.12	0.10	0.10
Fluoranthene	640	640	MTCA Method B-NC	--	--	640	--	--	--	--	0.12	0.10	0.10
Indeno(1,2,3-c,d)pyrene	--	--	See Total cPAHs TEQ	--	--	--	--	--	--	--	0.12	0.10	0.10
Pyrene	240	240	MTCA Method B-NC	--	--	240	--	--	--	--	0.12	0.10	0.10
Dibenzofuran	8	8	MTCA Method B-NC	--	--	8	--	--	--	--	1.08	1.00	1.00
Total cPAHs TEQ (ND = 0)[d]	0.023	0.20	Federal/State MCL	0.10	0.023	5	0	0.2	0.2	--	0.12	0.10	0.10
Total cPAHs TEQ (ND = 1/2 MDL/PQL)[d]	0.023	0.20	Federal/State MCL	0.10	0.023	5	0	0.2	0.2	--	0.12	0.10	0.10
Phenols (µg/L)													
2-Chlorophenol	40	40	MTCA Method B-NC	--	--	40	--	--	--	--	1.1	1.1	1.0
2-Methylphenol (o-Cresol)	800	800	MTCA Method B-NC	--	--	800	--	--	--	--	1.1	1.0	1.0
2,4-Dichlorophenol	48	48	MTCA Method B-NC	--	--	48	--	--	--	--	3.2	3.0	3.0
2,4-Dimethylphenol	320	320	MTCA Method B-NC	--	--	320	--	--	--	--	3.2	3.0	3.0
2,4-Dinitrophenol	32	32	MTCA Method B-NC	--	--	32	--	--	--	--	22	20	20
2,4,5-Trichlorophenol	1600	1,600	MTCA Method B-NC	--	--	1,600	--	--	--	--	5.4	5.0	5.0
2,4,6-Trichlorophenol	8	8	MTCA Method B-C	--	8	16	--	--	--	--	3.2	3.0	3.0
4-Chloro-3-Methylphenol	1600	1,600	MTCA Method B-NC	--	--	1,600	--	--	--	--	3.2	3.0	3.0
4-Methylphenol (p-Cresol)	1600	1,600	MTCA Method B-NC	--	--	1,600	--	--	--	--	2.2	2.0	2.0
4,6-Dinitro-2-methylphenol	1.3	11	PQL	--	--	1	--	--	--	--	11	10	10
Phenol	4800	4,800	MTCA Method B-NC	--	--	4,800	--	--	--	--	1.1	1.0	1.0
Pentachlorophenol	0.22	11	PQL	--	0.22	80	0	1	1	--	11	10	10

Table 5-2. Refined Screening Level Selection: Groundwater

COPC[a]	Preliminary SL	Refined SL	Basis[b]	Protection of Human Health and Beneficial Use			Drinking Water Maximum Contaminant Level			Adjustments (May 2024)			
				Method A	Method B Cancer	Method B Noncancer	MCL Goal (MCLG)	Federal MCL	State MCL	Natural Background	Average PQL[c]	Median PQL[c]	QAPP PQL[c]
Phthalates (µg/L)													
bis(2-Ethylhexyl)phthalate	6	6	MTCA Method B-C/MCL	--	6	320	0	6	6	--	3.2	3.0	3.0
Butylbenzyl phthalate	46	46	MTCA Method B-C	--	46	3,200	--	--	--	--	1.1	1.0	1.0
Diethyl phthalate	13000	13,000	MTCA Method B NC	--	--	13,000	--	--	--	--	1.1	1.0	1.0
Di-n-butyl phthalate	1600	1,600	MTCA Method B NC	--	--	1,600	--	--	--	--	1.1	1.0	1.0
Di-n-octyl phthalate	160	160	MTCA Method B NC	--	--	160	--	--	--	--	1.1	1.0	1.0
Dioxins and Furans (ng/L)													
2,3,7,8 Tetrachlorodibenzodioxin (TCDD)	0.00034	0.030	Federal/State MCL	--	0.00034	0.0056	0	0.03	0.03	--	0.0064	0.0050	0.0080
1,2,3,4,7,8 Hexachlorodibenzodioxin (HxCDD)	0.014	0.025	PQL	--	0.014	--	--	--	--	--	0.025	0.025	0.025
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=0)[e]	0.00034	0.0300	Federal/State MCL	--	0.00034	0.0056	0	0.03	0.03	--	0.0064	0.0050	0.0080
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=1/2 MDL/PQL)[e]	0.00034	0.0300	Federal/State MCL	--	0.00034	0.0056	0	0.03	0.03	--	0.0064	0.0050	0.0080

Footnotes:

a. COPCs were identified on the basis of previous detections above SLs and site use (Geosyntec, 2022; Geosyntec, 2023).

b. Basis of refined SLs was the maximum between representative background, ARARs, the minimum human health direct contact risk-based value, and the laboratory PQL. The sources of the refined SLs include:
Background. Natural Background Groundwater Arsenic Concentrations in Washington State (Ecology, 2021).
Human Health risk-based values. Washington State Department of Ecology. Cleanup Levels and Risk Calculation (CLARC) Tables (Ecology, 2024)
ARARs (i.e., MCLGs and MCLs). Washington State Department of Ecology. Cleanup Levels and Risk Calculation (CLARC) Tables (Ecology, 2024)

c. PQLs represent the average and median of practical quantitation limits/method detection limits provided by the analytical laboratories for the Phase 1,2,3 remedial investigation soil samples. The PQLs presented in the QAPP (Geosyntec, 2022) are also presented for context. The PQL considered for selection as the refined SL was the average PQL. The maximum between total and dissolved average PQLs was reported for metals.

d. SLs for benzo(a)pyrene are listed for selection of cPAH TEQs refined SLs based on Ecology guidance (Ecology, 2015).

e. SLs for 2,3,7,8 Tetrachlorodibenzodioxin are listed for selection of TCDD TEQs refined SLs based on Ecology guidance (Ecology, 2016).

Acronyms:

-- = not applicable or not available
C = cancer
COPC = chemical of potential concern
COC = chemical of concern
CLARC = Cleanup Levels and Risk Calculation
cPAH = carcinogenic polycyclic aromatic hydrocarbons
MCL = maximum contaminant level
MCLG = maximum contaminant level goal
MDL = method detection limit
MTCA = Model Toxics Control Act
µg/L = micrograms per liter
NC = noncancer
ND = no detection
PQL = practical quantitation limit
SL = screening level
TCDD = 2,3,7,8 Tetrachlorodibenzodioxin
TEQ = toxicity equivalent
WAC = Washington Administrative Code

References:

Washington Department of Ecology (Ecology). 2010. *Technical Memorandum #8 Natural Background for Dioxins/Furans in WA Soils* . Toxics Cleanup Program. Publication #10-09-053. August.
Ecology. 2015. *Implementation Memorandum #10: Evaluating the Human Health Toxicity of Carcinogenic PAHs (cPAHs) using Toxicity Equivalency Factors (TEFs)* . Toxics Cleanup Program. Publication # 15-09-049. April.
Ecology. 2016. *Implementation Memorandum #13: Dioxins, Furans, and Dioxin-Like PCB Congeners: Ecological Risk Calculation Methodology for Upland Soil* . Toxics Cleanup Program. Publication # 16-09-044. July.
Ecology. 2021. *Natural Background Groundwater Arsenic Concentrations in Washington State: Study Results* . Toxics Cleanup Program. Publication # 14-09-044. January.
Ecology. 2024. Cleanup Levels and Risk Calculation Tables. February update. Available at: https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/clarc/data-tables.
Geosyntec Consultants, Inc. (Geosyntec). 2022. *Final Remedial Investigation/Feasibility Study Work Plan Blakely Harbor Park Site* . January.
Geosyntec. 2023. *Final Remedial Investigation/Feasibility Study Work Plan/Sampling and Analysis Plan Addendum* . April.

Geosyntec consultants

Table 5-3a. Refined Screening Level Selection in Dry Weight Basis: Sediment

Initial COPC[a]	Bio accumulative?[b]	Preliminary Screening Level	Refined Screening Level			Risk Screening Criteria[e]		Washington State Benthic Criteria		Bioaccumulative SCO (Background/PQL Default)					Washington State Human Health Criteria					
															Beach Play (Child)		Clamming (Adult)		Netfishing (Adult)	
			Value[c]	Basisd	Units	Intertidal Area Becah play and Clamming	Subtidal Area Net-Fishing	AET SCO	AET CSL	Natural Background 90|90 UTL	BOLD Dataset 90%ile	Average PQL[f]	Median PQL[f]	QAPP PQL[f]	Cancer	Non-Cancer	Cancer	Non-Cancer	Cancer	Non-Cancer
Metals (mg/kg)																				
Arsenic	Yes	11	11	Bioaccumulative SCO	mg/kg dw	0.822	1.87	57	93	11	11	0.36	0.27	0.2	2.08	80.3	0.822	370	1.87	843
Cadmium	Yes	0.8	0.8	Bioaccumulative SCO	mg/kg dw	223	2490	5.1	6.7	0.8	0.7	0.19	0.13	0.1	--	223	--	1070	--	2490
Chromium	No	260	260	Benthic AET SCO	mg/kg dw	--	--	260	270	62	55	0.96	0.7	0.5	--	--	--	--	--	--
Copper	No	390	390	Benthic SCO/CSL	mg/kg dw	26700	184000	390	390	45	40	0.93	0.66	0.5	--	26,700	--	91,300	--	184,000
Lead	Yes	21	21	Bioaccumulative SCO	mg/kg dw	--	--	450	530	21	18	0.27	0.14	0.1	--	--	--	--	--	--
Mercury	Yes	0.2	0.2	Bioaccumulative SCO	mg/kg dw	--	--	0.41	0.59	0.2	0.2	0.04	0.0299	0.025	--	--	--	--	--	--
Silver	No	6.1	6.1	Benthic SCO/CSL	mg/kg dw	3340	23000	6.1	6.1	0.24	0.2	0.32	0.27	0.2	--	3,340	--	11,400	--	23,000
Zinc	No	410	410	Benthic AET SCO	mg/kg dw	200000	1380000	410	960	93	92	11	8	4	--	200,000	--	684,000	--	1,380,000
Polycyclic Aromatic Hydrocarbons (PAHs) (µg/kg dw)																				
2-Methylnaphthalene	No	670	670	Benthic AET SCO/CSL	µg/kg dw	357,000	4,890,000	670	670	--	DL	10	5	20	--	357,000	--	1,950,000	--	4,890,000
Acenaphthene	No	500	500	Benthic AET SCO/CSL	µg/kg dw	5,350,000	73,400,000	500	500	--	DL	8.8	5	5	--	5,350,000	--	29,200,000	--	73,400,000
Acenaphthylene	No	1300	1300	Benthic AET SCO/CSL	µg/kg dw	--	--	1300	1300	--	--	10	5	5	--	--	--	--	--	--
Anthracene	Yes	960	960	Benthic AET SCO/CSL	µg/kg dw	26,800,000	367,000,000	960	960	--	DL	9.0	5	5	--	26,800,000	--	146,000,000	--	367,000,000
Fluorene	No	540	540	Benthic AET SCO/CSL	µg/kg dw	3,570,000	48,900,000	540	540	--	--	8.5	5	5	--	3,570,000	--	19,500,000	--	48,900,000
Naphthalene	No	2100	2100	Benthic AET SCO/CSL	µg/kg dw	1,780,000	24,500,000	2100	2100	--	DL	9.1	5	5	--	1,780,000	--	9,740,000	--	24,500,000
Phenanthrene	No	1500	1500	Benthic AET SCO/CSL	µg/kg dw	--	--	1500	1500	--	0.0079	8.7	5	5	--	--	--	--	--	--
Benzo(a)anthracene	No	1300	1300	Benthic AET SCO/CSL	µg/kg dw	--	--	1300	1300	--	0.0062	9.2	5	5	--	--	--	--	--	--
Benzo(a)pyrene	No	1600	1600	Benthic AET SCO/CSL	µg/kg dw	26,800	367,000	1600	1600	--	0.0101	8.7	5	5	--	26,800	--	146,000	--	367,000
Benzo(b)fluoranthene	Yes	--	--	--	--	--	--	--	--	--	0.0164	8.0	5	5	--	--	--	--	--	--
Benzo(g,h,i)perylene	Yes	670	670	Benthic AET SCO	µg/kg dw	--	--	670	720	--	0.005	9.7	5	5	--	--	--	--	--	--
Benzo(j)fluoranthene	Yes	--	--	--	--	--	--	--	--	--	--	9.6	5	5	--	--	--	--	--	--
Benzo(k)fluoranthene	Yes	--	--	--	--	--	--	--	--	--	0.0088	7.9	5	5	--	--	--	--	--	--
Total Benzofluoranthenes	Yes	3200	3200	Benthic AET SCO	µg/kg dw	--	--	3200	3600	--	--	18.7	10	10	--	--	--	--	--	--
Chrysene	No	1400	1400	Benthic AET SCO	µg/kg dw	--	--	1400	2800	--	0.0069	8.2	5	5	--	--	--	--	--	--
Dibenzo(a,h)anthracene	Yes	230	230	Benthic AET SCO	µg/kg dw	--	--	230	230	--	DL	10	5	5	--	--	--	--	--	--
Fluoranthene	Yes	1700	1700	Benthic AET SCO	µg/kg dw	3,570,000	48,900,000	1700	2500	--	0.012	9.0	5	5	--	3,570,000	--	19,500,000	--	48,900,000
Indeno(1,2,3-c,d)pyrene	Yes	600	600	Benthic AET SCO	µg/kg dw	--	--	600	690	--	0.0048	9.0	5	5	--	--	--	--	--	--
Pyrene	Yes	2600	2600	Benthic AET SCO	µg/kg dw	2,680,000	36,700,000	2600	3300	--	0.012	7.9	5	5	--	2,680,000	--	14,600,000	--	36,700,000
Total LPAHs	No	5200	5200	Benthic AET SCO/CSL	µg/kg dw	--	--	5200	5200	--	0.0147	--			--	--	--	--	--	--
Total HPAHs	Yes	12000	12000	Benthic AET SCO	µg/kg dw	--	--	12000	17000	--	0.075	--			--	--	--	--	--	--
Total PAHs	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
Total cPAHs TEQ (ND = 0)	Yes	21	21	Bioaccumulative SCO	µg/kg dw	120	150	--	--	21	--	8.7	5	5	174	26,800	120	146,000	150	367,000
Total cPAHs TEQ (ND = 1/2 MDL/PQL)	Yes	21	21	Bioaccumulative SCO	µg/kg dw	120	150	--	--	21	--	8.7	5	5	174	26,800	120	146,000	150	367,000
Chlorinated Organics (µg/kg dw)																				
1,2,4-Trichlorobenzene	No	31	31	Benthic AET SCO	µg/kg dw	78,700	159,000	31	51	--	--	18	20	20	269,000	6,680,000	78,700	22,800,000	159,000	46,000,000
1,2-Dichlorobenzene	No	35	35	Benthic AET SCO	µg/kg dw	60,100,000	414,000,000	35	50	--	--	19	20	20	--	60,100,000	--	205,000,000	--	414,000,000
1,4-Dichlorobenzene	No	110	110	Benthic AET SCO	µg/kg dw	422,000	852,000	110	110	--	--	18	20	20	1,440,000	46,700,000	422,000	160,000,000	852,000	322,000,000
Hexachlorobenzene	Yes	22	22	Benthic AET SCO	µg/kg dw	1,430	2,880	22	70	--	--	17	20	20	4,870	534,000	1,430	1,830,000	2,880	3,680,000
Hexachlorobutadiene	Yes	11	11.0	Benthic AET SCO	µg/kg dw	29,200	59,000	11	120	--	--	7.2	5	20	99,900	668,000	29,200	2,280,000	59,000	4,600,000
Organic Chemicals/Phenols (µg/kg dw)																				
2,4-Dimethylphenol	No	29	88	PQL	µg/kg dw	2,230,000	29,500,000	29	29	--	--	88	100	100	--	2,230,000	--	11,900,000	--	29,500,000
2-Methylphenol (o-Cresol)	No	63	63	Benthic AET SCO/CSL	µg/kg dw	5,580,000	73,600,000	63	63	--	--	18	20	20	--	5,580,000	--	29,700,000	--	73,600,000
4-Methylphenol (p-Cresol)	No	670	670	Benthic AET SCO/CSL	µg/kg dw	11,200,000	147,000,000	670	670	--	--	18	20	20	--	11,200,000	--	59,500,000	--	147,000,000
Benzoic acid	No	650	650	Benthic AET SCO/CSL	µg/kg dw	446,000,000	5,890,000,000	650	650	--	--	184	200	200	--	446,000,000	--	2,380,000,000	--	5,890,000,000
Benzyl alcohol	No	57	57	Benthic AET SCO	µg/kg dw	11,200,000	147,000,000	57	73	--	--	21	20	20	--	11,200,000	--	59,500,000	--	147,000,000
Dibenzofuran	No	540	540	Benthic AET SCO/CSL	µg/kg dw	268,000	2,810,000	540	540	--	--	21	20	20	--	268,000	--	1,230,000	--	2,810,000
n-Nitrosodiphenylamine	No	28	28	Benthic AET SCO	µg/kg dw	121,000	301,000	28	40	--	--	18	20	20	266,000	--	121,000	--	301,000	--
Pentachlorophenol	Yes	360	360	Benthic AET SCO	µg/kg dw	705	1,820	360	690	--	DL	86	100	100	1,450	248,000	705	1,410,000	1,820	3,650,000
Phenol	No	42	42	Benthic AET SCO	µg/kg dw	33,500,000	442,000,000	42	1200	--	0.484	18	20	20	--	33,500,000	--	178,000,000	--	442,000,000

Table 5-3a. Refined Screening Level Selection in Dry Weight Basis: Sediment

Initial COPC[a]	Bio accumulative?[b]	Preliminary Screening Level	Refined Screening Level			Risk Screening Criteria[e]		Washington State Benthic Criteria		Bioaccumulative SCO (Background/PQL Default)					Washington State Human Health Criteria					
															Beach Play (Child)		Clamming (Adult)		Netfishing (Adult)	
			Value[c]	Basisd	Units	Intertidal Area Becah play and Clamming	Subtidal Area Net-Fishing	AET SCO	AET CSL	Natural Background 90|90 UTL	BOLD Dataset 90%ile	Average PQL[f]	Median PQL[f]	QAPP PQL[f]	Cancer	Non-Cancer	Cancer	Non-Cancer	Cancer	Non-Cancer
Phthalates (µg/kg dw)																				
bis(2-Ethylhexyl)phthalate	No	1300	1300	Benthic AET SCO	µg/kg dw	42,500	105,000	1300	1900	--	DL	53	50	50	93,000	2,230,000	42,500	11,900,000	105,000	29,500,000
Butylbenzyl phthalate	No	63	63	Benthic AET SCO	µg/kg dw	313,000	775,000	63	900	--	--	18	20	20	685,000	22,300,000	313,000	119,000,000	775,000	295,000,000
Diethyl phthalate	No	200	200	Benthic AET SCO	µg/kg dw	89,200,000	1,180,000,000	200	1200	--	--	45	50	20	--	89,200,000	--	476,000,000	--	1,180,000,000
Dimethyl phthalate	No	71	71	Benthic AET SCO	µg/kg dw	--	--	71	160	--	--	18	20	20	--	--	--	--	--	--
Di-n-butyl phthalate	No	1400	1400	Benthic AET SCO/CSL	µg/kg dw	11,200,000	147,000,000	1400	1400	--	--	21	20	20	--	11,200,000	--	59,500,000	--	147,000,000
Di-n-octyl phthalate	No	6200	6200	Benthic AET SCO/CSL	µg/kg dw	1,120,000	14,700,000	6200	6200	--	--	21	20	20	--	1,120,000	--	5,950,000	--	14,700,000
Dioxins and Furans (ng/kg dw)																				
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--
2,3,7,8 Tetrachlorodibenzodioxin (TCDD)	Yes	4	4	Bioaccumulative SCO	ng/kg dw	12.1	28.6	--	--	4	2.69	0.8	0.8	0.8	29	223	12	1,100	29	2,600
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND = 0)[i]	Yes	4	4	Bioaccumulative SCO	ng/kg dw	12.1	28.6	--	--	4	2.69	0.8	0.8	0.8	29	223	12	1,100	29	2,600
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND = 1/2 MDL/PQL)[i]	Yes	4	4	Bioaccumulative SCO	ng/kg dw	12.1	28.6	--	--	4	2.69	0.8	0.8	0.8	29	223	12	1,100	29	2,600

Notes:
Gray filled cells indicate initial COPC is bioaccumulative.

Footnotes:
a. COPCs were identified on the basis of previous detections above SLs and site use (Geosyntec, 2022; Geosyntec, 2023).
b. List of bioaccumulative compounds as per Dredge Material Management Plan, 2021. Prepared for U.S. Army Corps of Engineers, Environmental Protection Agency, Washington State Department of Natural Resources, Washington State Department of Ecology. July.
c. For polar COPCs and samples with total organic content
d. Refined SLs were identified as the lowest benthic criteria (Benthic SCO) for non-bioaccumulative compounds and adjusted to the maximum between natural background when available for bioaccumulative compounds and the PQL (Bioaccumulative SCO).
e. SLs were identified as the lowest between beach play and clamming criteria for intertidal area and as the net-fishing criteria for the subtidal area. Human health risk screening is not performed on a point-by-point comparison but on an area basis. Values calculated by using Appendix K to the SCUM (Ecology, 2021) and relevant parameters from the CLARC tables (February 2024). Concentrations are based on a target cancer risk of 1×10-6 and a target Hazard Quotient of 1.
f. PQLs represent the average and median of practical quantitation limits/method detection limits provided by the analytical laboratories for the Phase 1,2,3 remedial investigation soil samples. The PQLs presented in the QAPP (Geosyntec, 2022) are also presented for context. The PQL considered for selection as the refined SL was the average PQL.

Acronyms:

-- = not applicable or not available
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
AET = apparent effects threshold
COPC = chemical of potential concern
CSL = cleanup screening level
dw = dry weight
DL = detection limit
PQL = practical quantitation limit
SCO = sediment cleanup objective
SCUM = Sediment Cleanup Users Manual
SL = screening level
SMS = Sediment Management Standards
TCDD = 2,3,7,8 Tetrachlorodibenzodioxin
TEQ = toxicity equivalent
UTL = upper tolerance limit

References

Washington Department of Ecology (Ecology). 2021. *Sediment Cleanup User's Manual (SCUM)*. Toxics Cleanup Program. Publication Number 12-09-057. December.
Ecology. 2024. Cleanup Levels and Risk Calculation Tables. February update. Available at: https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/clarc/data-tables.
Geosyntec Consulting, Inc. (Geosyntec). 2022. *Final Remedial Investigation/Feasibility Study Work Plan Blakely Harbor Park Site*. January.
Geosyntec. 2023. *Final Remedial Investigation/Feasibility Study Work Plan/Sampling and Analysis Plan Addendum*. April.

Geosyntec consultants

Table 5-3b. Refined Screening Level Selection in Organic Carbon Basis: Sediment

COPC[a]	Bio accumulative?[b]	Preliminary Screening Level	Refined Screening Level		Washington State Benthic Criteria		Bioaccumulative SCO (Background/PQL Default)				
			Value[c]	Basis[d]	SMS SCO	SMS CSL	Natural Background 90|90 UTL	BOLD Dataset 90%ile	Average PQL[e] dw basis	Median PQL[e] dw basis	QAPP PQL[e] dw basis
Metals (mg/kg)											
Arsenic	Yes	11	11	Bioaccumulative SCO	57	93	11	11	0.36	0.27	0.2
Cadmium	Yes	0.8	0.8	Bioaccumulative SCO	5.1	6.7	0.8	0.7	0.19	0.13	0.1
Chromium	No	260	260	Benthic SMS SCO	260	270	62	55	0.96	0.7	0.5
Copper	No	390	390	Benthic SCO/CSL	390	390	45	40	0.93	0.66	0.5
Lead	Yes	21	21	Bioaccumulative SCO	450	530	21	18	0.27	0.14	0.1
Mercury	Yes	0.2	0.2	Bioaccumulative SCO	0.41	0.59	0.2	0.2	0.04	0.0299	0.025
Silver	No	6.1	6.1	Benthic SCO/CSL	6.1	6.1	0.24	0.2	0.32	0.27	0.2
Zinc	No	410	410	Benthic SMS SCO	410	960	93	92	11	8	4
Polycyclic Aromatic Hydrocarbons (PAHs) (mg/kg OC)											
2-Methylnaphthalene	No	38	38	Benthic SMS SCO	38	64	--	DL	10	5	20
Acenaphthene	No	16	16	Benthic SMS SCO	16	57	--	DL	8.8	5	5
Acenaphthylene	No	66	66	Benthic SMS SCO/CSL	66	66	--	--	10	5	5
Anthracene	Yes	220	220	Benthic SMS SCO	220	1200	--	DL	9.0	5	5
Fluorene	No	23	23	Benthic SMS SCO	23	79	--	--	8.5	5	5
Naphthalene	No	99	99	Benthic SMS SCO	99	170	--	DL	9.1	5	5
Phenanthrene	No	100	100	Benthic SMS SCO	100	480	--	0.0079	8.7	5	5
Benzo(a)anthracene	No	110	110	Benthic SMS SCO	110	270	--	0.0062	9.2	5	5
Benzo(a)pyrene	No	99	99	Benthic SMS SCO	99	210	--	0.0101	8.7	5	5
Benzo(b)fluoranthene	Yes	--	--	--	--	--	--	0.0164	8.0	5	5
Benzo(g,h,i)perylene	Yes	31	31	Benthic SMS SCO	31	78	--	0.005	9.7	5	5
Benzo(j)fluoranthene	Yes	--	--	--	--	--	--	--	9.6	5	5
Benzo(k)fluoranthene	Yes	--	--	--	--	--	--	0.0088	7.9	5	5
Total Benzofluoranthenes	Yes	230	230	Benthic SMS SCO	230	450	--	--	18.7	10	
Chrysene	No	110	110	Benthic SMS SCO	110	460	--	0.0069	8.2	5	5
Dibenzo(a,h)anthracene	Yes	12	12	Benthic SMS SCO	12	33	--	DL	10	5	5
Fluoranthene	Yes	160	160	Benthic SMS SCO	160	1200	--	0.012	9.0	5	5
Indeno(1,2,3-c,d)pyrene	Yes	34	34	Benthic SMS SCO	34	88	--	0.0048	9.0	5	5
Pyrene	Yes	1000	1000	Benthic SMS SCO	1000	1400	--	0.012	7.9	5	5
Total LPAHs	No	370	370	Benthic SMS SCO	370	780	--	0.0147	--	--	--
Total HPAHs	Yes	960	960	Benthic SMS SCO	960	5300	--	0.075	--	--	--
Total PAHs	--	--	--	--	--	--	--	--	--		
Total cPAHs TEQ (ND = 0)[11]	Yes	0.021	0.021	Bioaccumulative SCO	--	--	0.021	--	8.7	5	5
Total cPAHs TEQ (ND = 1/2 MDL/PQL)	Yes	0.021	0.021	Bioaccumulative SCO	--	--	0.021	--	8.7	5	5

Geosyntec consultants

Table 5-3b. Refined Screening Level Selection in Organic Carbon Basis: Sediment

COPC[a]	Bio accumulative?[b]	Preliminary Screening Level	Refined Screening Level		Washington State Benthic Criteria		Bioaccumulative SCO (Background/PQL Default)				
			Value[c]	Basis[d]	SMS SCO	SMS CSL	Natural Background 90|90 UTL	BOLD Dataset 90%ile	Average PQL[e] dw basis	Median PQL[e] dw basis	QAPP PQL[e] dw basis
Chlorinated Organics (mg/kg OC)											
1,2,4-Trichlorobenzene	No	0.81	0.81	Benthic SMS SCO	0.81	1.8	--	--	18	20	20
1,2-Dichlorobenzene	No	2.3	2.3	Benthic SMS SCO/CSL	2.3	2.3	--	--	19	20	20
1,4-Dichlorobenzene	No	3.1	3.1	Benthic SMS SCO	3.1	9	--	--	18	20	20
Dibenzofuran	No	15	15	Benthic SCO	15	58	--	--	21	20	20
Hexachlorobenzene	Yes	0.38	0.38	Benthic SMS SCO	0.38	2.3	--	--	17	20	20
Hexachlorobutadiene	Yes	3.9	3.9	Benthic SMS SCO	3.9	6.2	--	--	7	5	20
n-Nitrosodiphenylamine	No	11	11	Benthic SMS SCO/CSL	11	11	--	--	18	20	20
Phthalates (mg/kg OC)											
bis(2-Ethylhexyl)phthalate	No	47	47	Benthic SMS SCO	47	78	--	DL	53	50	50
Butylbenzyl phthalate	No	4.9	4.9	Benthic SMS SCO	4.9	64	--	--	18	20	20
Diethyl phthalate	No	61	61	Benthic SMS SCO	61	110	--	--	45	50	20
Dimethyl phthalate	No	53	53	Benthic SMS SCO	53	53	--	--	18	20	20
Di-n-butyl phthalate	No	220	220	Benthic SMS SCO	220	1700	--	--	21	20	20
Di-n-octyl phthalate	No	58	58	Benthic SMS SCO	58	4500	--	--	21	20	20

Notes:

Gray filled cells indicate initial COPC is bioaccumulative.

Footnotes:

a. COPCs were identified on the basis of previous detections above SLs and site use (Geosyntec, 2022; Geosyntec, 2023).

b. List of bioaccumulative compounds as per Dredge Material Management Plan, 2021. Prepared for U.S. Army Corps of Engineers, Environmental Protection Agency, Washington State Department of Natural Resources, Washington State Department of Ecology. July.

c. For polar COPCs and samples with total organic content within the range 0.5 to 3.5%, the SMS SCO was used for comparison to results. For nonpolar initial COPCs and samples with total organic content outside the range of 0.5 to 3.5%, the AET SCO was used for comparison to results (Ecology, 2021).

d. Refined screening levels were identified as the lowest benthic criteria (Benthic SCO) for non-bioaccumulative compounds and adjusted to the maximum between natural background when available for bioaccumulative compounds and the PQL (Bioaccumulative SCO).

e. PQLs represent the average and median of practical quantitation limits/method detection limits provided by the analytical laboratories for the Phase 1,2,3 remedial investigation soil samples. The PQLs presented in the QAPP (Geosyntec, 2022) are also presented for context. The PQL considered for selection as the refined SL was the average PQL.

Acronyms:

-- = not applicable or not available
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
COPC = chemical of potential concern
CSL = cleanup screening level
dw = dry weight
DL = detection limit
PQL = practical quantitation limit
OC = organic carbon
SCO = sediment cleanup objective
SCUM = Sediment Cleanup Users Manual
SL = screening level
SMS = Sediment Management Standards
TCDD = 2,3,7,8 Tetrachlorodibenzodioxin
TEQ = toxicity equivalent
UTL = upper tolerance limit

References

Washington Department of Ecology (Ecology). 2021. *Sediment Cleanup User's Manual (SCUM)* . Toxics Cleanup Program. Publication Number 12-09-057. December.

Ecology. 2024. Cleanup Levels and Risk Calculation Tables. February update. Available at: https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/clarc/data-tables.

Geosyntec Consultants, Inc. (Geosyntec). 2022. *Final Remedial Investigation/Feasibility Study Work Plan Blakely Harbor Park Site* . January.

Geosyntec. 2023. *Final Remedial Investigation/Feasibility Study Work Plan/Sampling and Analysis Plan Addendum* . April.

Table 5-4. Summary Statistics for Chemicals of Potential Concern: Soil

COPC[a]	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum	Depth of Maximum	Mean Detected Concentration	CoV Detected Concentration	Median Detected Concentration	90th %ile Detected Concentration
Metals (mg/kg)											
Arsenic	159	159	100	1.85	60.3	SB-21	0 to 2 ft bgs	8.71	0.808	7.03	14.9
Cadmium	159	145	91	0.04	1.7	HA-45	0 to 1 ft bgs	0.32	0.87	0.23	0.652
Chromium	159	159	100	3.17	92.7	HA-46	0 to 1 ft bgs	31.2	0.556	28.2	51.9
Copper	154	154	100	6.29	778	SB-19	0 to 2 ft bgs	83.1	1.15	62.9	140
Lead	159	159	100	1.25	5160	SB-19	0 to 2 ft bgs	228	2.86	35.6	496
Mercury	147	129	88	0.00491	2.17	HA-02	1 to 2 ft bgs	0.112	2.31	0.0608	0.16
Zinc	154	154	100	26.7	1980	SB-19	2 to 6 ft bgs	194	1.57	100	321
Petroleum Hydrocarbons (mg/kg)											
Diesel Range Organics (DRO)	145	92	63	5.35	4010	SB-21	2 to 4 ft bgs	180	3.11	29.1	234
Lube Oil	145	111	77	12.7	10500	SB-21	2 to 4 ft bgs	418	3.29	82.8	630
Polycyclic Aromatic Hydrocarbons (µg/kg)											
1-Methylnaphthalene	156	55	35	0.67	979	HA-13	1 to 2 ft bgs	71.3	2.31	13.4	204
2-Methylnaphthalene	159	75	47	1.34	2140	HA-13	1 to 2 ft bgs	82	3.19	12.1	177
Acenaphthene	159	71	45	0.22	2080	SB-21	0 to 2 ft bgs	102	3.17	12.5	271
Anthracene	159	121	76	0.52	4430	SB-21	0 to 2 ft bgs	140	3.86	9.74	205
Benzo(a)anthracene	159	133	84	0.54	17300	SB-21	0 to 2 ft bgs	436	4.15	25.8	241
Benzo(a)pyrene	159	127	80	0.62	16900	SB-21	0 to 2 ft bgs	543	3.97	46.4	281
Benzo(b)fluoranthene	159	127	80	1.09	10200	HA-13	1 to 2 ft bgs	360	3.83	50.6	298
Benzo(k)fluoranthene	159	131	82	0.41	6700	HA-13	1 to 2 ft bgs	221	4.13	21.5	127
2-Chloronaphthalene	156	0	0	ND	ND	NA		ND	ND	ND	ND
Chrysene	159	140	88	1.31	18300	HA-13	1 to 2 ft bgs	556	4.09	41.1	321
Dibenzo(a,h)anthracene	159	113	71	0.23	2450	HA-13	1 to 2 ft bgs	96.9	3.42	18.1	139
Fluoranthene	159	148	93	0.54	41400	HA-13	1 to 2 ft bgs	1090	4.45	55.6	519
Fluorene	159	91	57	0.18	2780	HA-13	1 to 2 ft bgs	113	3.63	8.8	118
Indeno(1,2,3-c,d)pyrene	159	127	80	1.22	10300	HA-13	1 to 2 ft bgs	392	3.64	53.6	614
Naphthalene	159	123	77	1.34	10500	SB-22	6 to 10 ft bgs	231	4.55	23	341
Pyrene	159	147	92	0.7	47100	HA-13	1 to 2 ft bgs	1230	4.53	50.9	697
Dibenzofuran	156	54	35	2.07	2540	HA-13	1 to 2 ft bgs	141	2.61	31.4	278
Total cPAHs TEQ (ND = 1/2 MDL/PQL)	159	141	89	0.87	21500	SB-21	1 to 2 ft bgs	633	4.14	40.4	347
Total cPAHs TEQ (ND = 0)	159	141	89	0.0771	21500	SB-21	1 to 2 ft bgs	632	4.14	40.4	347
Phenols (µg/kg)											
2,4,5-Trichlorophenol	152	0	0	ND	ND	NA		ND	ND	ND	ND
2,4,6-Trichlorophenol	152	0	0	ND	ND	NA		ND	ND	ND	ND
2,4-Dichlorophenol	152	0	0	ND	ND	NA		ND	ND	ND	ND
2,4-Dimethylphenol	143	7	5	8	235	SB-28	12 to 14 ft bgs	81.5	0.985	58.4	175
2,4-Dinitrophenol	152	0	0	ND	ND	NA		ND	ND	ND	ND
2-Chlorophenol	152	0	0	ND	ND	NA		ND	ND	ND	ND
2-Methylphenol (o-Cresol)	156	13	8	6.5	316	SB-28	12 to 14 ft bgs	71.7	1.21	40	129
4,6-Dinitro-2-methylphenol	152	0	0	ND	ND	NA		ND	ND	ND	ND
4-Chloro-3-Methylphenol	152	0	0	ND	ND	NA		ND	ND	ND	ND
4-Methylphenol (p-Cresol)	156	27	17	8.2	1000	SB-28	12 to 14 ft bgs	155	1.69	36.4	399
Phenol	155	68	44	4.7	301	HA-13	1 to 2 ft bgs	37.3	1.62	14.5	91.1
Pentachlorophenol	152	0	0	ND	ND	NA		ND	ND	ND	ND

Table 5-4. Summary Statistics for Chemicals of Potential Concern: Soil

COPC[a]	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum	Depth of Maximum	Mean Detected Concentration	CoV Detected Concentration	Median Detected Concentration	90th %ile Detected Concentration
Phthalates (µg/kg)											
bis(2-Ethylhexyl)phthalate	156	48	31	6.7	524	HA-16	0 to 1 ft bgs	59.7	1.78	18.4	192
Butylbenzyl phthalate	156	2	1	12.9	15.4	HA-50b	0 to 1 ft bgs	14.1	0.125	14.1	15.2
Diethyl phthalate	156	27	17	19.8	257	HA-16	0 to 1 ft bgs	53.7	1.05	26.9	133
Dimethyl phthalate	156	2	1	5.8	6.6	HA-15	0 to 1 ft bgs	6.2	0.0912	6.2	6.52
Di-n-butyl phthalate	156	14	9	6	660	SB-19	2 to 6 ft bgs	100	1.69	48.8	161
Di-n-octyl phthalate	156	0	0	ND	ND	NA		ND	ND	ND	ND
Dioxins and Furans (ng/kg)											
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	164	154	94	0.06	515	SB-22	4 to 6 ft bgs	6.1	6.85	0.692	6.72
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	164	145	88	0.068	4140	SB-22	4 to 6 ft bgs	35.8	9.64	1.69	13.8
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=1/2 MDL/PQL)	164	164	100	0.457	11400	SB-22	4 to 6 ft bgs	94.2	9.47	5.26	57.2
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=0)	164	164	100	0.0853	11400	SB-22	4 to 6 ft bgs	93.9	9.51	4.77	57.1

Acronyms:

%ile = percentile
% = percent
bgs = below ground surface
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
ft = feet
COPC = chemical of potential concern
CoV = coefficient of variance
MDL = method detection limit
NA = not applicable
ND = not detected
PQL = practical quantitation limit

Table 5-5. Summary Statistics for Chemicals of Potential Concern: Groundwater

COPC[a]	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum	Mean Detected Concentration	CoV Detected Concentration	Median Detected Concentration	90th %ile Detected Concentration
Total Metals (µg/L)										
Arsenic	21	21	100	0.42	4.24	GW-19	1.94	0.524	1.68	3.08
Cadmium	21	3	14	0.38	0.42	GW-26	0.4	0.05	0.4	0.416
Chromium	21	16	76.2	1.88	335	GW-27	44.4	1.87	11.2	88.4
Copper	21	6	28.6	3.84	23.1	GW-27	11.3	0.637	10	19.6
Lead	21	4	19	0.538	8.3	GW-18	5.01	0.716	5.61	8.06
Mercury	21	4	19	0.014	0.026	GW-19	0.0203	0.303	0.0205	0.0257
Zinc	21	3	14.3	10.4	123	GW-26	75.2	0.774	92.1	117
Dissolved Metals (µg/L)										
Arsenic	21	14	66.7	0.63	2.55	GW-26	1.55	0.408	1.45	2.4
Cadmium	21	4	19	0.37	0.59	GW-24	0.48	0.199	0.48	0.569
Chromium	21	13	61.9	0.375	16	GW-19	7.67	0.753	7.7	15.2
Copper	21	3	14.3	3.49	9.16	G-27	6.38	0.444	6.5	8.63
Lead	21	0	0	ND	ND	NA	ND	ND	ND	ND
Mercury	21	4	19	0.013	0.021	GW-27	0.0187	0.206	0.0205	0.021
Zinc	21	1	4.76	42.2	42.2	GW-29	42.2	N/A	42.2	42.2
Petroleum Hydrocarbons (µg/L)										
tph, diesel range organics	21	1	5	205	205	GW-26	205	N/A	205	205
Lube Oil	21	1	5	251	251	GW-19	251	N/A	251	251
Polycyclic Aromatic Hydrocarbons (µg/L)										
1-Methylnaphthalene	21	0	0	ND	ND	NA	ND	ND	ND	ND
2-Methylnaphthalene	21	0	0	ND	ND	NA	ND	ND	ND	ND
Acenaphthene	21	0	0	ND	ND	NA	ND	ND	ND	ND
Benzo(a)anthracene	21	0	0	ND	ND	NA	ND	ND	ND	ND
Benzo(a)pyrene	21	0	0	ND	ND	NA	ND	ND	ND	ND
Benzo(b)fluoranthene	21	0	0	ND	ND	NA	ND	ND	ND	ND
Benzo(k)fluoranthene	21	0	0	ND	ND	NA	ND	ND	ND	ND
2-Chloronaphthalene	21	0	0	ND	ND	NA	ND	ND	ND	ND
Chrysene	21	0	0	ND	ND	NA	ND	ND	ND	ND
Dibenzofuran	21	0	0	ND	ND	NA	ND	ND	ND	ND
Dibenzo(a,h)anthracene	21	0	0	ND	ND	NA	ND	ND	ND	ND
Fluoranthene	21	0	0	ND	ND	NA	ND	ND	ND	ND
Fluorene	21	0	0	ND	ND	NA	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	21	0	0	ND	ND	NA	ND	ND	ND	ND
Naphthalene	21	0	0	ND	ND	NA	ND	ND	ND	ND
Pyrene	21	0	0	ND	ND	NA	ND	ND	ND	ND
Total cPAHs TEQ (ND = 1/2 MDL/PQL)	21	0	0	ND	ND	NA	ND	ND	ND	ND
Total cPAHs TEQ (ND = 0L)	21	0	0	ND	ND	NA	ND	ND	ND	ND

Table 5-5. Summary Statistics for Chemicals of Potential Concern: Groundwater

COPC[a]	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum	Mean Detected Concentration	CoV Detected Concentration	Median Detected Concentration	90th %ile Detected Concentration
Phenols (µg/L)										
2-Chlorophenol	21	0	0	ND	ND	NA	ND	ND	ND	ND
2-Methylphenol (o-Cresol)	21	0	0	ND	ND	NA	ND	ND	ND	ND
2,4-Dichlorophenol	21	0	0	ND	ND	NA	ND	ND	ND	ND
2,4-Dimethylphenol	21	0	0	ND	ND	NA	ND	ND	ND	ND
2,4-Dinitrophenol	21	0	0	ND	ND	NA	ND	ND	ND	ND
2,4,5-Trichlorophenol	21	0	0	ND	ND	NA	ND	ND	ND	ND
2,4,6-Trichlorophenol	21	0	0	ND	ND	NA	ND	ND	ND	ND
4-Chloro-3-Methylphenol	21	0	0	ND	ND	NA	ND	ND	ND	ND
4-Methylphenol (p-Cresol)	21	0	0	ND	ND	NA	ND	ND	ND	ND
4,6-Dinitro-2-methylphenol	21	0	0	ND	ND	NA	ND	ND	ND	ND
Phenol	21	0	0	ND	ND	NA	ND	ND	ND	ND
Pentachlorophenol	21	0	0	ND	ND	NA	ND	ND	ND	ND
Phthalates (µg/L)										
bis(2-Ethylhexyl)phthalate	21	1	4.76	0.7	0.7	GW-29	0.7	N/A	0.7	0.7
Butylbenzyl phthalate	21	0	0	ND	ND	NA	ND	ND	ND	ND
Diethyl phthalate	21	1	4.76	0.4	0.4	GW-24	0.4	N/A	0.4	0.4
Di-n-butyl phthalate	21	0	0	ND	ND	NA	ND	ND	ND	ND
Di-n-octyl phthalate	21	0	0	ND	ND	NA	ND	ND	ND	ND
Dioxins and Furans (ng/L)										
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	21	0	0	ND	ND	NA	ND	ND	ND	ND
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	21	1	4.76	0.00105	0.00105	GW-18	0.00105	N/A	0.00105	0.00105
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=1/2 MDL/PQL)	21	8	38.1	0.000103	0.00529	GW-18	0.0017	1.06	0.00147	0.0036
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=0)	21	8	38.1	0.00000875	0.00315	GW-18	0.000539	2.04	0.0000325	0.0016

Acronyms:

% = percent
µg/L = micrograms per liter
mg/L = milligrams per liter
ng/L = nanograms per Liter
COPC = chemical of potential concern
CoV = coefficient of variance
MDL = method detection limit
N/A = not applicable
ND = non=detect
PQL = practical quantitation limit
%ile = percentile

Table 5-6. Summary Statistics for Chemicals of Potential Concern: Sediment

COPC[a]	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum	Depth of Maximum	Mean Detected Concentration	CoV Detected Concentration	Median Detected Concentration	90th %ile Detected Concentration
Metals (mg/kg dw)											
Arsenic	180	180	100	2.82	66.3	SC-17	0 to 2 ft bml	9.77	0.765	7.93	16
Cadmium	180	180	100	0.06	4.56	SC-34	0 to 1.5 ft bml	0.563	1.05	0.36	1.3
Chromium	180	180	100	6.78	66	SC-10	2 to 4 ft bml	21.6	0.476	19.4	34.1
Copper	180	180	100	4.61	1660	SC-17	0 to 2 ft bml	67.8	2.43	34.1	98.5
Lead	180	180	100	0.86	3940	SC-17	0 to 2 ft bml	127	2.85	31.9	245
Mercury	180	172	96	0.000047	2.2	BH2-20	0 to 0.33 ft bml	0.191	1.67	0.0817	0.477
Silver	180	180	100	0.027	3.63	SC-11	4 to 6 ft bml	0.183	1.87	0.1	0.29
Zinc	180	180	100	19.3	554	SC-17	0 to 2 ft bml	79.2	0.982	59.3	138
Polycyclic Aromatic Hydrocarbons (µg/kg dw)											
2-Methylnaphthalene	180	109	61	1.14	1500	BH2-32	0 to 0.33 ft bml	72.4	2.26	27.1	133
Acenaphthene	180	115	64	0.59	3600	BH2-32	0 to 0.33 ft bml	135	3.12	33	230
Acenaphthylene	180	130	72	1.2	1100	BH2-32	0 to 0.33 ft bml	65	1.86	29	140
Anthracene	180	143	79	0.93	5500	BH2-32	0 to 0.33 ft bml	225	2.63	48	519
Fluorene	180	130	72	0.72	4200	BH2-32	0 to 0.33 ft bml	138	3.04	36	271
Naphthalene	180	142	79	1.4	3200	BH2-32	0 to 0.33 ft bml	231	1.85	84	637
Phenanthrene	180	160	89	0.73	24000	BH2-32	0 to 0.33 ft bml	823	2.9	152	1720
Benzo(a)anthracene	180	150	83	0.7	9200	BH2-32	0 to 0.33 ft bml	396	2.43	88.3	1070
Benzo(a)pyrene	180	149	83	0.8	7400	BH2-32	0 to 0.33 ft bml	375	2.17	89	982
Benzo(b)fluoranthene	134	101	75	1.47	1880	SG-23	0 to 0.33 ft bml	166	1.75	50.6	482
Benzo(g,h,i)perylene	180	148	82	1.09	3500	BH2-32	0 to 0.33 ft bml	240	1.8	77.5	649
Benzo(j)fluoranthene	134	100	75	0.56	959	SG-56	0 to 0.33 ft bml	92.8	1.74	32.2	262
Benzo(k)fluoranthene	134	101	75	0.87	1260	SG-23	0 to 0.33 ft bml	104	1.83	30.7	328
Total benzofluoranthenes	134	102	76	1.38	4090	SG-23	0 to 0.33 ft bml	358	1.78	108	1020
Chrysene	180	148	82	0.96	8900	BH2-32	0 to 0.33 ft bml	420	2.26	101	1090
Dibenzo(a,h)anthracene	180	116	64	0.93	980	BH2-32	0 to 0.33 ft bml	70.8	1.69	22.1	167
Fluoranthene	180	161	89	0.47	19000	BH2-32	0 to 0.33 ft bml	827	2.4	191	2330
Indeno(1,2,3-c,d)pyrene	180	143	79	0.94	4000	BH2-32	0 to 0.33 ft bml	237	1.91	75	607
Pyrene	180	159	88	0.7	23000	BH2-32	0 to 0.33 ft bml	935	2.46	207	2500
Low Molecular Polycyclic Aromatic Hydrocarbons	180	164	91	0.73	43100	BH2-32	0 to 0.33 ft bml	1500	2.74	305	3500
High Molecular Polycyclic Aromatic Hydrocarbons	180	164	91	5.28	76000	BH2-32	0 to 0.33 ft bml	3500	2.28	866	10200
Total cPAHs TEQ (ND = 1/2 MDL/PQL)	180	152	84	0.61	8910	BH2-32	0 to 0.33 ft bml	457	2.15	113	1220
Total cPAHs TEQ (ND = 0)	180	152	84	0.101	8910	BH2-32	0 to 0.33 ft bml	456	2.15	112	1220

Geosyntec consultants

Table 5-6. Summary Statistics for Chemicals of Potential Concern: Sediment

COPC[a]	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum	Depth of Maximum	Mean Detected Concentration	CoV Detected Concentration	Median Detected Concentration	90th %ile Detected Concentration
Polycyclic Aromatic Hydrocarbons (mg/kg OC)											
2-Methylnaphthalene	180	109	61	0.0247	158	SG-10	0 to 0.33 ft bml	2.6	5.82	0.715	1.95
Acenaphthene	180	115	64	0.0114	230	SG-10	0 to 0.33 ft bml	3.98	5.46	0.895	4.98
Acenaphthylene	180	130	72	0.0127	15.1	SG-56	0 to 0.33 ft bml	1.34	1.36	0.929	2.35
Anthracene	180	143	79	0.0182	290	SG-10	0 to 0.33 ft bml	5.93	4.21	2.01	9.17
Fluorene	180	130	72	0.0151	197	SG-10	0 to 0.33 ft bml	3.66	4.8	1.11	4.92
Naphthalene	180	142	79	0.142	157	SG-10	0 to 0.33 ft bml	5.08	2.72	2.57	9.21
Phenanthrene	180	160	89	0.0732	1930	SG-10	0 to 0.33 ft bml	25.7	6	6.8	29.5
Benzo(a)anthracene	180	150	83	0.0146	492	SG-10	0 to 0.33 ft bml	10.5	3.93	4.16	16.4
Benzo(a)pyrene	180	149	83	0.0174	546	SG-10	0 to 0.33 ft bml	10.8	4.22	4.46	17.5
Benzo(b)fluoranthene	134	101	75	0.00783	357	SG-10	0 to 0.33 ft bml	8.09	4.42	2.74	10
Benzo(g,h,i)perylene	180	148	82	0.0195	350	SG-10	0 to 0.33 ft bml	7.26	4.01	3.45	10.3
Benzo(j)fluoranthene	134	100	75	0.0105	180	SG-10	0 to 0.33 ft bml	4.52	4.08	1.58	5.83
Benzo(k)fluoranthene	134	101	75	0.00845	226	SG-10	0 to 0.33 ft bml	5.13	4.43	1.7	6.71
Total benzofluoranthenes	134	102	76	0.0268	763	SG-10	0 to 0.33 ft bml	17.5	4.36	5.86	22.4
Chrysene	180	148	82	0.0177	600	SG-10	0 to 0.33 ft bml	12	4.2	4.71	20
Dibenzo(a,h)anthracene	180	116	64	0.00571	117	SG-10	0 to 0.33 ft bml	2.41	4.53	0.94	3.37
Fluoranthene	180	161	89	0.0568	1280	SG-10	0 to 0.33 ft bml	23.3	4.42	8.62	33.3
Indeno(1,2,3-c,d)pyrene	180	143	79	0.0135	330	SG-10	0 to 0.33 ft bml	7.02	3.97	3.36	9.94
Pyrene	180	159	88	0.0557	1640	SG-10	0 to 0.33 ft bml	27.1	4.83	9.5	42.9
Low Molecular Polycyclic Aromatic Hydrocarbons	180	164	91	0.21	2970	SG-10	0 to 0.33 ft bml	43	5.45	14.9	49.2
High Molecular Polycyclic Aromatic Hydrocarbons	180	164	91	0.228	6120	SG-10	0 to 0.33 ft bml	106	4.58	42.1	174
Chlorinated Organics (µg/kg dw)											
1,2,4-Trichlorobenzene	177	0	0	ND	ND	NA		ND	ND	ND	ND
1,2-Dichlorobenzene	177	8	5	0.9	2.9	SG-04	0 to 0.33 ft bml	2.06	0.376	2.35	2.76
1,4-Dichlorobenzene	177	17	10	1.2	8	SG-23	0 to 0.33 ft bml	3.79	0.66	4	7.08
Hexachlorobenzene	177	8	5	0.9	57.2	SG-36	0 to 0.33 ft bml	9.61	2.03	1.8	24.6
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	177	0	0	ND	ND	NA		ND	ND	ND	ND
Chlorinated Organics (mg/kg OC)											
1,2,4-Trichlorobenzene	177	0	0	ND	ND	NA		ND	ND	ND	ND
1,2-Dichlorobenzene	177	8	5	0.011	1.3	SC-38	5.8 to 7.9 ft bml	0.207	2.14	0.0395	0.481
1,4-Dichlorobenzene	177	17	10	0.012	1.6	SC-38	5.8 to 7.9 ft bml	0.187	2.01	0.065	0.312
Hexachlorobenzene	177	8	5	0.022	1.8	SC-38	5.8 to 7.9 ft bml	0.557	1.17	0.345	1.44
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	177	0	0	ND	ND	NA		ND	ND	ND	ND
Organic Chemicals/Phenols (µg/kg dw)											
2,4-Dimethylphenol	177	26	15	2.6	69.6	SG-23	0 to 0.33 ft bml	13.7	1.05	8.75	30.2
2-Methylphenol (o-Cresol)	177	35	20	1.7	46.5	SG-23	0 to 0.33 ft bml	11.6	1.02	7.5	29.5
4-Methylphenol (p-Cresol)	137	77	56	1.1	2480	SC-11	8 to 10 ft bml	119	2.55	41	222
Benzoic acid	175	51	29	14.4	1140	SC-11	8 to 10 ft bml	91.7	1.79	39.7	163
Benzyl alcohol	175	20	11	2.8	72.3	SC-11	4 to 6 ft bml	20.5	0.968	12.6	54.9
Dibenzofuran	177	78	44	1.34	820	BH2-32	0 to 0.33 ft bml	107	1.49	63	217
n-Nitrosodiphenylamine	177	2	1	72	89	BH2-32	0 to 0.33 ft bml	80.5	0.149	80.5	87.3
Pentachlorophenol	177	14	8	2.1	83.4	SG-22	0 to 0.33 ft bml	12	1.75	6.75	15.4
Phenol	177	125	71	2.4	2300	BH2-37	0 to 0.33 ft bml	186	1.97	30.7	630

Table 5-6. Summary Statistics for Chemicals of Potential Concern: Sediment

COPC[a]	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum	Depth of Maximum	Mean Detected Concentration	CoV Detected Concentration	Median Detected Concentration	90th %ile Detected Concentration
Organic Chemicals/Phenols (mg/kg OC)											
Dibenzofuran	180	159	88	0.0557	22.3	SC-53	1 to 2.4 ft bml	27.1	4.83	9.5	42.9
N-Nitrosodiphenylamine	180	159	88	0.0557	1640	BH2-32	0 to 0.33 ft bml	27.1	4.83	9.5	42.9
Phthalates (µg/kg dw)											
bis(2-Ethylhexyl)phthalate	177	39	22	5.6	1900	SC-12	0 to 1.4 ft bml	87.3	3.59	15.4	58.9
Butylbenzyl phthalate	177	30	17	1.1	690	BH2-07	0 to 0.33 ft bml	89.9	1.79	7	236
Diethyl phthalate	177	33	19	20.1	193	SC-54	6.8 to 8.8 ft bml	37.8	0.893	28	44.7
Dimethyl phthalate	177	4	2	1.6	101	SC-11	8 to 10 ft bml	47.9	1.06	44.5	95
Di-n-butyl phthalate	177	17	10	5.8	112	SC-20	0 to 1.5 ft bml	38.1	0.791	43	70
Di-n-octyl phthalate	177	9	5	7.6	380	BH2-11	0 to 0.33 ft bml	166	0.874	96	356
Phthalates (mg/kg OC)											
bis(2-Ethylhexyl)phthalate	177	39	22	0.0807	17.4	SC-38	5.8 to 7.9 ft bml	2.94	1.35	1.08	8.8
Butyl benzyl phthalate	177	30	17	0.016	10.9	BH2-18	0 to 0.33 ft bml	1.56	1.52	0.585	3.61
Diethyl phthalate	177	33	19	0.116	160	SC-54	6.6 to 8.8 ft bml	8.64	3.21	2.14	8.5
Dimethyl phthalate	177	4	2	0.041	33.8	SG-25	0 to 0.33 ft bml	8.55	1.97	0.176	23.8
Di-n-butyl phthalate	177	17	10	0.0345	66.6	SC-38	5.8 to 7.9 ft bml	10.5	1.64	3.42	26.1
Di-n-Octyl Phthalate	177	9	5	0.042	11	BH2-40	0 to 0.33 ft bml	3.6	1	2.46	7.69
Dioxins and Furans (ng/kg dw)											
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	133	111	83	0.0416	16.8	SG-10	0 to 0.33 ft bml	1.1	2.27	0.393	1.58
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=1/2 MDL/PQL)	133	133	100	0.377	1380	SC-34	1.5 to 3.3 ft bml	36.2	4.73	3.71	22
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=0)	133	133	100	0.201	1380	SC-34	1.5 to 3.3 ft bml	35.1	4.88	2.72	21.8

Acronyms:

% = percent
µg/kg = micrograms per kilogram
CAS = chemical abstract service
COPC = chemical of potential concern
CoV = coefficient of variance
bml = below mudline
dw = dry weight
ft = feet
mg/kg = milligrams per kilogram
MDL = method detection limit
N/A = not applicable
ND = non=detect
ng/kg= nanograms per kilogram
OC = organic carbon
PQL = practical quantitation limit

Table 5-7. Identification of Chemicals of Concern: Soil

COPC[a]	Maximum Detected Concentration	Maximum MDL/PQL[b]	Screening Level	Basis of Preliminary SL[a]	Number of Samples Analyzed	Number of Detected Results	Detection Frequency	Number of Detections Exceeding SL	Detections FOE	No. of NDs Exceedances	NDs FOE	Total FOE[c]	Proceed[d]	Rationale
Metals (mg/kg)														
Arsenic	60.3	NA	7	Natural Background	159	159	100%	80	50%	NA	NA	50%	Yes	Max>SL
Cadmium	1.7	1.93	1	Natural Background	159	145	91%	7	4%	1	0.6%	5%	No	FOE<5%
Chromium	92.7	NA	48	Natural Background	159	159	100%	23	14%	NA	NA	14%	Yes	Max>SL
Copper	778	NA	36	Natural Background	154	154	100%	115	75%	NA	NA	75%	Yes	Max>SL
Lead	5160	NA	50	Ecological - Plants	159	159	100%	72	45%	NA	NA	45%	Yes	Max>SL
Mercury	2.17	0.137	0.07	Natural Background	147	129	88%	55	37%	2	1%	39%	Yes	Max>SL
Zinc	1540	NA	85	Natural Background	154	154	100%	93	60%	NA	NA	60%	Yes	Max>SL
Petroleum Hydrocarbons (mg/kg)														
Diesel Range Organics (DRO)	4010	28	200	MTCA TEE Soil Biota[e]	145	92	63%	11	8%	0	0%	8%	Yes	Max>SL
Lube Oil	10500	17.1	--		145	111	77%	28	19%	0	0%	19%	Yes	Max>SL
Polycyclic Aromatic Hydrocarbons (µg/kg)														
1-Methylnaphthalene	979	61.7	4.2	Protection of Groundwater - Saturated	156	55	35%	46	29%	83	53%	83%	Yes	Max>SL
2-Methylnaphthalene	2140	59.8	88	Protection of Groundwater - Saturated	159	75	47%	15	9%	0	0%	9%	Yes	Max>SL
Acenaphthene	2080	29.4	160	Protection of Marine Surface Water	159	71	45%	9	6%	0	0%	6%	Yes	Max>SL
Anthracene	4430	27.4	2400	Protection of Marine Surface Water	159	121	76%	3	2%	0	0%	2%	No	FOE<5%
Fluorene	2780	55.5	80	Protection of Marine Surface Water	159	91	57%	15	9%	0	0%	9%	Yes	Max>SL
Naphthalene	6150	19.1	240	Protection of Groundwater - Saturated	159	123	77%	15	9%	0	0%	9%	Yes	Max>SL
Benzo(a)anthracene	17300	22.9	0.057	Protection of Marine Surface Water	159	133	84%	133	84%	26	16%	100%	Yes	Max>SL
Benzo(a)pyrene	16900	15	0.016	Protection of Marine Surface Water	159	127	80%	127	80%	32	20%	100%	Yes	Max>SL
Benzo(b)fluoranthene	10200	15	0.096	Protection of Marine Surface Water	159	127	80%	127	80%	32	20%	100%	Yes	Max>SL
Benzo(k)fluoranthene	6700	14.8	0.94	Protection of Marine Surface Water	159	131	82%	128	81%	8	5%	86%	Yes	Max>SL
2-Chloronaphthalene	NA	59.8	280	Protection of Marine Surface Water	156	0	0%	0	0%	0	0%	0%	No	Max<SL
Chrysene	18300	6	2.9	Protection of Marine Surface Water	159	140	88%	128	81%	3	2%	82%	Yes	Max>SL
Dibenzo(a,h)anthracene	2450	22.9	0.029	Protection of Marine Surface Water	159	113	71%	113	71%	46	29%	100%	Yes	Max>SL
Fluoranthene	41400	5	300	Protection of Marine Surface Water	159	148	93%	30	19%	0	0%	19%	Yes	Max>SL
Indeno(1,2,3-c,d)pyrene	10300	15	0.31	Protection of Marine Surface Water	159	127	80%	127	80%	32	20%	100%	Yes	Max>SL
Pyrene	47100	5.7	550	Protection of Marine Surface Water	159	147	92%	19	12%	0	0%	12%	Yes	Max>SL
Dibenzofuran	2540	59.8	76	Protection of Groundwater - Saturated	156	54	35%	17	11%	0	0%	11%	Yes	Max>SL
Phenols (µg/kg)														
2,4,5-Trichlorophenol	NA	299	1100	Protection of Marine Surface Water	152	0	0%	0	0%	0	0%	0%	No	DF<5%
2,4,6-Trichlorophenol	NA	299	0.19	Protection of Marine Surface Water	152	0	0%	0	0%	152	100%	100%	No	DF<5%
2,4-Dichlorophenol	NA	299	4.3	Protection of Marine Surface Water	152	0	0%	0	0%	152	100%	100%	No	DF<5%
2,4-Dimethylphenol	235	299	76	Protection of Marine Surface Water	143	7	5%	3	2%	13	9%	11%	No	FOE<5%
2,4-Dinitrophenol	NA	598	9.2	Protection of Groundwater - Saturated	152	0	0%	0	0%	152	100%	100%	No	DF<5%
2-Chlorophenol	NA	138	11	Protection of Marine Surface Water	152	0	0%	0	0%	152	100%	100%	No	DF<5%
2-Methylphenol (o-Cresol)	316	66.5	470	Protection of Groundwater - Saturated	156	13	8%	0	0%	0	0%	0%	No	Max<SL
4,6-Dinitro-2-methylphenol	NA	598	1.3	Protection of Groundwater - Saturated	152	0	0%	0	0%	152	100%	100%	No	DF<5%
4-Chloro-3-Methylphenol	NA	299	28	Protection of Marine Surface Water	152	0	0%	0	0%	25	16%	16%	No	DF<5%
4-Methylphenol (p-Cresol)	1000	73.8	940	Protection of Groundwater - Saturated	156	27	17%	2	1%	0	0%	1%	No	FOE<5%
Phenol	301	99.4	2300	Protection of Marine Surface Water	155	68	44%	0	0%	0	0%	0%	No	DF<5%
Pentachlorophenol	NA	312	0.0018	Protection of Groundwater - Saturated	152	0	0%	0	0%	152	100%	100%	No	DF<5%
Phthalates (µg/kg)														
bis(2-Ethylhexyl)phthalate	524	101	5.1	Protection of Marine Surface Water	156	48	31%	48	31%	107	69%	99%	Yes	Max>SL
Butylbenzyl phthalate	15.4	94	0.18	Protection of Marine Surface Water	156	2	1%	2	1%	154	99%	100%	No	DF<5%
Diethyl phthalate	257	294	74	Protection of Marine Surface Water	156	27	17%	5	3%	11	7%	10%	No	FOE<5%
Dimethyl phthalate	6.6	59.8	190	Protection of Marine Surface Water	156	2	1%	0	0%	0	0%	0%	No	DF<5%
Di-n-butyl phthalate	183	59.8	15	Protection of Marine Surface Water	156	14	9%	9	6%	18	12%	17%	Yes	Max>SL
Di-n-octyl phthalate	NA	59.8	23000	Protection of Groundwater - Saturated	156	0	0%	0	0%	0	0%	0%	No	DF<SL

Table 5-7. Identification of Chemicals of Concern: Soil

COPC[a]	Maximum Detected Concentration	Maximum MDL/PQL[b]	Screening Level	Basis of Preliminary SL[a]	Number of Samples Analyzed	Number of Detected Results	Detection Frequency	Number of Detections Exceeding SL	Detections FOE	No. of NDs Exceedances	NDs FOE	Total FOE[c]	Proceed[d]	Rationale
Dioxins and Furans (ng/kg)														
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	515	0.35	0.0013	Protection of Surface Water	164	154	94%	154	94%	10	6%	100%	Yes	Max>SL
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	4140	2.5	9.8	Protection of Groundwater - Saturated	164	145	88%	20	12%	0	0%	12%	Yes	Max>SL
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=1/2 MDL/PQL)	11387.4	NA	5.2	Natural Background	164	164	100%	82	50%	0	0%	50%	Yes	Max>SL
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=0)	11387.4	NA	5.2	Natural Background	164	164	100%	80	49%	0	0%	49%	Yes	Max>SL

Notes:
Gray filled cells indicate COPC not identified as a COC.

Footnotes:
a. The basis of the SL was the maximum between a representative background and the risk-based value. The sources of the SLs include:
Background. Natural Background Soil Metals Concentrations in Washington State, Puget Sound 90th percentile (Ecology, 1994) and Natural Background for Dioxins/Furans in Washington State Soils (Ecology, 2010).
Human Health risk-based values. Washington State Department of Ecology. Cleanup Levels and Risk Calculation (CLARC) Tables (Ecology, 2024).
Ecological risk-based values. the Model Toxics Control Act (MTCA) Regulation, Chapter 173-340 WAC Table 749-3.
b. The selected non-detect value presented was either the maximum MDL or the PQL. Selection of either the MDL or PQL as the non-detect value for a sample was reviewed during data validation discussed in Section 6.4 of the report.
c. The total FOE was based on the number of detected results that exceed the SL plus the number of MDLs/PQLs that exceeded the SL.
d. Identification of a COPC as a COC was based on the following criteria:
If the DF or detections FOE of the COPC was less than or equal to 5%, the COPC was not identified as a COC.
If the maximum detected concentration of the COPC was less than the SL, the COPC was not identified as a COC.
e. The SL for petroleum hydrocarbons was applied to the sum of DRO and lube oil results.
f. The TCDD TEQ was calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #13 (Ecology, 2016).

Acronyms:
-- - not applicable/not available
% = percent
< = less than
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
COPC = chemical of potential concern
COC = chemical of concern
DRO = diesel range organics
DF = detection frequency
FOE = frequency of exceedance
MDL = method detection limit
PQL = practical quantitation limit
SL = screening level
TCDD = 2,3,7,8 Tetrachlorodibenzodioxin
TEE = terrestrial ecological evaluation
TEQ = toxicity equivalent
WAC = Washington Administrative Code

References:
Washington Department of Ecology (Ecology). 1994. Natural Background Soil Metals Concentrations in Washington State. Toxics Cleanup Program. Publication #94-115. October.
Ecology. 2010. Technical Memorandum #8 Natural Background for Dioxins/Furans in WA Soils. Toxics Cleanup Program. Publication #10-09-053. August.
Ecology. 2015. Implementation Memorandum #10: Evaluating the Human Health Toxicity of Carcinogenic PAHs (cPAHs) using Toxicity Equivalency Factors (TEFs). Toxics Cleanup Program. Publication # 15-09-049. April.
Ecology. 2016. Implementation Memorandum #13: Dioxins, Furans, and Dioxin-Like PCB Congeners: Ecological Risk Calculation Methodology for Upland Soil. Toxics Cleanup Program. Publication # 16-09-044. July.
Ecology. 2024. Cleanup Levels and Risk Calculation Tables. February update. Available at: https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/clarc/data-tables.

Table 5-8. Identification of Chemicals of Concern: Groundwater

COPC	Maximum Detected Concentration	Screening Level	Basis of Preliminary SL[a]	Number of Samples Analyzed	Number of Detected Results	Detection Frequency	Number of Detected Exceedances	Detections FOE	Maximum MDL/PQL[b]	Number of ND Exceedances	ND FOE	Total FOE[c]	Proceed[d]	Rationale
Total Metals (µg/L)														
Arsenic	4.24	8	Natural Background	21	21	100%	0	0%	NA	NA	NA	0%	No	Max<SL
Cadmium	0.42 J	5	MTCA Method A - MCL	21	3	14%	0	0%	0.6	0	0%	0%	No	Max<SL
Chromium	335	50	MTCA Method A	21	16	76%	4	19%	10	0	0%	19%	No	See Dissolved
Copper	23.1	640	MTCA Method B Non Cancer	21	6	29%	0	0%	10	0	0%	0%	No	Max<SL
Lead	8.3 J+	15	MTCA Method A - MCL	21	4	19%	0	0%	2	0	0%	0%	No	Max<SL
Mercury	0.026 J	2	MTCA Method A - MCL	21	6	29%	0	0%	0.1	0	0%	0%	No	Max<SL
Zinc	123	4800	MTCA Method B Non Cancer	21	4	19%	0	0%	58.4	0	0%	0%	No	Max<SL
Dissolved Metals (µg/L)														
Arsenic	2.55	8	Natural Background	21	14	67%	0	0%	4	0	0%	0%	No	Max<SL
Cadmium	0.59 J	5	MTCA Method A - MCL	21	4	19%	0	0%	0.6	0	0%	0%	No	Max<SL
Chromium	16	50	MTCA Method A	21	13	62%	0	0%	10	0	0%	0%	No	Max<SL
Copper	9.16	640	MTCA Method B Non Cancer	21	3	14%	0	0%	5	0	0%	0%	No	Max<SL
Lead	ND	15	MTCA Method A - MCL	21	0	0%	0	0%	1.03	0	0%	0%	No	DF<5%
Mercury	0.021 J	2	MTCA Method A - MCL	21	4	19%	0	0%	0.1	0	0%	0%	No	Max<SL
Zinc	42.2 J	4800	MTCA Method B Non Cancer	21	1	5%	0	0%	58.4	0	0%	0%	No	Max<SL
Petroleum Hydrocarbons (µg/L)														
Diesel Range Organics (DRO)[e]	205	500	MTCA Method A	21	1	5%	0	0%	100	0	0%	0%	No	Max<SL
Motor Oil Range Organics (ORO)	251	500	MTCA Method A	21	1	5%	0	0%	200	0	0%	0%	No	Max<SL
Polycyclic Aromatic Hydrocarbons (µg/L)														
1-Methylnaphthalene	ND	1.5	MTCA Method B Cancer	21	0	0%	0	0%	0.06	0	0%	0%	No	DF<5%
2-Methylnaphthalene	ND	32	MTCA Method B Non Cancer	21	0	0%	0	0%	0.6	0	0%	0%	No	DF<5%
Acenaphthene	ND	480	MTCA Method B Non Cancer	21	0	0%	0	0%	0.06	0	0%	0%	No	DF<5%
Anthracene	ND	2400	MTCA Method B Non Cancer	21	0	0%	0	0%	0.07	0	0%	0%	No	DF<5%
Fluorene	ND	320	MTCA Method B Non Cancer	21	0	0%	0	0%	0.05	0	0%	0%	No	DF<5%
Naphthalene	ND	160	MTCA Method B Non Cancer	21	0	0%	0	0%	0.05	0	0%	0%	No	DF<5%
Benzo(a)anthracene	ND	--	--	21	0	0%	NA	NA	0.14	NA	NA	NA	No	See total
Benzo(a)pyrene	ND	0.023	MTCA Method B Cancer	21	0	0%	0	0%	0.17	21	100%	100%	No	DF<5%
Benzo(b)fluoranthene	ND	--	--	21	0	0%	NA	NA	0.26	NA	NA	NA	No	See total
Benzo(k)fluoranthene	ND	--	--	21	0	0%	NA	NA	0.26	NA	NA	NA	No	See total
beta-chloronaphthalene	ND	640	MTCA Method B Non Cancer	21	0	0%	0	0%	0.6	0	0%	0%	No	DF<5%
Chrysene	ND	--	--	21	0	0%	NA	NA	0.17	NA	NA	NA	No	See total
Dibenzo(a,h)anthracene	ND	--	--	21	0	0%	NA	NA	0.27	NA	NA	NA	No	See total
Fluoranthene	ND	640	MTCA Method B Non Cancer	21	0	0%	0	0%	0.05	0	0%	0%	No	DF<5%
Indeno(1,2,3-c,d)pyrene	ND	--	--	21	0	0%	NA	NA	0.25	NA	NA	NA	No	See total
Pyrene	ND	240	MTCA Method B Non Cancer	21	0	0%	0	0%	0.08	0	0%	0%	No	DF<5%
Dibenzofuran	ND	8	MTCA Method B Non Cancer	21	0	0%	0	0%	0.6	0	0%	0%	No	DF<5%
Total cPAHs TEQ (ND = 1/2 MDL/PQL)[f]	ND	0.023	MTCA Method B Cancer	21	0	0%	0	0%	0.3	21	100%	100%	No	DF<5%
Total cPAHs TEQ (ND = 0)[f]	ND	0.023	MTCA Method B Cancer	21	0	0%	0	0%	0.3	0	0%	0%	No	DF<5%
Phenols (µg/L)														
2-Chlorophenol	ND	40	MTCA Method B Non Cancer	21	0	0%	0	0%	0.6	0	0%	0%	No	DF<5%
2-Methylphenol (o-Cresol)	ND	800	MTCA Method B Non Cancer	21	0	0%	0	0%	0.6	0	0%	0%	No	DF<5%
2,4-Dichlorophenol	ND	48	MTCA Method B Non Cancer	21	0	0%	0	0%	2.6	0	0%	0%	No	DF<5%
2,4-Dimethylphenol	ND	320	MTCA Method B Non Cancer	21	0	0%	0	0%	3	0	0%	0%	No	DF<5%
2,4-Dinitrophenol	ND	32	MTCA Method B Non Cancer	21	0	0%	0	0%	5	0	0%	0%	No	DF<5%
2,4,5-Trichlorophenol	ND	1600	MTCA Method B Non Cancer	21	0	0%	0	0%	3	0	0%	0%	No	DF<5%
2,4,6-Trichlorophenol	ND	8	MTCA Method B Cancer	21	0	0%	0	0%	3.4	0	0%	0%	No	DF<5%
4-Chloro-3-Methylphenol	ND	1600	MTCA Method B Non Cancer	21	0	0%	0	0%	2.7	0	0%	0%	No	DF<5%
4-Methylphenol (p-Cresol)	ND	1600	MTCA Method B Non Cancer	21	0	0%	0	0%	0.8	0	0%	0%	No	DF<5%
4,6-Dinitro-2-methylphenol	ND	1.3	MTCA Method B Non Cancer	21	0	0%	0	0%	7.1	21	100%	100%	No	DF<5%
Phenol	ND	4800	MTCA Method B Non Cancer	21	0	0%	0	0%	0.7	0	0%	0%	No	DF<5%
Pentachlorophenol	ND	0.22	MTCA Method B Cancer	21	0	0%	0	0%	3.6	21	100%	100%	No	DF<5%
Phthalates (µg/L)														
bis(2-Ethylhexyl)phthalate	0.7 J	6	MTCA Method B Non Cancer	21	1	5%	0	0%	1	0	0%	0%	No	DF<5%
Butylbenzyl phthalate	ND	46	MTCA Method B Cancer	21	0	0%	0	0%	1.1	0	0%	0%	No	DF<5%
Diethyl phthalate	0.4 J	13000	MTCA Method B Non Cancer	21	1	5%	0	0%	0.8	0	0%	0%	No	DF<5%
Di-n-butyl phthalate	ND	1600	MTCA Method B Non Cancer	21	0	0%	0	0%	0.8	0	0%	0%	No	DF<5%
Di-n-octyl phthalate	ND	160	MTCA Method B Non Cancer	21	0	0%	0	0%	0.8	0	0%	0%	No	DF<5%

Table 5-8. Identification of Chemicals of Concern: Groundwater

COPC	Maximum Detected Concentration	Screening Level	Basis of Preliminary SL[a]	Number of Samples Analyzed	Number of Detected Results	Detection Frequency	Number of Detected Exceedances	Detections FOE	Maximum MDL/PQL[b]	Number of ND Exceedances	ND FOE	Total FOE[c]	Proceed[d]	Rationale
Dioxins and Furans (ng/L)														
2,3,7,8 Tetrachlorodibenzodioxin (TCDD)	ND	0.00034	MTCA Method B Cancer	21	0	0%	0	0%	4.27	21	100%	100%	No	DF<5%
1,2,3,4,7,8 Hexachlorodibenzodioxin (HxCDD)	0.00105 J	0.014	MTCA Method B Cancer	21	1	5%	0	0%	4.28	0	0%	0%	No	DF<5%
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=1/2 MDL/PQL)[g]	0.00529	0.00034	MTCA Method B Cancer	21	8	38%	5	24%	0.00253	13	62%	86%	Yes	Max>SL
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=0)[g]	0.00315	0.00034	MTCA Method B Cancer	21	8	38%	2	10%	0.0253	13	62%	71%	Yes	Max>SL

Notes:
Gray filled cells indicate COPC not identified as a COC.

Footnotes:
a. The basis of the selected SL was the maximum between a representative background and the risk-based value. The sources of the SLs include:
Background. Natural Background Groundwater Arsenic Concentrations in Washington State (Ecology, 2021).
Human Health risk-based values. Washington State Department of Ecology. Cleanup Levels and Risk Calculation (CLARC) Tables (Ecology, 2024).
b. The selected ND value presented was either the maximum MDL or PQL. Selection of either the MDL or PQL as the ND value for a sample was reviewed during data validation discussed in Section 6.4 of the report.
c. The total FOE was based on the number of detected results that exceed the selected SL plus the number of MDLs/PQLs that exceeded the SL.
d. Identification of a COPC as a COC was based on the following criteria:
If the DF or detections FOE of the COPC was less than or equal to 5%, the COPC was not identified as a COC.
If the maximum detected concentration of the COPC was less than the SL, the COPC was not identified as a COC.
e. The SL for petroleum hydrocarbons was applied to the sum of DRO and ORO results.
f. The cPAH TEQ was calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #10 (Ecology, 2015) for the following COPCs: Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, and Indeno(1,2,3-cd)pyrene.
g. The TCDD TEQ was calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #13 (Ecology, 2016).

Acronyms:

-- = not applicable/not available	COC = chemical of concern	FOE = frequency of exceedance	PQL = practical quantitation limit	WAC = Washington Administrative Code
% = percent	COPC = chemical of potential concern	MDL = method detection limit	SL = screening level	
< = less than	cPAH = carcinogenic polycyclic aromatic hydrocarbons	MTCA = Model Toxics Control Act	TCDD = 2,3,7,8 Tetrachlorodibenzodioxin	
µg/L = micrograms per liter	DRO = diesel range organics	ND = no detection	TEE = terrestrial ecological evaluation	
CAS = chemical abstract service	DF = detection frequency	ORO = motor oil range organics	TEQ = toxicity equivalent	

References:
Washington Department of Ecology (Ecology). 2010. Technical Memorandum #8 Natural Background for Dioxins/Furans in WA Soils. Toxics Cleanup Program. Publication #10-09-053. August.
Ecology. 2015. Implementation Memorandum #10: Evaluating the Human Health Toxicity of Carcinogenic PAHs (cPAHs) using Toxicity Equivalency Factors (TEFs). Toxics Cleanup Program. Publication # 15-09-049. April.
Ecology. 2016. Implementation Memorandum #13: Dioxins, Furans, and Dioxin-Like PCB Congeners: Ecological Risk Calculation Methodology for Upland Soil. Toxics Cleanup Program. Publication # 16-09-044. July.
Ecology. 2021. Natural Background Groundwater Arsenic Concentrations in Washington State: Study Results. Toxics Cleanup Program. Publication # 14-09-044. January.
Ecology. 2024. Cleanup Levels and Risk Calculation Tables. February update. Available at: https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/clarc/data-tables.

Table 5-9. Identification of Chemicals of Concern: Sediment

COPC	Bioaccumulative? (Yes/No)[a]	Maximum Detected	Maximum MDL/PQL[c]	Screening Level	Basis of Preliminary/Refined SL[b]	Number of Samples Analyzed	Number of Detected Results	Detection Frequency	Number of Detections Compared to SL	Number of Detections Exceeding SL	Detections FOE	Number of ND Exceeding SL	ND FOE	Total FOE[d]	Proceed[e]	Rationale
Metals (mg/kg dw)																
Arsenic	Yes	66.3	NA	11	Bioaccumulative SCO	180	180	100%	180	50	28%	0	NA	28%	Yes	Max>SL
Cadmium	Yes	4.56	NA	0.8	Bioaccumulative SCO	180	180	100%	180	35	19%	0	NA	19%	Yes	Max>SL
Chromium	No	66	NA	260	Benthic SCO	180	180	100%	180	0	0%	0	NA	0%	No	Max<SL
Copper	No	1660	NA	390	Benthic SCO	180	180	100%	180	4	2%	0	NA	2%	No	FOE<5%
Lead	Yes	3940	NA	21	Bioaccumulative SCO	180	180	100%	180	104	58%	0	NA	58%	Yes	Max>SL
Mercury	Yes	2.2	0.028	0.2	Bioaccumulative SCO	180	172	96%	172	44	24%	0	0%	24%	Yes	Max>SL
Silver	No	3.63	NA	6.1	Benthic SCO/CSL	180	180	100%	180	0	0%	0	NA	0%	No	Max<SL
Zinc	No	554	NA	410	Benthic SCO	180	180	100%	180	3	2%	0	NA	2%	No	FOE<5%
Polycyclic Aromatic Hydrocarbons (µg/kg dw)																
2-Methylnaphthalene	No	1500	140	670	Marine AET SCO/CSL	180	109	61%	72	1	1%	0	0%	1%	No	FOE<5%
Acenaphthene	No	3600	49	500	Marine AET SCO/CSL	180	115	64%	77	6	3%	0	0%	3%	No	FOE<5%
Acenaphthylene	No	1100	67	1300	Marine AET SCO/CSL	180	130	72%	80	0	0%	0	0%	0%	No	Max<SL
Anthracene	Yes	5500	49	960	Marine AET SCO/CSL	180	143	79%	90	5	3%	0	0%	3%	No	FOE<5%
Fluorene	No	4200	13	540	Marine AET SCO/CSL	180	130	72%	80	4	2%	0	0%	2%	No	FOE<5%
Naphthalene	No	3200	40	2100	Marine AET SCO/CSL	180	142	79%	89	1	1%	0	0%	1%	No	FOE<5%
Phenanthrene	No	24000	29	1500	Marine AET SCO/CSL	180	160	89%	105	21	12%	0	0%	12%	Yes	Max>SL
Benzo(a)anthracene	No	9200	0.86	1300	Marine AET SCO/CSL	180	150	83%	96	9	5%	0	0%	5%	No	FOE=5%
Benzo(a)pyrene	No	7400	31	1600	Marine AET SCO/CSL	180	149	83%	95	5	3%	0	0%	3%	No	FOE<5%
Benzo(b)fluoranthene	Yes	1880	1.43	--	--	134	101	75%	61	0	0%	0	0%	0%	No	See total
Benzo(g,h,i)perylene	Yes	3500	22	670	Marine AET SCO	180	148	82%	95	14	8%	0	0%	8%	Yes	Max>SL
Benzo(j)fluoranthene	Yes	959	2.04	--	--	134	100	75%	61	0	0%	0	0%	0%	No	See total
Benzo(k)fluoranthene	Yes	1260	0.79	--	--	134	101	75%	61	0	0%	0	0%	0%	No	See total
Total benzofluoranthenes	Yes	4086	5.22	3200	Marine AET SCO	134	102	76%	62	2	1%	0	0%	1%	No	FOE<5%
Chrysene	No	8900	31	1400	Marine AET SCO	180	148	82%	95	10	6%	0	0%	6%	Yes	Max>SL
Dibenzo(a,h)anthracene	Yes	980	190	230	Marine AET SCO/CSL	180	116	64%	76	8	4%	0	0%	4%	No	FOE<5%
Fluoranthene	Yes	19000	0.49	1700	Marine AET SCO	180	161	89%	105	21	12%	0	0%	12%	Yes	Max>SL
Indeno(1,2,3-c,d)pyrene	Yes	4000	12	600	Marine AET SCO	180	143	79%	90	15	8%	0	0%	8%	Yes	Max>SL
Pyrene	Yes	23000	5	2600	Marine AET SCO	180	159	88%	103	15	8%	0	0%	8%	Yes	Max>SL
Low Molecular Polycyclic Aromatic Hydrocarbons[f]	No	43100	140	5200	Marine AET SCO	180	164	91%	108	9	5%	0	0%	5%	No	FOE=5%
High Molecular Polycyclic Aromatic Hydrocarbons[g]	Yes	75980	5.22	12000	Marine AET SCO	180	164	91%	107	9	5%	0	0%	5%	No	FOE=5%
Total cPAHs TEQ (ND = 1/2 MDL/PQL)[h]	Yes	8907	5.22	21	Bioaccumulative SCO	180	152	84%	97	124	69%	0	0%	69%	Yes	Max>SL
Total cPAHs TEQ (ND = 0)[i]	Yes	8907	5.22	21	Bioaccumulative SCO	180	152	84%	97	124	69%	0	0%	69%	Yes	Max>SL
Polycyclic Aromatic Hydrocarbons (mg/kg OC)																
2-Methylnaphthalene	No	158	26.7	38	Benthic SCO	180	109	61%	37	1	1%	0	0%	1%	No	FOE<5%
Acenaphthene	No	230	13.3	16	Benthic SCO	180	115	64%	38	3	2%	0	0%	2%	No	FOE<5%
Acenaphthylene	No	15.1	13.3	66	Benthic SCO/CSL	180	130	72%	50	0	0%	0	0%	0%	No	Max<SL
Anthracene	Yes	290	13.3	220	Benthic SCO	180	143	79%	53	1	1%	0	0%	1%	No	FOE<5%
Fluorene	No	197	13.3	23	Benthic SCO	180	130	72%	50	3	2%	0	0%	2%	No	FOE<5%
Naphthalene	No	157	13.3	99	Benthic SCO	180	142	79%	53	1	1%	0	0%	1%	No	FOE<5%
Phenanthrene	No	1930	31.1	100	Benthic SCO	180	160	89%	55	4	2%	0	0%	2%	No	FOE<5%
Benzo(a)anthracene	No	492	1.4	110	Benthic SCO	180	150	83%	54	1	1%	0	0%	1%	No	FOE<5%
Benzo(a)pyrene	No	546	31.1	99	Benthic SCO	180	149	83%	54	1	1%	0	0%	1%	No	FOE<5%
Benzo(b)fluoranthene	Yes	357	2.28	--	--	134	101	75%	40	0	0%	0	0%	0%	See total	
Benzo(g,h,i)perylene	Yes	350	31.1	31	Benthic SCO	180	148	82%	53	2	1%	0	0%	1%	No	FOE<5%
Benzo(j)fluoranthene	Yes	180	1.1	--	--	134	100	75%	39	0	0%	0	0%	0%	See total	
Benzo(k)fluoranthene	Yes	226	1.3	--	--	134	101	75%	40	0	0%	0	0%	0%	See total	
Total benzofluoranthenes	Yes	763	8.32	230	Benthic SCO	134	102	76%	40	1	1%	0	0%	1%	No	FOE<5%
Chrysene	No	600	31.1	110	Benthic SCO	180	148	82%	53	2	1%	0	0%	1%	No	FOE<5%
Dibenzo(a,h)anthracene	Yes	117	26.7	12	Benthic SCO	180	116	64%	40	2	1%	0	0%	1%	No	FOE<5%
Fluoranthene	Yes	1280	0.78	160	Benthic SCO	180	161	89%	56	2	1%	0	0%	1%	No	FOE<5%
Indeno(1,2,3-c,d)pyrene	Yes	330	21.3	34	Benthic SCO	180	143	79%	53	2	1%	0	0%	1%	No	FOE<5%
Pyrene	Yes	1640	3.84	1000	Benthic SCO	180	159	88%	56	1	1%	0	0%	1%	No	FOE<5%
Low Molecular Polycyclic Aromatic Hydrocarbons[f]	No	2974	31.1	370	Benthic SCO	180	164	91%	56	2	1%	0	0%	1%	No	FOE<5%
High Molecular Polycyclic Aromatic Hydrocarbons[g]	Yes	6118	8.32	960	Benthic SCO	180	164	91%	57	2	1%	0	0%	1%	No	FOE<5%
Chlorinated Organics (µg/kg dw)																
1,2,4-Trichlorobenzene	No	NA	95	31	Marine AET SCO	177	0	0%	0	0	0%	0	0%	0%	No	DF<5%
1,2-Dichlorobenzene	No	2.9	190	35	Marine AET SCO	177	8	5%	6	0	0%	0	0%	0%	No	Max<SL
1,4-Dichlorobenzene	No	8	130	110	Marine AET SCO/CSL	177	17	10%	12	0	0%	0	0%	0%	No	Max<SL
Hexachlorobenzene	Yes	57.2	240	22	Marine AET SCO	177	8	5%	5	1	1%	0	0%	1%	No	FOE<5%
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	Yes	NA	240	11	Marine AET SCO	177	0	0%	0	0	0%	0	0%	0%	No	DF<5%
Chlorinated Organics (mg/kg OC)																
1,2,4-Trichlorobenzene	No	NA	26.7	0.81	Benthic SCO	177	0	0%	0	0	0%	0	0%	0%	No	DF<5%
1,2-Dichlorobenzene	No	1.3	26.7	2.3	Benthic SCO/CSL	177	8	5%	2	0	0%	0	0%	0%	No	Max<SL
1,4-Dichlorobenzene	No	1.6	26.7	3.1	Benthic SCO	177	17	10%	5	0	0%	0	0%	0%	No	Max<SL
Hexachlorobenzene	Yes	1.8	26.7	0.38	Benthic SCO	177	8	5%	3	3	2%	0	0%	2%	No	Max<SL
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	Yes	NA	26.7	3.9	Benthic SCO	177	0	0%	0	0	0%	0	0%	0%	No	DF<5%

Table 5-9. Identification of Chemicals of Concern: Sediment

COPC	Bioaccumulative? (Yes/No)[a]	Maximum Detected	Maximum MDL/PQL[c]	Screening Level	Basis of Preliminary/Refined SL[b]	Number of Samples Analyzed	Number of Detected Results	Detection Frequency	Number of Detections Compared to SL	Number of Detections Exceeding SL	Detections FOE	Number of ND Exceeding SL	ND FOE	Total FOE[d]	Proceed[e]	Rationale
Organic Chemicals/Phenols (µg/kg dw)																
2,4-Dimethylphenol[i]	No	69.6	240	29	Marine AET SCO/CSL	177	26	15%	20	0	0%	0	0%	0%	No	FOE<5%
2-Methylphenol (o-Cresol)	No	46.5	150	63	Marine AET SCO/CSL	177	35	20%	26	0	0%	0	0%	0%	No	Max<SL
4-Methylphenol (p-Cresol)	No	2480	7.4	670	Marine AET SCO/CSL	137	77	56%	48	2	1%	0	0%	1%	No	FOE<5%
Benzoic acid	No	1140	9100	650	Marine AET SCO/CSL	175	51	29%	36	1	1%	0	0%	1%	No	FOE<5%
Benzyl alcohol	No	72.3	1200	57	Marine AET SCO	175	20	11%	13	2	1%	0	0%	1%	No	FOE<5%
Dibenzofuran	No	820	93	540	Marine AET SCO/CSL	177	78	44%	54	3	2%	0	0%	2%	No	FOE<5%
n-Nitrosodiphenylamine	No	89	130	28	Marine AET SCO	177	2	1%	2	2	1%	0	0%	1%	No	FOE<5%
Pentachlorophenol	Yes	83.4	2100	360	Marine AET SCO	177	14	8%	9	0	0%	0	0%	0%	No	Max<SL
Phenol	No	2300	230	420	Marine AET SCO	177	125	71%	80	18	10%	0	0%	10%	Yes	Max>SL
Organic Chemicals/Phenols (mg/kg OC)																
Dibenzofuran	No	1640	3.84	15	Benthic SCO	180	159	88%	56	1	1%	0	0%	1%	No	FOE<5%
N-Nitrosodiphenylamine	No	1640	3.84	11	Benthic SCO/CSL	180	159	88%	56	1	1%	0	0%	1%	No	FOE<5%
Phthalates (µg/kg dw)																
bis(2-Ethylhexyl)phthalate	No	1900	1100	1300	Marine AET SCO	177	39	22%	9	1	1%	0	0%	1%	No	FOE<5%
Butylbenzyl phthalate	No	690	800	63	Marine AET SCO	177	30	17%	7	11	6%	0	0%	6%	Yes	Max>SL
Diethyl phthalate	No	193	1200	200	Marine AET SCO	177	33	19%	11	0	0%	0	0%	0%	No	Max<SL
Dimethyl phthalate	No	101	200	71	Marine AET SCO	177	4	2%	1	2	1%	0	0%	1%	No	FOE<5%
Di-n-butyl phthalate	No	112	900	1400	Marine AET SCO/CSL	177	17	10%	5	0	0%	0	0%	0%	No	Max<SL
Di-n-octyl phthalate	No	380	900	6200	Marine AET SCO/CSL	177	9	5%	3	0	0%	0	0%	0%	No	Max<SL
Phthalates (mg/kg OC)																
bis(2-Ethylhexyl)phthalate	No	17.4	311	47	Benthic SCO	177	39	22%	9	0	0%	0	0%	0%	No	FOE<5%
Butyl benzyl phthalate	No	10.9	107	4.9	Benthic SCO	177	30	17%	7	3	2%	0	0%	2%	No	FOE<5%
Diethyl phthalate	No	160	800	61	Benthic SCO	177	33	19%	11	1	1%	0	0%	1%	No	FOE<5%
Dimethyl phthalate	No	33.8	80	53	Benthic SCO	177	4	2%	1	0	0%	0	0%	0%	No	Max<SL
Di-n-butyl phthalate	No	66.6	267	220	Benthic SCO	177	17	10%	5	0	0%	0	0%	0%	No	Max<SL
Di-n-Octyl Phthalate	No	11.0	80	58	Benthic SCO	177	9	5%	3	0	0%	0	0%	0%	No	Max<SL
Dioxins and Furans (ng/kg dw)																
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	Yes	16.8	1.5	4	Bioaccumulative SCO	133	111	83%	111	6	5%	0	0%	5%	See total	
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=1/2 MDL/PQL)[j]	Yes	1377	NA	4	Bioaccumulative SCO	133	133	100%	133	65	49%	0	0%	49%	Yes	Max>SL
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=0)[j]	Yes	1377	NA	4	Bioaccumulative SCO	133	133	100%	133	52	39%	0	0%	39%	Yes	Max>SL

Notes:
Gray filled cells indicate COPC not identified as a COC.

Footnotes:
a. List of bioaccumulative compounds as per Dredge Material Management Plan, 2021. Prepared for U.S. Army Corps of Engineers, Environmental Protection Agency, Washington State Department of Natural Resources, Washington State Department of Ecology. July.
b. For nonbioaccumulative chemicals, the selected SL was the SMS SCO value, adjusted up to natural background as appropriate. For bioaccumulative chemicals, the SL was the natural background; when no natural background was present, the same criteria as per nonbioaccumulative chemicals was applied. In the instances where the total organic for a sample was outside the range 0.5 to 3 %, the minimum AET SCO was used in place of the SMS SCO when no natural background value was available.
c. The selected ND value presented was either the maximum MDL or PQL. Selection of either the MDL or PQL as the ND value for a sample was reviewed during data validation discussed in Section 6.4 of the report.
d. The total FOE was based on the number of detected results that exceed the selected SL plus the number of MDLs/PQLs that exceeded the SL.
e. Identification of a COPC as a COC was based on the following criteria:
If the DF or detections FOE of the COPC was less than or equal to 5%, the COPC was not identified as a COC.
If the maximum detected concentration of the COPC was less than the SL, the COPC was not identified as a COC.
f. The Low Molecular Weight Polycyclic Aromatic Hydrocarbon value was calculated by summing the following chemicals: Acenaphthene, Acenaphthylene, Anthracene, Fluorene, Naphthalene, and Phenanthrene.
g. The High Molecular Weight Polycyclic Aromatic Hydrocarbon value was calculated by summing the following chemicals: Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b+j+k)fluoranthene, Benzo(g,h,i)perylene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-c,d)pyrene, and Pyrene.
h. The cPAH TEQ was calculated by summing the product of the Toxicity

i- 2,4- Dimethylphenol is the only COPC for which the refined SL is adjusted to average PQL.
j. The TCDD TEQ was calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #13 (Ecology, 2016).

Acronyms:
-- = not applicable/not available
< = less than
µg/kg = micrograms per kilogram
AET = apparent effects threshold
CAS = chemical abstract service
COPC = chemical of potential concern
COC = chemical of concern
cPAH = carcinogenic polycyclic aromatic hydrocarbons
CSL = cleanup screening level
dw = dry weight
DF = detection frequency
FOE = frequency of exceedance
MDL = method detection limit
mg/kg = milligrams per kilogram
ND = no detections
OC = organic carbon
PQL = practical quantitative limit
SCO = sediment cleanup objective
SCUM = Sediment Cleanup Users Manual
SL = screening level
SMS = Sediment Management Standards
TCDD = 2,3,7,8 Tetrachlorodibenzodioxin
TEQ = toxicity equivalent
UTL = upper tolerance limit

References:
Washington Department of Ecology (Ecology). 2015. Implementation Memorandum #10: Evaluating the Human Health Toxicity of Carcinogenic PAHs (cPAHs) using Toxicity Equivalency Factors (TEFs). Toxics Cleanup Program. Publication # 15-09-049. April.
Ecology. 2016. Implementation Memorandum #13: Dioxins, Furans, and Dioxin-Like PCB Congeners: Ecological Risk Calculation Methodology for Upland Soil. Toxics Cleanup Program. Publication # 16-09-044. July.
Ecology. 2021. Sediment Cleanup User's Manual (SCUM). Toxics Cleanup Program. Publication Number 12-09-057. December.
Ecology. 2024. Cleanup Levels and Risk Calculation Tables. February update. Available at: https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/clarc/data-tables.

Geosyntec consultants

Table 5-10. Identification of Refined Chemicals of Concern: Soil

Purpose: Soil COC Identification

COPC	CAS	Maximum Detected	Maximum MDL/PQL[b]	Screening Level	Basis of Refined SL	Number of Samples Analyzed	Number of Detected Results	Detection Frequency	Number of Detections Exceeding SL	Detections FOE	Number of ND Exceeding SL	ND FOE	Total FOE[c]	Proceed[d]	Rationale
Metals (mg/kg)															
Arsenic	7440-38-2	60.3	NA	7	Natural Background/Eco - Wildlife	159	159	100%	80	50%	0	NA	50%	Yes	Max>SL
Chromium	7440-47-3	92.7	NA	48	Natural Background	159	159	100%	23	14%	0	NA	14%	Yes	Max>SL
Copper	7440-50-8	778	NA	50	Eco - Soil Biota	154	154	100%	102	66%	0	NA	66%	Yes	Max>SL
Lead	7439-92-1	5,160	NA	50	Eco - Plants	159	159	100%	72	45%	0	NA	45%	Yes	Max>SL
Mercury	7439-97-6	2.17	0.137	0.1	Eco - Soil Biota	147	129	88%	37	25%	1	1%	26%	Yes	Max>SL
Zinc	7440-66-6	1540	NA	86	Eco - Plants	154	154	100%	91	59%	0	NA	59%	Yes	Max>SL
Petroleum Hydrocarbons (mg/kg)															
Diesel Range Organics (DRO)	DRO	4010	28	200	MTCA TEE Soil Biota[e]	145	92	63%	11	8%	0	0%	8%	Yes	Max>SL
Lube Oil	Lube_Oil	10500	17.1	--		145	111	77%	28	19%	0	0%	19%	Yes	Max>SL
Polycyclic Aromatic Hydrocarbons (µg/kg)															
1-Methylnaphthalene	90-12-0	979	61.7	34000	MTCA Method B C	156	55	35%	0	0%	0	0%	0%	No	Max<SL
2-Methylnaphthalene	91-57-6	2140	59.8	320000	MTCA Method B NC	159	75	47%	0	0%	0	0%	0%	No	Max<SL
Acenaphthene	83-32-9	2080	29.4	4800000	MTCA Method B NC	159	71	45%	0	0%	0	0%	0%	No	Max<SL
Anthracene	120-12-7	4430	27.4	24000000	MTCA Method B NC	159	121	76%	0	0%	0	0%	0%	No	Max<SL
Fluorene	86-73-7	2780	55.5	30000	Eco - Soil Biota	159	91	57%	0	0%	0	0%	0%	No	Max<SL
Naphthalene	91-20-3	6150	19.1	1600000	MTCA Method B NC	159	123	77%	0	0%	0	0%	0%	No	Max<SL
Benzo(a)anthracene	56-55-3	17300	22.9	--	See Total cPAHs TEQ	159	133	84%	0	0%	0	NA	0%	Yes	See total
Benzo(a)pyrene	50-32-8	16900	15	100	Method A Res	159	127	80%	46	29%	0	0%	29%	Yes	See total
Benzo(b)fluoranthene	205-99-2	10200	15	--	See Total cPAHs TEQ	159	127	80%	0	0%	0	NA	0%	Yes	See total
Benzo(k)fluoranthene	207-08-9	6700	14.8	--	See Total cPAHs TEQ	159	131	82%	0	0%	0	NA	0%	Yes	See total
beta-chloronaphthalene	91-58-7	NA	59.8	6400000	MTCA Method B NC	156	0	0%	0	0%	0	0%	0%	No	Max<SL
Chrysene	218-01-9	18300	6	--	See Total cPAHs TEQ	159	140	88%	0	0%	0	NA	0%	Yes	See total
Dibenzo(a,h)anthracene	53-70-3	2450	22.9	--	See Total cPAHs TEQ	159	113	71%	0	0%	0	NA	0%	Yes	See total
Fluoranthene	206-44-0	41400	5	3200000	MTCA Method B NC	159	148	93%	0	0%	0	0%	0%	No	Max<SL
Indeno(1,2,3-c,d)pyrene	193-39-5	10300	15	--	See Total cPAHs TEQ	159	127	80%	0	0%	0	NA	0%	Yes	See total
Pyrene	129-00-0	47100	5.7	2400000	MTCA Method B NC	159	147	92%	0	0%	0	0%	0%	No	Max<SL
Dibenzofuran	132-64-9	2540	59.8	80000	MTCA Method B NC	156	54	35%	0	0%	0	0%	0%	No	Max<SL
Total cPAHs TEQ (ND = 1/2 MDL/PQL)[f]	PAHs_TEQ_ND_halfR	21525	19.8	100	Method A Res	159	141	89%	56	35%	0	0%	35%	Yes	Max>SL
Total cPAHs TEQ (ND = 0)[f]	cPAHs_TEQ_ND0	21525	19.8	100	Method A Res	159	141	89%	56	35%	0	0%	35%	Yes	Max>SL
Phthalates (µg/kg)															
bis(2-Ethylhexyl)phthalate	117-81-7	524	101	71000	MTCA Method B C	156	48	31%	0	0%	0	0%	0%	No	Max<SL
Butylbenzyl phthalate	85-68-7	15.4	94	530000	MTCA Method B C	156	2	1%	0	0%	0	0%	0%	No	Max<SL
Diethyl phthalate	84-66-2	257	294	100000	Eco - Plants	156	27	17%	0	0%	0	0%	0%	No	Max<SL
Dimethyl phthalate	131-11-3	6.6	59.8	200000	Eco - Soil Biota	156	2	1%	0	0%	0	0%	0%	No	Max<SL
Di-n-butyl phthalate	84-74-2	183	59.8	200000	Eco - Plants	156	14	9%	0	0%	0	0%	0%	No	FOE<5%

Table 5-10. Identification of Refined Chemicals of Concern: Soil

Purpose: Soil COC Identification

COPC	CAS	Maximum Detected	Maximum MDL/PQL[b]	Screening Level	Basis of Refined SL	Number of Samples Analyzed	Number of Detected Results	Detection Frequency	Number of Detections Exceeding SL	Detections FOE	Number of ND Exceeding SL	ND FOE	Total FOE[c]	Proceed[d]	Rationale
Dioxins and Furans (ng/kg)															
2,3,7,8 Tetrachlorodibenzodioxin (TCDD)	1746-01-6	515	0.35	13	MTCA Method B C	164	154	94%	8	5%	0	0%	5%	See total	
1,2,3,4,7,8 Hexachlorodibenzodioxin (HxCDD)	39227-28-6	4140	2.5	160	MTCA Method B C	164	145	88%	2	1%	0	0%	1%	See total	
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=1/2 MDL/PQL)[g]	DF_TEQ_halfRL	11387.4	NA	5.2	Natural Background	164	164	100%	82	50%	0	NA	50%	Yes	Max>SL
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=0)[g]	DF_TEQ_ND0	11387.4	NA	5.2	Natural Background	164	164	100%	80	49%	0	NA	49%	Yes	Max>SL

Notes:

Gray filled cells indicate COPC not identified as a COC.

Footnotes:

a. The basis of the selected SLs was the maximum between a representative background and the risk-based value. The sources of the SLs include:
Background - Natural Background Soil Metals Concentrations in Washington State, Puget Sound 90th percentile (Ecology, 1994) and Natural Background for Dioxins/Furans in Washington State Soils (Ecology, 2010).
Human Health risk-based values - Washington State Department of Ecology. Cleanup Levels and Risk Calculation (CLARC) Tables (Ecology, 2024).
Ecological risk based values - the Model Toxics Control Act (MTCA) Regulation, Chapter 173-340 WAC Table 749-3.
b. The selected non-detect value presented was either the maximum MDL or PQL. Selection of either the MDL or PQL as the non-detect value for a sample was reviewed during data validation discussed in Section 6.4 of the report.
c. The total FOE was based on the number of detected results that exceeded the selected preliminary screening level plus the number of MDLs/PQLs that exceeded the preliminary screening level.
d. Identification of a COPC as a COC was based on the following criteria:
If the DF or detections FOE of the COPC was less than or equal to 5%, the COPC was not identified as a COC.
If the maximum detected concentration of the COC was less than the SL, the COPC was not identified as a COC.
e. The SL for petroleum hydrocarbons was applied to the sum of DRO and lube oil results.
Toxicity Equivalency Factors referenced from the Washington
g. The TCDD TEQ was calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #13 (Ecology, 2016).

Acronyms:

-- = not applicable/not available
% = percent
< = less than
µg/kg = micrograms per kilogram
CAS = chemical abstract service
COC = chemical of concern
cPAH = carcinogenic polycyclic aromatic hydrocarbons
DRO = diesel range organics
DF = detection frequency
FOE = exceedance frequency
MDL = method detection limit
mg/kg = milligrams per kilogram
MTCA = Model Toxics Control Act
ND = no detections
PQL = practical quantitative limit
SL = screening level
TCDD = 2,3,7,8 Tetrachlorodibenzodioxin
TEE = terrestrial ecological evaluation
TEQ = toxicity equivalent
WAC = Washington Administrative Code

References:

Washington Department of Ecology (Ecology). 1994. *Natural Background Soil Metals Concentrations in Washington State* . Toxics Cleanup Program. Publication #94-115. October.
Ecology. 2010. *Technical Memorandum #8 Natural Background for Dioxins/Furans in WA Soils* . Toxics Cleanup Program. Publication #10-09-053. August.
Ecology. 2015. *Implementation Memorandum #10: Evaluating the Human Health Toxicity of Carcinogenic PAHs (cPAHs) using Toxicity Equivalency Factors (TEFs)* . Toxics Cleanup Program. Publication # 15-09-049. April.
Ecology. 2016. *Implementation Memorandum #13: Dioxins, Furans, and Dioxin-Like PCB Congeners: Ecological Risk Calculation Methodology for Upland Soil* . Toxics Cleanup Program. Publication # 16-09-044. July.
Ecology. 2024. Cleanup Levels and Risk Calculation Tables. February update. Available at: https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/clarc/data-tables.

Table 5-11. Identification of Refined Chemicals of Concern: Groundwater

Purpose: Groundwater COC Identification

COPC	CAS	Maximum Detected Concentration	Screening Level	Basis of Refined SL[a]	Number of Samples Analyzed	Number of Detected Results	Detection Frequency	Number of Detections Exceeding SL	Detections FOE	Maximum MDL/PQL[b]	Number of ND Exceeding SL	ND FOE	Total FOE[c]	Proceed[d]	Rationale
Dioxins and Furans (ng/L)															
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=1/2 MDL/PQL)[e]	DF_TEQ_halfRL	0.00529	0.03	Federal/State MCL	21	8	38%	0	0%	0.0253	0	0%	0%	No	Max<SL
Tetrachlorodibenzo-p-dioxin (TCDD) TEQ (ND=0)[e]	DF_TEQ_ND0	0.00315	0.03	Federal/State MCL	21	8	38%	0	0%	0.00253	0	0%	0%	No	Max<SL

Notes:

Gray filled cells indicate COPC not identified as a COC.

Footnotes:

a. The basis of the selected SL was the maximum between a representative background, the risk-based value, ARARs, and the average PQL. The sources of the preliminary screening levels include:
Human Health risk-based and ARAR values - Washington State Department of Ecology. Cleanup Levels and Risk Calculation (CLARC) Tables (Ecology, 2024).

b. The selected non-detect value presented was either the maximum MDL/PQL. Selection of either the MDL or PQL as the non-detect value for a sample was reviewed during data validation discussed in Section 6.4 of the report.

c. The total FOE was based on the number of detected results that exceeded the selected SL plus the number of MDLs/PQLs that exceeded the SL.

d. Identification of a COPC as a COC was based on the following criteria:
If the DF or detections FOE of the COPC was less than or equal to 5%, the COPC was not identified as a COC.
If the maximum detected concentration of the COC was less than the SL, the COPC was not identified as a COC.

e. The TCDD TEQ was calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #13 (Ecology, 2016).

Acronyms:

% = percent
< = less than
µg/L = micrograms per liter
ARAR = Applicable or Relevant and Appropriate Requirement
CAS = chemical abstract service
COC = chemical of concern
DF = detection frequency
FOE = frequency of exceedance
MDL = method detection limit
MTCA = Model Toxics Control Act
ND = no detections
PQL = practical quantitative limit
SL = screening level
TCDD = 2,3,7,8 Tetrachlorodibenzodioxin
TEQ = toxicity equivalent

References:

Ecology. 2016. *Implementation Memorandum #13: Dioxins, Furans, and Dioxin-Like PCB Congeners: Ecological Risk Calculation Methodology for Upland Soil* . Toxics Cleanup Program. Publication # 16-09-044. July.
Ecology. 2024. Cleanup Levels and Risk Calculation Tables. February update. Available at: https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/clarc/data-tables.

Geosyntec consultants

Table 6-1. Surface Sediment Bioassay Results

Surface Sediment Location ID	Total Fines %	TOC %	Visual Wood Debris %	Sulfide[a] mg/kg	Ammonia[a] mg/kg	Rationale for Bioassay	Bioassay Results					
							Worm *Neanthes arenaceodentata* Chronic Test		Amphipod *Eohaustorius estuarius* Acute Survival Test		Larval *Mytilus galloprovincialis* Acute Test	
							SCO[b]	CSL[b]	SCO[c]	CSL[c]	SCO[d]	CSL[d]
SG-04	11.3	4.95	75	7.65 J	13.7	Elevated wood debris	Pass	Pass	Pass	Pass	Pass	Pass
SG-05	38.2	8.64	10	112 J	10.1	SCO/CSL Exceedances	Fail	Fail	Pass	Pass	Pass	Pass
SG-06	57	9.95	--	1330 J	5	SCO/CSL Exceedances	Pass	Pass	Pass	Pass	Pass	Pass
SG-15	14.6	1.49 J	0	383	12.7	Refining potential SMA	Pass	Pass	Pass	Pass	Pass	Pass
SG-22	21.8	19.45	80	300.5 J	15	SCO Exceedances, elevated sulfide and wood debris	Pass	Pass	Pass	Pass	Pass	Pass
SG-27	13.1	2.56	5	211 J	9.23	Spatial bounding, elevated sulfide	Pass	Pass	Pass	Pass	Pass	Pass
SG-31	17	1.07	0	150 J	6.18	Refining potential SMA	Pass	Pass	Pass	Pass	Pass[e]	Pass
SG-33	51.3	2.54	13	871 J	20.5	Spatial bounding, elevated sulfide	Pass	Pass	Pass	Pass	Pass[e]	Pass
SG-35	28.2	3.11 J	16	871 J	5.54	Refining potential SMA	Pass	Pass	Pass	Pass	Pass	Pass
SG-36	20.9	4.43	10	728 J	14.1	SCO Exceedances, elevated sulfide and wood debris	Pass	Pass	Pass	Pass	Pass	Pass
SG-37	13.45	0.68	15	68.3 J	5.9 J	Spatial bounding, elevated sulfide	Pass	Pass	Pass	Pass	Pass	Pass
SG-39	14.8	1.6	3	951 J	15.4	Spatial bounding, elevated sulfide	Pass	Pass	Pass	Pass	Pass	Pass
SG-41	19.3	6.83	12	785 J	12.2	SCO Exceedances, elevated sulfide and wood debris	Pass	Pass	Pass	Pass	Pass	Pass
SG-42	16.9	0.66	5	46.4 J	3.64	Refining potential RI boundary	Pass	Pass	Pass	Pass	Pass	Pass
SG-10A	14	0.13	5	1.09 U, R	0.61	Exceedances detected in Phase 1 sample	Pass	Pass	Pass	Pass	Pass	Pass
SG-11A	26	0.72	0	1.05 U, R	3.18	Exceedances detected in Phase 1 sample	Pass	Pass	Pass	Pass	Pass	Pass
SG-46	30	8	10	459	10.4	Confirm result of Phase 1 bioassay test	Pass	Pass	--	--	--	--
SG-47	32	14	35	564	19.9	Confirm result of Phase 1 bioassay test	Pass	Pass	--	--	--	--
SG-48	26	9.1	60	431	17.1	Confirm result of Phase 1 bioassay test	Pass	Pass	--	--	--	--
SG-49	4	0.35	8	22.3 J	14.9	Refining potential SMA	Pass	Pass	Pass	Pass	Pass	Pass

Table 6-1. Surface Sediment Bioassay Results

Footnotes:

a. SMS criteria for freshwater sediment were used as unofficial benchmarks to first assess sulfide and ammonia concentrations (SCUM, Table 8-1, Ecology, 2021). Sulfide unofficial benchmarks are 39 mg/kg (SCO) and 61 mg/kg (CSL); ammonia unofficial benchmarks are 230 mg/kg (SCO) and 300 mg/kg (CSL).

b. Polychaete growth and survival test fails SCO when MIG_T/MIG_R <0.70 and difference between sample and control is statistically significant; CSL when MIG_T/MIG_R <0.50, and difference between sample and control is statistically significant.

c. Amphipod survival test fails SCO when M_T/M_R >0.25 and difference between sample and control is statistically significant; CSL when MT/MR ≥0.30 and difference between sample and control is statistically significant.

d. Larval development test fails SCO when N_T/N_R >0.85 and difference between sample and control is statistically significant; CSL when NT/NR <0.70 and difference between sample and control is statistically significant.

e. Samples SG-31 and SG-33 (NT = 207 and 222, respectively) do not fail SCO criteria when compared to a sand control (MC = 240), which meets the acceptability criteria (i.e., demonstrates 86.6% normal survivorship), and therefore are considered to be passing. However, when compared to relevant reference samples with 12% and 48% fines (NR = 259 and 265, respectively) they do not meet the SCO criteria as the reference samples have higher larvae counts than the sand control (MC = 240). The difference in the sand control and reference sample larvae counts can be attributed to high variability and imprecision in the initial stocking density counts (I = 275.2), which is typical for this species and test.

Acronyms:

"--" indicates either not applicable or not analyzed
% = percent
mg/kg = milligrams per kilogram
CSL = Cleanup Screening Level
I = Mean Stocking Density (number of larvae initially stocked) = 275.2
MIG_R = Reference Mean Individual Growth Rate
MIG_T = Treatment Mean Individual Growth Rate
M_R = Reference Mortality
M_T = Treatment Mortality
NR = Mean number normal in Reference
NT = Mean number normal in Treatment
RI = remedial investigation
SCO = Sediment Cleanup Objective
SMA = Sediment Management Area

Table 6-2. Bioassay Results and Carbon Load in Surface Sediment

In-water Area	Mill Pond	Inner Harbor	Outer Harbor
Potential Benthic Toxicity			
Bioassay Results	Failure of SCO and CSL at one location (SG-05)	No bioassay failures	No bioassay failures
Fraction of Fine Sediment Particles in % (sum of silt and clay)			
Range	11 - 57	4 - 26	13.5 - 51
Median	31	14	18
Total Organic Carbon Content in %			
Range	5 - 14	0.1 - 20	0.6 - 6.8
Median	8.9	0.7	1.6
Abundance of Woody Debris in %			
Range	10 - 75	0 - 80	0 - 16
Median	35	5	11

Notes:
1. Summary statistics for fine sediment particles, total organic carbon content, and wood debris are calculated only for surface sediment tested for bioassay toxicity in the areas.
2. Bioassay testing at Inner Harbor stations SG-31 and SG-33 complies with SCO criteria when compared to a sand control. SG-31 failed SCO criteria when compared to a reference sample containing 12% total fines, and SG-33 failed SCO criteria when compared to a reference sample containing 48% fines; however, these samples are considered passes based on comparison with the sand control. The negative sand control is an acceptable endpoint for comparing Site results, especially when the organisms performed exceptionally well in the native reference substrate.
3. Abundance of wood debris was evaluated in the field on the sediment sample as collected (dry method) and on the sediment sample diluted with water (wet method). The value reported represents the maximum value among the wet and dry field methodologies.

Table 7-1a. Summary of COCs and Risk Screening

COC	Above HH Risk Thresholds	Above Eco Risk Thresholds
Soil		
Arsenic	**Yes**	No
Chromium	No	No
Copper	No	**Yes**
Lead	No	**Yes**
Mercury	No	No
Zinc	No	**Yes**
Diesel Range Organics	No	No
Lube Oil	No	No
Benzo(a)anthracene	See cPAH TEQ	NA
Benzo(a)pyrene	See cPAH TEQ	No
Benzo(b)fluoranthene	See cPAH TEQ	NA
Benzo(k)fluoranthene	See cPAH TEQ	NA
Chrysene	See cPAH TEQ	NA
Dibenzo(a,h)anthracene	See cPAH TEQ	NA
Indeno(1,2,3-c,d)pyrene	See cPAH TEQ	NA
Total cPAH TEQ (ND = 1/2 MDL/PQL)[a]	**Yes**	No
TCDD	See TCDD TEQ	See TCDD TEQ
HxCDD	See TCDD TEQ	See TCDD TEQ
Total TCDD TEQ (ND=1/2 MDL/PQL)[b]	**Yes**	**Yes**
Sediment		
Arsenic	**Yes**	No
Cadmium	No	No
Lead	**Yes**	**Yes**
Mercury	No	**Yes**
Benzo(a)pyrene	See totals	No
Benzo(g,h,i)perylene	See totals	**Yes**
Chrysene	See totals	**Yes**
Fluoranthene	See totals	**Yes**
Indeno(1,2,3-c,d)pyrene	See totals	**Yes**
Phenanthrene	No	**Yes**
Pyrene	See totals	**Yes**
Total HPAH	**Yes**	No
Total cPAHs TEQ (ND=1/2 MDL/PQL)[a]	**Yes**	**Yes**
Phenol	No	**Yes**
Butylbenzyl phthalate	No	**Yes**
Total TCDD TEQ (ND=1/2 MDL/PQL)[b]	**Yes**	No

Notes:

1. COCs were identified for soil and sediment analytes. No COC was identified among analytes evaluated in groundwater samples.
2. Total HPAH were not identified as a COC but were evaluated for risk human health and to the ecosystem.

Footnotes:

a. The carcinogenic polycyclic aromatic hydrocarbons were calculated by summing the products of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum Number 10 (Ecology, 2015) for following chemicals: Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, and Indeno(1,2,3-cd)pyrene.

b. The tetrachlorodibenzo-p-dioxin toxicity equivalence quotient was calculated by summing the products of the mammal Toxicity Equivalency referenced from the Van den Berg, et al. 2006 with the 17 dioxin/furan congener listed in the table.

Acronyms:

COC = chemical of concern
cPAH = carcinogenic PAH
HH = human health
HPAH = high molecular weight PAH
HxCDD = 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin
MDL = method detection limit
ND = no detection
PAH = polycyclic aromatic hydrocarbons
PQL = practical quantitation limit
TBD = to be determined
TCDD = 2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEQ = toxicity equivalents

Geosyntec consultants

Table 7-1b. Risk Screening Summary

Retained COC	Soil[a]					Sediment[b]					
	Human Health		Ecological[c]			Human Health Intertidal		Human Health Site-wide		Ecological Site-wide	
	Cancer Direct Contact	Noncancer Direct Contact	Plant	Soil-Biota	Wildlife	Direct Contact Beach Play	Direct Contact Clamming	Direct Contact Net Fishing	Bioaccumulation	Benthic (Points)	Bioaccumulation (Area)
Screening Level:	MTCA Method B Cancer	MTCA Method B Noncancer	WAC Table 749-3	WAC Table 749-3	WAC Table 749-3	SCUM Appendix K	SCUM Appendix K	SCUM Appendix K	NB/PQL Bioaccumulation SCO	SMS Benthic SCOs	NB/PQL Bioaccumulation SCO
Point of Compliance:	0-15 ft bgs	0-15 ft bgs	0-6 ft bgs	0-6 ft bgs	0-6 ft bgs	0-2 ft bml	0-2 ft bml	0-10 cm bml	0-10 cm bml	0-10 cm bml	0-10 cm bml
Area Considered in SWAC:	North and South Upland	North and South Upland	North and South Upland	North and South Upland	North and South Upland	Mill Pond/ Inner Harbor	Mill Pond/ Inner Harbor	Mill Pond/ Inner and Outer Harbor	Mill Pond/ Inner and Outer Harbor	All	Mill Pond/ Inner and Outer Harbor
Arsenic	**SWAC>SL**	SWAC<SL			HQ=1	**SWAC>SLs**	**SWAC>SLs**	**SWAC>SLs**	SWAC<SL		SWAC<SL
Cadmium									SWAC<SL		SWAC<SL
Chromium			HQ=1	HQ=1	SWAC<SL						
Copper			HQ=1	**SWAC>SL**	SWAC<SL					**Exceed**	
Lead		SWAC<SL	**SWAC>SL**	SWAC<SL	**SWAC>SL**				**SWAC>SL**	**Exceed**	**SWAC>SL**
Mercury			SWAC<SL	SWAC<SL	SWAC<SL				SWAC<SL	**Bioassay Risk**	SWAC<SL
Zinc			**SWAC>SL**	SWACs<SL	SWAC<SL						
Diesel Range Organics (DRO)				HQ=1	SWAC<SL						
Phenanthrene										**Exceed**	
Total HPAHs									**SWAC>SL**	**Exceed**	**SWAC>SL**
Total cPAH TEQ (ND = 1/2 MDL/PQL)	**SWAC>SL**	SWAC<SL				ELCR=1E-6	**SWAC>SLs**	**SWAC>SLs**			
Phenol										**Exceed**	
Butyl Benzyl Phthalate										**Exceed**	
TCDD TEQ (ND=1/2 MDL/PQL)	**SWAC>SL**	SWAC<SL			**SWAC>SL**	SWAC<SLs	**SWAC>SLs**	SWAC<SLs	**SWAC>SL**		**SWAC>SL**

Notes:

1. SWACs were developed as area-based values for comparison to human health and ecological screening levels. The benthic screening levels are point-by-point based screening criteria.

Definitions:

Bold - The COC SWAC exceeds the SL

< - less than

> - greater than

Bioassay risk - the COC exceeded in a sample in which the bioassay result did not pass.

Footnotes:

a. The SWACs for the upland area include data collected from 0 to 15 feet bgs for comparison to human health direct contact screening levels and from 0 to 6 feet bgs for comparison to ecological screening levels.

b. The SWACs for the intertidal area include data collected from 0 to 2 feet bml for comparison to human health direct contact screening levels and the SWACs for the site-wide

c. The calculated SWAC is above the SL; however, the resulting HQ is equivalent to 1 which indicates risk does not exceed an acceptable threshold.

Acronyms:

bgs = below ground surface
bml = below mudline
COC = chemical of concern
cm = centimeters
DRO = diesel range organics
ft = feet
HQ = hazard quotient
MDL = method detection limit
MTCA = model toxics control act
NA = not applicable
PQL = practical quantitation limit
SL = screening level
SWAC = spatially weighted average concentrations
TCDD = 2,3,7,8 Tetrachlorodibenzodioxin
SMS = sediment management standards

Table 7-2. Human Health Direct Contact Risk Screening: Soil

COC	Maximum Detected Concentration	Maximum MDL/PQL[a]	95% UCL	IDW SWAC	No. of Samples Analyzed	No. of Detected Results	Detection Frequency	MTCA Method B Cancer SL[b]	No. of Detections Exceeding SL	Detected FOE	No. of NDs Exceeding SL	ND FOE	Total FOE[c]	ELCR[d]	Exceed?	Rationale[e]	MTCA Method B Noncancer SL[b]	No. of Detections Exceeding SL	Detected FOE	No. of NDs Exceeding SL	ND FOE	Total FOE[c]	HQ[f]	Exceed?	Rationale[e]
Metals (mg/kg)																									
Arsenic	60.3	NA	12.9	8	157	157	100%	0.67	157	100%	NA	NA	100%	1E-05	Yes	SWAC>SL	24	3	2%	NA	NA	2%	0.33	No	SWAC<SL
Chromium	92.7	NA	NC	NC	157	157	100%	--	NA	NA	NA	NA	NA	NA	NA		120,000	0	0%	NA	NA	0%	0.0008	No	Max<SL
Copper	778	NA	NC	NC	152	152	100%	--	NA	NA	NA	NA	NA	NA	NA		3,200	0	0%	NA	NA	0%	0.24	No	Max<SL
Lead	5,160	NA	957	179	157	157	100%	--	NA	NA	NA	NA	NA	NA	NA		250	28	18%	NA	NA	18%	NA	No	SWAC<SL
Mercury	2.17	0.137	NC	NC	145	127	88%	--	NA	NA	NA	NA	NA	NA	NA		--	NA	NA	NA	NA	NA		NA	
Zinc	1,540	NA	NC	NC	152	152	100%	--	NA	NA	NA	NA	NA	NA	NA		24,000	0	0%	NA	NA	0%	0.06	No	Max<SL
Petroleum Hydrocarbons[g] (mg/kg)																									
Diesel Range Organics (DRO)	4,010	28	NC	NC	143	91	64%	--	NA	NA	NA	NA	NA	NA	NA		2,000	3	2%	0	0%	2%	2	No	FOE<5%
Lube Oil	10500	17.1	NC	NC	143	109	76%	--	NA	NA	NA	NA	NA	NA	NA		2,000	4	3%	0	0%	3%	5	No	FOE<5%
Polycyclic Aromatic Hydrocarbons (µg/kg)																									
Benzo(a)pyrene	17	0.015	NC	NC	157	125	80%	190	26	17%	NA	0	17%	See total	See total		24	0	0%	0	0%	0	0.0006	No	Max<SL
Total cPAH TEQ (ND = 1/2 MDL/PQL)[h]	22	0.0198		213	157	139	89%	190	37	24%	NA	0	24%	1E-06	Yes	SWAC>SL	--	NA	NA	NA	NA	NA	NA	NA	
Dioxins and Furans (ng/kg)																									
2,3,7,8 Tetrachlorodibenzodioxin (TCDD)	515	0.517	NC	NC	157	152	97%	13	8	5%	NA	0	5%	See total	See total		93	1	1%	0	0%	1%	See total	No	Max<SL
1,2,3,4,7,8 Hexachlorodibenzodioxin (HxCDD)	4140	2.5	NC	NC	157	142	90%	160	2	1%	NA	0	1%	See total	See total		--	NA	NA	NA	NA	NA	See total	NA	
Total TCDD TEQ (ND=1/2 MDL/PQL)[i]	11,387	NA		25.8	157	157	100%	13	46	29%	NA	NA	29%	2E-06	Yes	SWAC>SL	93	11	7%	NA	NA	7%	0.3	No	SWAC<SL

Notes:

Gray filled cells indicate the COC was not identified for exceeding an acceptable risk threshold.

1. The soil data included in the human health direct contact screening were samples collected between 0 to 15 feet below ground surface.

Footnotes:

a. The selected non-detect value presented was either the maximum detection limit or the practical quantitation limit. Selection of either the MDL or PQL as the non-detect value for a

b. The human health direct contact risk-based screening levels were referenced from WA Department of Ecology (2024).

c. The total FOE was based on the number of detected results that exceed plus the number of MDLs/PQLs that exceeded the direct contact risk-based screening level.

d. The excess cancer lifetime risk was calculated with the following equation:

$$ELCR = \frac{SWAC\ or\ Max}{Cancer\ SL} \times 10^{-6}$$

e. The rationale for identification of COCs that exceed an acceptable threshold are as follows:

If the DF and detections FOE of the COC was less than or equal to 5%, the COC did not have a SWAC developed due to being an insignificant contributor to cumulative risk.

If the maximum detected concentration and/or SWAC COC was less than the direct contact risk-based screening level, the COC was not identified as exceeding an acceptable threshold.

If the individual ELCR did not exceed 1E-6, the COC was not identified as exceeding an acceptable risk threshold.

If the individual HQ did not exceed 1, the COC was not identified as exceeding an acceptable risk threshold.

f. The hazard quotient was calculated with the following equation:

$$HQ = \frac{SWAC\ or\ Max}{Noncancer\ SL}$$

g. The screening criteria for petroleum hydrocarbons was applied to the sum of DRO and lube oil results.

h. The carcinogenic polycyclic aromatic hydrocarbons are calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology

i. The TCDD TEQ was calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #13 (Ecology,

Acronyms:

-- = not applicable/not available
< - less than
% = percentages
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
COC = chemical of concern
cPAH = carcinogenic polycyclic aromatic hydrocarbons
DF = detection frequency
DRO = diesel range organics
ELCR = excess cancer lifetime risk
FOE = frequency of exceedances
HQ = hazard quotient
IDW = inverse distance weighting
MDL = method detection limit
MTCA = Model Toxics Control Act
NA = not applicable
NC = not calculated
ND = no detection
PQL = practical quantitative limit
SL = screening level
SWAC = spatially weighted average concentrations
TCDD = 2,3,7,8 Tetrachlorodibenzodioxin
TEQ = toxicity equivalent

References:

Washington State Department of Ecology (Ecology). 2015. *Implementation Memorandum #10: Evaluating the Human Health Toxicity of Carcinogenic PAHs (cPAHs) using Toxicity Equivalency Factors (TEFs)* . Toxics Cleanup Program. Publication # 15-09-049. April.

Ecology. 2016. *Implementation Memorandum #13: Dioxins, Furans, and Dioxin-Like PCB Congeners: Ecological Risk Calculation Methodology for Upland Soil* . Toxics Cleanup Program. Publication # 16-09-044. July.

Ecology. 2024. Cleanup Levels and Risk Calculation Tables. February update. Available at: https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/clarc/data-tables.

Table 7-3. Human Health Direct Contact Beach Play Risk Screening: Intertidal Sediment

COC	Bio accumulative? (Yes/No)[a]	Intertidal Maximum Detected Concentration	Intertidal Maximum MDL/PQL[a]	IDW SWAC	No. of Samples Analyzed	No. of Detected Results	Detection Frequency	Cancer SL[b]	No. of Detections Exceeding SL	Detected FOE	No. of NDs Exceeding SL	ND FOE	Total FOE[c]	ELCR[d]	Exceed?	Rationale[e]	Noncancer SL[b]	No. of Detections Exceeding SL	Detected FOE	No. of NDs Exceeding SL	NDs FOE	Total FOE[c]	HQ[f]	Exceed?	Rationale[e]
Metals (mg/kg dw)																									
Arsenic	Yes	66.3	NA	7.91	63	63	100%	2.08	63	100%	NA	NA	100%	4E-06	Yes	SWAC>SL	80.3	0	0%	NA	NA	0%	0.1	No	SWAC<SL
Cadmium	Yes	2.20	NA	NC	63	63	100%	--	NA	NA	NA	NA	NA	NA	No	Max<SL	223	0	0%	NA	NA	0%	0.01	No	Max<SL
Lead	Yes	3,940	NA	NC	51	51	100%	--	NA	NA	NA	NA	NA	NA	NA		--	NA	NA	NA	NA	NA	NA	NA	
Mercury	Yes	0.48	0.0213	NC	63	61	97%	--	NA	NA	NA	NA	NA	NA	NA		--	NA	NA	NA	NA	NA	NA	NA	
Polycyclic Aromatic Hydrocarbons (µg/kg dw)																									
Fluoranthene	Yes	11,000	0.49	NC	63	62	98%	--	NA	NA	NA	NA	NA	NA	NA		3,570,000	0	0%	0	0%	0%	0.003	No	Max<SL
Pyrene	Yes	12,000	0.65	NC	63	62	98%	--	NA	NA	NA	NA	NA	NA	NA		2,680,000	0	0%	0	0%	0%	0.004	No	Max<SL
Total cPAH TEQ (ND=1/2 MDL/PQL)[g]	Yes	4,707	5.22	252	63	62	98%	174	23	37%	0	0	37%	1E-06	No	SWAC=1E-6	--	NA	NA	NA	NA	NA	NA	NA	
Organic Chemicals/Phenols (µg/kg dw)																									
Phenol	No	2,300	230	NC	54	48	89%	--	NA	NA	NA	NA	NA	NA	NA		33,500,000	0	0%	0	0%	0%	0.00007	No	Max<SL
Phthalates (µg/kg dw)																									
Butylbenzyl phthalate	No	690	400	NC	57	14	25%	685,000	0	0%	0	0%	0%	1E-09	No	Max<SL	22,300,000	0	0%	0	0%	0%	0.00003	No	Max<SLs
Dioxins and Furans (ng/kg dw)																									
TCDD TEQ (ND=1/2 MDL/PQL)h	Yes	269	NA	7.97	54	54	100%	29	7	13%	NA	NA	NA	3E-07	No	SWAC<SL	223	2	4%	NA	NA	NA	0.04	No	SWAC<SL

Notes:

Gray filled cells indicate the COC was not identified for exceeding an acceptable risk threshold.

The sediment data included in the beach play direct contact screening were samples collected in the intertidal zone from 0 to 2 feet below mudline.

Footnotes:

a. The selected non-detect value presented was either the maximum detection limit or the practical quantitation limit. Selection of either the MDL or PQL as the non-detect value for a sample was reviewed during data validation discussed in Section 6.4 of the report.

b. The screening levels were referenced from the RI/FS Work Plan Addendum (Geosyntec, 2023)

c. The total FOE was based on the number of detected results that exceed plus the number of MDLs/PQLs that exceeded the direct contact-based screening level.

d. The excess cancer lifetime risk was calculated with the following equation:

$$ELCR = \frac{SWAC\ or\ Max}{Cancer\ SL} \times 10^{-6}$$

e. The rationale for identification of COCs that exceed an acceptable threshold are as follows:

If the DF and detections FOE of the COC was less than or equal to 5%, the COC did not have a SWAC developed due to being an insignificant contributor to cumulative risk.

If the maximum detected concentration and/or SWAC COC was less than the direct contact risk-based screening level, the COC was not identified as exceeding an acceptable threshold.

If the individual ELCR did not exceed 1E-6, the COC was not identified as exceeding an acceptable risk threshold.

If the individual HQ did not exceed 1, the COC was not identified as exceeding an acceptable risk threshold.

f. The hazard quotient was calculated with the following equation:

$$HQ = \frac{SWAC\ or\ Max}{Noncancer\ SL}$$

g. The carcinogenic polycyclic aromatic hydrocarbons were calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #10 for the following Chemicals: Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, and Indeno(1,2,3-cd)pyrene.

h. The TCDD TEQ was calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #13 (Ecology, 2016).

Acronyms:

-- = not applicable/not available
< - less than
% = percentages
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
COC = chemical of concern
cPAH = carcinogenic polycyclic aromatic hydrocarbons
dw = dry weight
DF = detection frequency
FOE = frequency of exceedances
ELCR = excess cancer lifetime risk
HQ = hazard quotient
IDW = inverse distance weighting
MDL = method detection limit
NC = not calculated
ND = non detected
PQL = practical quantitative limit
SL = screening level
SWAC = spatially weighted average concentrations
TCDD = 2,3,7,8 Tetrachlorodibenzodioxin
TEQ = toxicity equivalent

References:

Ecology. 2015. *Implementation Memorandum #10: Evaluating the Human Health Toxicity of Carcinogenic PAHs (cPAHs) using Toxicity Equivalency Factors (TEFs)*. Toxics Cleanup Program. Publication # 15-09-049. April.

Ecology. 2016. *Implementation Memorandum #13: Dioxins, Furans, and Dioxin-Like PCB Congeners: Ecological Risk Calculation Methodology for Upland Soil*. Toxics Cleanup Program. Publication # 16-09-044. July.

Geosyntec, 2023. *Final Remedial Investigation/Feasibility Study Work Plan/Sampling and Analysis Plan Addendum*. April.

Table 7-4. Human Health Direct Contact Clamming Risk Screening: Intertidal Sediment

COC	Bioaccumu-lative? (Yes/No)[a]	Intertidal Maximum Detected	Intertidal Maximum MDL/PQL[a]	IDW SWAC	No. of Samples Analyzed	No. of Detected Results	Detection Frequency	Cancer SL[b]	No. of Detected Exceeding SL	Detected FOE	No. of NDs Exceeding SL	ND FOE	Total FOE[c]	ELCR[d]	Exceed?	Rationale[e]	Noncancer SL[b]	No. of Detected Exceeding SL	Detected FOE	No. of NDs Exceeding SL	ND FOE	Total FOE[c]	HQ[f]	Exceed?	Rationale[e]
Metals (mg/kg dw)																									
Arsenic	Yes	66.3	NA	8	63	63	100%	0.822	63	100%	NA	NA	100%	1E-05	Yes	SWAC>SL	370	0	0%	NA	NA	0%	0.02	No	SWAC<SL
Cadmium	Yes	2.20	NA	NC	63	63	100%	--	NA	NA	NA	NA	NA	NA	NA		1070	0	0%	NA	NA	0%	0.002	No	Max<SL
Lead	Yes	3,940	NA	NC	63	63	100%	--	NA	NA	NA	NA	NA	NA	NA		--	NA	NA	NA	NA	NA	NA	NA	
Mercury	Yes	0.48	0.0213	NC	63	61	97%	--	NA	NA	NA	NA	NA	NA	NA		--	NA	NA	NA	NA	NA	NA	NA	
Polycyclic Aromatic Hydrocarbons (µg/kg dw)																									
Benzo(a)pyrene	Yes	3,900	31	NC	63	61	97%	120	NA	NA	NA	NA	NA	NA	See total		146,000	0	0%	0	0%	0%	0.03	No	
Fluoranthene	Yes	11,000	0.49	NC	63	62	98%	--	NA	NA	NA	NA	NA	NA	NA		19,500,000	0	0%	0	0%	0%	0.0006	No	Max<SL
Pyrene	Yes	12,000	0.65	NC	63	62	98%	--	NA	NA	NA	NA	NA	NA	NA		14,600,000	0	0%	0	0%	0%	0.0008	No	Max<SL
Total cPAH TEQ (ND=1/2 MDL/PQL)[g]	Yes	4,707	5.22	213	63	62	98%	120	34	54%	0	0%	47%	2E-06	Yes	SWAC>SL	--	NA	NA	NA	NA	NA	NA	NA	
Organic Chemicals/Phenols (µg/kg dw)																									
Phenol	No	1,670	230	NC	60	48	80%	--	NA	NA	NA	NA	NA	NA	NA		178,000,000	0	0%	0	0%	0%	0.000009	No	Max<SL
Dioxins and Furans (ng/kg dw)																									
TCDD TEQ (ND=1/2 MDL/PQL)[h]	Yes	269	NA	25.8	54	54	100%	12	16	30%	NA	NA	30%	2E-06	Yes	SWAC>SL	1,100	0	0%	NA	NA	0%	0.02	No	SWAC<SL

Notes:

Gray filled cells indicate the COC did not exceed an acceptable risk threshold.

Data included in the clamming direct contact screening were samples collected in the intertidal zone from 0 to 2 feet below mudline.

Footnotes:

a - List of bioaccumulative compounds as per Dredge Material Management Plan, 2021. Prepared for U.S. Army Corps of Engineers, Environmental Protection Agency, Washington State Department of Natural Resources, Washington State Department of Ecology. July.

a. The selected non-detect value presented was either the maximum detection limit or the practical quantitation limit. Selection of either the MDL or PQL as the non-detect value for a sample was reviewed during data validation discussed in Section 6.4 of the report.

b. The screening levels were referenced from the RI/FS Work Plan Addendum (Geosyntec, 2023)
based screening level.

d. The excess cancer lifetime risk was calculated with the following equation:

$$ELCR = \frac{SWAC\ or\ Max}{Cancer\ SL} \times 10^{-6}$$

e. The rationale for identification of COCs that exceed an acceptable threshold are as follows:

If the DF and detections FOE of the COC was less than or equal to 5%, the COC did not have a SWAC developed due to being an insignificant contributor to cumulative risk.

If the maximum detected concentration and/or SWAC COC was less than the direct contact risk-based screening level, the COC was not identified as exceeding an acceptable threshold.

If the individual ELCR did not exceed 1E-6, the COC was not identified as exceeding an acceptable risk threshold.

If the individual HQ did not exceed 1, the COC was not identified as exceeding an acceptable risk threshold.

f. The hazard quotient was calculated with the following equation:

$$HQ = \frac{SWAC\ or\ Max}{Noncancer\ SL}$$

g. The carcinogenic polycyclic aromatic hydrocarbons were calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #10 for the following Chemicals: Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, and Indeno(1,2,3-cd)pyrene.

h. The TCDD TEQ was calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #13 (Ecology, 2016).

Acronyms:

-- = not applicable/not available
< - less than
% = percentages
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
COC = chemical of concern
cPAH = carcinogenic polycyclic aromatic hydrocarbons
dw = dry weight
DF = detection frequency
ELCR = excess cancer lifetime risk
FOE = frequency of exceedances
HQ = hazard quotient
IDW = inverse distance weighting
MDL = method detection limit
NA = not applicable
NC = not calculated
ND = no detection
PQL = practical quantitative limit
SL = screening level
SWAC = spatially weighted average concentrations
TCDD = 2,3,7,8 Tetrachlorodibenzodioxin
TEQ = toxicity equivalent

References:

Washington Department of Ecology (Ecology). 2015. *Implementation Memorandum #10: Evaluating the Human Health Toxicity of Carcinogenic PAHs (cPAHs) using Toxicity Equivalency Factors (TEFs)* . Toxics Cleanup Program. Publication # 15-09-049. April.

Ecology. 2016. *Implementation Memorandum #13: Dioxins, Furans, and Dioxin-Like PCB Congeners: Ecological Risk Calculation Methodology for Upland Soil* . Toxics Cleanup Program. Publication # 16-09-044. July.

Table 7-5. Human Health Direct Contact Net Fishing Initial Risk Screening: Surface Sediment

COC	Bio accumulative? (Yes/No)[a]	Maximum Detected Concentration	Maximum MCL/PQL[a]	IDW SWAC	No. of Samples Analyzed	No. of Detected Results	Detection Frequency	Cancer SL[b]	No. of Detections Exceeding SL	Detected FOE	No. of NDs Exceeding SL	ND FOE	Total FOE[c]	ELCR[d]	Exceed?	Rationale[e]	Noncancer SL[b]	No. of Detections Exceeding SL	Detected FOE	No. of NDs Exceeding SL	NDs FOE	Total FOE[c]	HQ[f]	Exceed?	Rationale[e]
Metals (mg/kg dw)																									
Arsenic	Yes	30.1	NA	7.18	89	89	100%	1.87	89	100%	NA	NA	100%	4E-06	Yes	SWAC>SL	843	89	0%	NA	NA	0%	0.009	No	SWAC<SL
Cadmium	Yes	2.80	NA	NC	89	89	100%	--	NA	NA	NA	NA	NA	NA	NA		1070	0	0%	NA	NA	0%	0.003	No	Max<SLs
Lead	Yes	757	NA	NC	89	89	100%	--	NA	NA	NA	NA	NA	NA	NA		--	NA	NA	NA	NA	NA	NA	NA	
Mercury	Yes	2.20	0.00468	NC	89	87	98%	--	NA	NA	NA	NA	NA	NA	NA		--	NA	NA	NA	NA	NA	NA	NA	
Polycyclic Aromatic Hydrocarbons (µg/kg dw)																									
Benzo(a)pyrene	Yes	7,400	31	NC	89	87	98%	150	NA	NA	NA	NA	NA	NA	See total		367,000	0	0%	NA	NA	0%	0.02	No	Max<SL
Fluoranthene	Yes	19,000	NA	NC	89	89	100%	--	NA	NA	NA	NA	NA	NA	NA		48,900,000	0	0%	NA	NA	0%	0.0004	No	Max<SL
Pyrene	Yes	23,000	NA	NC	89	89	100%	--	NA	NA	NA	NA	NA	NA	NA		36,700,000	0	0%	NA	NA	0%	0.0006	No	Max<SL
Total cPAH TEQ (ND=1/2 MDL/PQL)g	Yes	8,907	NA	274	89	89	100%	150	43	48%	NA	NA	48%	2E-06	Yes	SWAC>SL	--	NA	NA	NA	NA	NA	NA	NA	
Organic Chemicals/Phenols (µg/kg dw)																									
Phenol	No	2,300	NA	NC	86	62	72%	--	NA	NA	NA	NA	NA	NA	NA		442,000,000	0	0%	0	0%	0%	0.000005	No	Max<SL
Phthalates (µg/kg dw)																									
Butylbenzyl phthalate	No	690	400	NC	86	18	21%	775,000	0	0%	0	0%	0%	9E-10	No	Max<SL	295,000,000	0	0%	0	0%	0%	0.000002	No	Max<SLs
Dioxins and Furans (ng/kg dw)																									
Total TCDD TEQ (ND=1/2 MDL/PQL)h	Yes	257	NA	4.75	65	65	100%	29	5	8%	NA	NA	8%	2E-07	No	SWAC<SL	2,600	0	0%	NA	NA	0%	0.002	No	SWAC<SL

Notes:

Gray filled cells indicate the COC was not identified for exceeding an acceptable risk threshold.

The sediment data included in the net fishing direct contact screening were samples collected in the surface sediment (0 to 10 centimeters below the mudline).

Footnotes:

a. The selected non-detect value presented was either the maximum detection limit or the practical quantitation limit. Selection of either the MDL or PQL as the non-detect value for a sample was reviewed during data validation discussed in Section 6.4 of the report.

b. The screening levels were referenced from the RI/FS Work Plan Addendum (Geosyntec, 2023)

c. The total FOE was based on the number of detected results that exceed plus the number of MDLs/PQLs that exceeded the direct contact-based screening level.

d. The excess cancer lifetime risk was calculated with the following equation:

$$ELCR = \frac{SWAC\ or\ Max}{Cancer\ SL} \times 10^{-6}$$

e. The rationale for identification of COCs that exceed an acceptable threshold are as follows:

If the DF and detections FOE of the COC was less than or equal to 5%, the COC did not have a SWAC developed due to being an insignificant contributor to cumulative risk.

If the maximum detected concentration and/or SWAC COC was less than the direct contact risk-based screening level, the COC was not identified as exceeding an acceptable threshold.

If the individual ELCR did not exceed 1E-6, the COC was not identified as exceeding an acceptable risk threshold.

If the individual HQ did not exceed 1, the COC was not identified as exceeding an acceptable risk threshold.

f. The hazard quotient was calculated with the following equation:

$$HQ = \frac{SWAC\ or\ Max}{Noncancer\ SL}$$

g. The carcinogenic polycyclic aromatic hydrocarbons were calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #10 for the following Chemicals: Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, and Indeno(1,2,3-cd)pyrene.

h. The TCDD TEQ was calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #13 (Ecology, 2016).

Acronyms:

-- = not applicable/not available
< = less than
% = percentages
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
COC = chemical of concern
cPAH = carcinogenic polycyclic aromatic hydrocarbons
dw = dry weight
DF = detection frequency
FOE = frequency of exceedances
ELCR = excess cancer lifetime risk
HQ = hazard quotient
IDW = inverse distance weighting
MDL = method detection limit
NA - not applicable
NC = not calculated
ND = no detection
PQL = practical quantitative limit
SL = screening level
SWAC = spatially weighted average concentrations
TCDD = 2,3,7,8 Tetrachlorodibenzodioxin
TEQ = toxicity equivalent

References:

Washington State Department of Ecology (Ecology). 2015. *Implementation Memorandum #10: Evaluating the Human Health Toxicity of Carcinogenic PAHs (cPAHs) using Toxicity Equivalency Factors (TEFs)* . Toxics Cleanup Program. Publication # 15-09-049. April.

Ecology. 2016. *Implementation Memorandum #13: Dioxins, Furans, and Dioxin-Like PCB Congeners: Ecological Risk Calculation Methodology for Upland Soil* . Toxics Cleanup Program. Publication # 16-09-044. July.

Table 7-6. Bioaccumulative Risk Screening: Surface Sediment

COC	Bio accumulative? (Yes/No)[a]	Maximum Detected Concentration	Maximum MDL/PQL[b]	IDW SWAC	Screening Level	Basis of SL[c]	No. of Samples Analyzed	No. of Detected Results	Detection Frequency	Maximum Detected Considered TOC Range	No. of Detections Exceeding SL	Detected FOE	No. of NDs Exceeding SL	ND FOE	Total FOE[d]	Exceed?	Rationale[e]
Metals (mg/kg dw)																	
Arsenic	Yes	30.1	NA	7.2	11	Bioaccumulative SCO	89	89	100%	66.3	29	33%	0	NA	33%	No	SWAC<SL
Cadmium	Yes	2.80	NA	0.54	0.8	Bioaccumulative SCO	89	89	100%	66.3	24	27%	0	NA	27%	No	SWAC<SL
Lead	Yes	757	NA	47	21	Bioaccumulative SCO	89	89	100%	66	70	79%	0	NA	79%	Yes	SWAC>SL
Mercury	Yes	2.20	0.005	0.125	0.2	Bioaccumulative SCO	89	87	98%	66.3	28	31%	0	0%	31%	No	SWAC<SL
Polycyclic Aromatic Hydrocarbons (µg/kg dw)																	
Benzo(g,h,i)perylene	Yes	2,260	NA	See total	9.7	PQL/Bioaccumulative SCO	49	49	100%	66	44	90%	0	0%	90%	See total	See total
Fluoranthene	Yes	7,050	NA	See total	9	PQL/Bioaccumulative SCO	49	49	100%	66	46	94%	0	0%	94%	See total	See total
Indeno(1,2,3-c,d)pyrene	Yes	1,740	12	See total	9	PQL/Bioaccumulative SCO	49	49	100%	66	43	88%	0	0%	88%	See total	See total
Pyrene	Yes	7,110	NA	See total	7.9	PQL/Bioaccumulative SCO	49	49	100%	66	46	94%	0	0%	94%	See total	See total
Total HPAHs[f]	Yes	32,414	NA	2,296	75.1	BOLD 90th Percentile	49	49	100%	66	45	92%	0	0%	92%	Yes	SWAC>SL
Total cPAH TEQ (ND=1/2 MDL/PQL)[g]	Yes	4,261	NA	274	21	Bioaccumulative SCO	49	49	100%	66	40	82%	0	0%	82%	Yes	SWAC>SL
Dioxins and Furans (ng/kg dw)																	
TCDD TEQ (ND=1/2 MDL/PQL)[h]	Yes	257	NA	4.75	4	Bioaccumulative SCO	40	40	100%	66	23	58%	0	NA	58%	Yes	SWAC>SL

Notes:

Gray filled cells indicate the COC was not identified for exceeding an acceptable risk threshold.

The sediment data included in the bioaccumulation screening were samples collected in the surface sediment (0 to 10 centimeters below the mudline).

Footnotes:

a. List of bioaccumulative compounds as per Dredge Material Management Plan, 2021. Prepared for U.S. Army Corps of Engineers, Environmental Protection Agency, Washington State Department of Natural Resources, Washington State Department of Ecology. July.

b. The selected non-detect value presented is either the maximum detection limit or the practical quantitation limit. Selection of either the MDL or PQL as the non-detect value for a sample was reviewed during data validation discussed in Section 6.4 of the report.

c. The screening levels were referenced from the RI/FS Work Plan Addendum (Geosyntec, 2023)

d. The total FOE was based on the number of detected results that exceed plus the number of MDLs/PQLs that exceeded the bioaccumulation-based screening level

e. The rationale for additional evaluation in the risk screening is as follows:

If the DF and detections FOE of the COC was less than or equal to 5%, the COC did not have a SWAC developed due to being an insignificant contributor to cumulative risk.

If the maximum detected concentration and/or SWAC COC was less than the direct contact risk-based screening level, the COC was not identified as exceeding an acceptable threshold.

f. The High Molecular Weight Polycyclic Aromatic Hydrocarbon value is calculated by summing the following chemicals: Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b+j+k)fluoranthene, Benzo(g,h,i)perylene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-c,d)pyrene, and Pyrene.

g. The carcinogenic polycyclic aromatic hydrocarbons were calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #10 for the following chemicals: Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, and Indeno(1,2,3-cd)pyrene.

h. The TCDD TEQ was calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #13 (Ecology, 2016).

Acronyms:

-- = not applicable/not available
< - less than
% = percentages
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
COC = chemical of concern
cPAH = carcinogenic polycyclic aromatic hydrocarbons
dw = dry weight
DF = detection frequency
FOE = frequency of exceedances
IDW = inverse distance weighting
MDL = method detection limit
NA = not applicable
NC = not calculated
ND = non detected
PQL = practical quantitative limit
SL = screening level
SCO = sediment cleanup objective
SWAC = spatially weighted average concentrations
TCDD = 2,3,7,8 Tetrachlorodibenzodioxin
TEQ = toxicity equivalent
TOC = total organic carbon

References:

Washington State Department of Ecology (Ecology). 2015. *Implementation Memorandum #10: Evaluating the Human Health Toxicity of Carcinogenic PAHs (cPAHs) using Toxicity Equivalency Factors (TEFs)* . Toxics Cleanup Program. Publication # 15-09-049. April.

Ecology. 2016. *Implementation Memorandum #13: Dioxins, Furans, and Dioxin-Like PCB Congeners: Ecological Risk Calculation Methodology for Upland Soil* . Toxics Cleanup Program. Publication # 16-09-044. July.

Table 7-7. Ecological Direct Contact/Bioaccumulation Risk Screening: Soil

COC	Maximum Detected	Maximum MDL/PQL[a]	IDW SWAC	No. of Samples Analyzed	No. of Detected Results	Detection Frequency	Plant SL[b]	No. of Detected Exceeding SL	Detected FOE	No. of NDs Exceeding SL	NDs FOE	Total FOE[c]	HQ[d]	Exceed?	Rationale[e]	Soil Invertebrate Screening Level[b]	No. of Detected Exceeding SL	Detected FOE	No. of NDs Exceeding SL	NDs FOE[e]	Total FOE[c]	HQ[d]	Exceed?	Rationale[e]	Wildlife Screening Level[b]	No. of Detected Exceeding SL	Detected FOE	No. of NDs Exceeding SL	NDs FOE	Total FOE[c]	HQ[d]	Exceed?	Rationale[e]
Metals (mg/kg)																																
Arsenic	60.3	NA	7.8	117	117	100%	--	NA	NA	NA	NA	NA	NA	NA		--	NA	NA	NA	NA	NA	NA	NA	NA	7	54	46%	NA	NA	46%	1	No	HQ=1
Chromium	92.7	NA	40.0	117	117	100%	42	25	21%	NA	NA	21%	1	No	HQ=1	42	25	21%	NA	NA	21%	1	No	HQ=1	67	6	5%	NA	NA	5%	0.6	No	SWAC<SL
Copper	778	NA	78.9	112	112	100%	100	25	22%	0	0%	22%	1	No	HQ=1	50	74	66%	NA	NA	66%	2	Yes	SWAC>SL	217	6	5%	NA	NA	5%	0.4	No	SWAC<SL
Lead	5,160	NA	177	117	117	100%	50	68	58%	NA	NA	58%	4	Yes	SWAC>SL	500	15	13%	NA	NA	13%	0.4	No	SWAC<SL	118	52	44%	NA	NA	44%	2	Yes	SWAC>SL
Mercury	2.17	0.137	0.114	116	108	93%	0.3	5	4%	0	0%	4%	0.4	No	SWAC<SL	0.1	36	31%	0	0%	31%	1	No	HQ=1	5.5	0	0%	0	0	0%	0.02	No	SWAC<SL
Zinc	1,540	NA	166	112	112	100%	86	72	64%	NA	NA	64%	2	Yes	SWAC>SL	200	26	23%	NA	NA	23%	0.8	No	SWAC<SL	360	12	11%	NA	NA	11%	0.5	No	SWAC<SL
Petroleum Hydrocarbons (mg/kg)																																
Diesel Range Organics (DRO)[f]	4010	28	221	143	92	64%	--	NA	NA	NA	NA	NA	NA	NA		200	10	7%	0	0%	7%	1	No	HQ=1	2000	3	2%	0%	0%	2%	0.1	No	SWAC<SL
Polycyclic Aromatic Hydrocarbons (µg/kg)																																
Benzo(a)pyrene	16900	15	NA	157	125	80%	--	NA	NA	NA	NA	NA	NA	NA		--	NA	NA	NA	NA	NA	NA	NA		12	2	1%	0	0	1%	1408	No	FOE<5%
Dioxins and Furans (ng/kg)																																
2,3,7,8 Tetrachlorodibenzodioxin (TCDD)	515	0.517	NA	157	153	97%	--	NA	NA	NA	NA	NA	NA	NA		--	NA	NA	NA	NA	NA	NA	NA		--	NA	NA	NA	NA	NA	NA	See total	See total
1,2,3,4,7,8 Hexachlorodibenzodioxin (HxCDD)	4,140	2.5	NA	157	142	90%	--	NA	NA	NA	NA	NA	NA	NA		--	NA	NA	NA	NA	NA	NA	NA		--	NA	NA	NA	NA	NA	NA	See total	See total
Total TCDD TEQ (ND=1/2 MDL/PQL)g	11,400	NA	23.1	157	157	100%	--	NA	NA	NA	NA	NA	NA	NA		--	NA	NA	NA	NA	NA	NA	NA		3.15	92	59%	NA	NA	59%	7	Yes	SWAC>SL

Notes:
Gray filled cells indicate the COC was not identified for exceeding an acceptable risk threshold.
The soil data included in the ecological direct contact screening were samples collected between 0 to 6 feet below ground surface.

Footnotes:
a. The selected ND value presented was either the maximum detection limit or the practical quantitation limit. Selection of either the MDL or PQL as the ND value for a sample was reviewed during data validation discussed in Section 6.4 of the report.
b. The ecological risk-based screening levels were referenced from Washington Administrative Code Table 749-3.
c. The total FOE was based on the number of detected results that exceed plus the number of MDLs/PQLs that exceeded the ecological risk-based screening level.
d. The hazard quotient was calculated with the following equation:

$$HQ = \frac{SWAC\ or\ Max}{Noncancer\ SL}$$

e. The rationale for identification of COCs that exceed an acceptable threshold are as follows:
If the DF and detections FOE of the COC was less than or equal to 5%, the COC did not have a SWAC developed due to being an insignificant contributor to cumulative risk.
If the maximum detected concentration and/or SWAC COC was less than the direct contact risk-based screening level, the COC was not identified as exceeding an acceptable threshold.
If the individual HQ did not exceed 1, the COC was not identified as exceeding an acceptable risk threshold.
f. The screening criteria for petroleum hydrocarbons was applied to the sum of DRO and lube oil results.
g. The mammalian TCDD TEQ was calculated by summing the product of the Toxicity Equivalency Factors referenced from the Washington Ecology Implementation Memorandum #13 (Ecology, 2016). Screening for the mammalian TCDD TEQ is protective of avia

Acronyms:

-- = not applicable/not available	DF = detection frequency	IDW = inverse distance weighting
< - less than	FOE = frequency of exceedances	PQL = practical quantitative limit
% = percentages	HQ = hazard quotient	SL = screening level
µg/kg = micrograms per kilogram	MDL = method detection limit	SCO = sediment cleanup objective
mg/kg = milligrams per kilogram	NA = not applicable	SWAC = spatially weighted average concentrations
ng/kg = nanograms per kilogram	NC = not calculated	
COC = chemical of concern	ND = no detection	TEQ = toxicity equivalent

References:
Washington State Department of Ecology (Ecology). 2016. *Implementation Memorandum #13: Dioxins, Furans, and Dioxin-Like PCB Congeners: Ecological Risk Calculation Methodology for Upland Soil* . Toxics Cleanup Program. Publication # 16-

Table 7-8. Ecological Benthic Risk Screening: Surface Sediment

COC	Maximum Detected	Maximum MDL/PQL[a]	Benthic Screening Level	Basis of SL[b,c]	EF of Maximum	No. of Samples Analyzed	No. of Detected Results	Detection Frequency	No. of Detected Exceeding SL	Detected FOE	No. of NDs Exceeding SL	NDs FOE	Total FOE[d]	Exceed?	Bioassay Test	Rationale[e]
Metals (mg/kg)																
Arsenic	30.1	NA	57	Benthic SCO	<1	49	49	100%	0	0%	NA	NA	0%	No		Max<SL
Cadmium	1.72	NA	5.1	Benthic SCO	<1	49	49	100%	0	0%	NA	NA	0%	No		Max<SL
Lead	757	NA	450	Benthic SCO	1.7	49	49	100%	2	4%	NA	NA	4%	Yes	NAAL	Max>SL
Mercury	0.83	0.005	0.41	Benthic SCO	2.0	49	47	96%	6	12%	0	0%	12%	Yes	CSL	Bioassay>CSL
Polycyclic Aromatic Hydrocarbons (µg/kg dw)																
Benzo(g,h,i)perylene	2,260	NA	670	Marine AET SCO	3.4	49	28	57%	4	8%	NA	NA	8%	Yes	NAAL	Max>SL
Chrysene	3,180	NA	1400	Marine AET SCO	2.3	49	28	57%	3	6%	NA	NA	6%	Yes	NAAL	Max>SL
Fluoranthene	7,050	NA	1700	Marine AET SCO	4.1	49	28	57%	4	8%	NA	NA	8%	Yes	NAAL	Max>SL
Indeno(1,2,3-c,d)pyrene	1,740	NA	600	Marine AET SCO	2.9	49	28	57%	4	8%	NA	NA	8%	Yes	NAAL	Max>SL
Phenanthrene	7,770	NA	1,500	Marine AET SCO/CSL	5.18	49	28	57%	6	12%	NA	NA	12%	Yes	NAAL	Max>SL
Pyrene	7,110	NA	2600	Marine AET SCO	2.7	49	28	57%	3	6%	NA	NA	6%	Yes	NAAL	Max>SL
Polycyclic Aromatic Hydrocarbons (mg/kg OC)																
Benzo(g,h,i)perylene	28	NA	31	Benthic SCO	<1	49	21	43%	0	0%	NA	NA	0%	No		Max<SL
Chrysene	34	NA	110	Benthic SCO	<1	49	21	43%	0	0%	NA	NA	0%	No		Max<SL
Fluoranthene	65	NA	160	Benthic SCO	<1	49	21	43%	0	0%	NA	NA	0%	No		Max<SL
Indeno(1,2,3-c,d)pyrene	19	NA	34	Benthic SCO	<1	49	21	43%	0	0%	NA	NA	0%	No		Max<SL
Phenanthrene	59	NA	100	Benthic SCO	<1	49	21	43%	0	0%	NA	NA	0%	No		Max<SL
Pyrene	71	NA	1000	Benthic SCO	<1	49	21	43%	0	0%	NA	NA	0%	No		Max<SL
Organic Chemicals/Phenols (µg/kg dw)																
Phenol	398	NA	420	Marine AET SCO	0.9	46	21	46%	2	4%	0	0%	4%	Yes	NAAL	Max>SL
Phthalates (µg/kg dw)																
Butylbenzyl phthalate	20.9	9.4	63	Marine AET SCO	0.3	46	5	11%	0	0%	15	0%	0%	Yes	NAAL	Max>SL
Phthalates (µg/kg dw)																
Butylbenzyl phthalate	3.37	3.2	4.9	Benthic SCO	1	46	2	4%	0	0%	14	0%	0%	Yes	NAAL	Max>SL

Notes:

Gray filled cells indicate the COC was not identified for exceeding an acceptable risk threshold.

The sediment data included in the bioaccumulation screening were samples collected in the surface sediment (0 to 10 centimeters below the mudline).

Footnotes:

a. The selected ND value presented is either the maximum detection limit or the practical quantitation limit. Selection of either the MDL or PQL as the ND value for a sample was reviewed during data validation as discussed in Section 6.4 of the report.
b. The screening levels were referenced from the RI/FS Work Plan Addendum (Geosyntec, 2023)
c. For samples with total organic carbon within the acceptable range (0.5 to 3%), the OC normalized SCO is used for comparison. In the instances where the total organic for a sample is outside the range 0.5 to 3 %, the AET SCO was used for comparison.
d. The total FOE was based on the number of detected results that exceed plus the number of MDLs/PQLs that exceeded the ecological risk-based screening level.
e. The rationale for identification of COCs that exceed an acceptable threshold are as follows:
If the maximum detected concentration of the COC was less than the benthic screening level, the COC was not identified as exceeding an acceptable threshold.
If the DF and detections FOE of the COC was less than or equal to 5%, the COC was not identified as exceeding an acceptable risk threshold.
If concentrations of a COC exceeded the benthic SL but bioassay results passed, the COC was not identified as exceeding an acceptable risk threshold.

Acronyms:

-- = not applicable/not available	AET = apparent effect threshold	EF = exceedance factor	NC = not calculated	SCO = sediment cleanup objective
< - less than	COC = chemical of concern	FOE = frequency of exceedances	ND = no detection	SCUM = Sediment Cleanup Users Manual
% = percentages	CSL = cleanup screening level	MDL = method detection limit	OC = organic carbon	SMS = Sediment Management Standards
µg/kg = micrograms per kilogram	dw = dry weight	NA = not applicable	PQL = practical quantitative limit	
mg/kg = milligrams per kilogram	DF = detection frequency	NAAL = not available at all locations	SL = screening level	

References:

Washington State Department of Ecology (Ecology). 2021. *Sediment Cleanup User's Manual (SCUM)* . Toxics Cleanup Program. Publication Number 12-09-057. December.
Ecology. 2024. Cleanup Levels and Risk Calculation Tables. February update. Available at: https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/clarc/data-tables.

Table 7-9a. Wood Debris and Wood Decomposition Indicators in Surface Sediment

Analyte		Mill Pond	Inner Harbor	Outer Harbor
Wood Debris (%)	min-max median average	0 - 75 15 23.7	5 - 80 5 10	0 - 53 10 16
Total Organic Carbon (%)	min-max median average	0.2 - 14 3.5 5.06	0.15 - 20.7 0.8 3.88	0.35 - 6.83 1.6 2.15
Total Volatile Solids (%)	min-max median average	1.7 - 18.5 6.3 9.03	1.36 - 29.85 2.86 6.9	1.85 - 11.3 4.76 5.4
Bulk Sediment Ammonia (mg/kg)	min-max median average	1.2 - 19.9 8.1 8.61	0.5 - 18.3 3.4 6.1	3.64 - 26.7 9.62 11.42
Bulk Sediment Sulfide (mg/kg)	min-max median average	1.03 - 1330 59.8 275.5	1.03 - 1020 105 167	13.7 - 951 271 362.63
Apparent Redox Potential Discontinuity (cm)	min-max median average	NA	1.6 - 2.9 2.6 2.4	1.4 - 2.6 1.5 1.9

Notes
The dataset include the 43 surface grab samples collected between 2021 and 2023 field investigations. Apparent redox potential discontinuity is reported for locations measured in proximity of the surface grab locations during the sediment profile imaging (SPI) survey.

Acronyms:
% = percent
cm = centimeters
mg/kg = milligrams per kilogram
NA = not available

Geosyntec consultants

Table 7-9b. Surface Sediment Indicators of Wood Debris Potential Impact

RI Sampling Location	TOC	TVS	Woody Debris	Bulk Ammonia (mg/kg)	Bulk Sulfide (mg/kg)	Bioassay Test	Phenol (mg/kg)	cPAH TEQ (mg/kg)	Total PAH (mg/kg)	TCDD TEQ (ng/kg)	SPI survey Sampling Location	Distance from RI Location (ft)	SPI Penetration Depth (cm)	RPD Depth (cm)	Methane	Feeding Voids (Count)	Successional Stage
Mill Pond																	
SG-43	0.21	1.67	0	1.47	1.03	NA	0.004	0.001	0.01	0.38	BHPS-MP-131-B	604	18.8	Ind	None	None	1
SG-44	0.29	2.97	0	1.84	1.19	NA	0.004	0.004	0.04	0.68	BHPS-MP-131-B	528	18.8	Ind	None	None	1
SG-45	1.13	5.08	0	3.88	1.13	NA	0.007	0.103	1.06	2.40	BHPS-MP-131-B	435	18.8	Ind	None	None	1
SG-01	0.31	2.05	40	1.21	4.46	NA	0.005	0.004	0.05	NA	BHPS-MP-131-B	365	18.8	Ind	None	None	1
SG-02	2.1	5.36	20	14.7	390	NA	0.130	0.504	5.73	3.71	BHPS-MP-131-B	244	18.8	Ind	None	None	1
SG-03	2	4.25	29.4	6.04	4.74	NA	0.398	0.089	1.21	3.71	BHPS-MP-127-B	79	16	Ind	None	None	2
SG-04	4.95	7.3	75	13.7	7.65	Pass	1.250	0.100	1.46	5.33	BHPS-MP-127-C	89	17.7	Ind	Low	None	1
SG-05	8.64	17.56	10	10.1	112	**Fail**	0.099	0.270	3.09	10.24	BHPS-MP-131-C	112	18.8	Ind	Low	1	3
SG-06	9.95	16.26	5	3	1330	Pass	0.093	0.170	2.44	7.18	BHPS-MP-123-A	121	20.1	Ind	Low	3	3
SG-46	8	12.81	10	10.4	459	Pass	0.134	0.692	5.40	7.82	BHPS-MP-131-C	50	18.8	Ind	Low	1	3
SG-47	14	18.46	35	19.9	564	Pass	0.123	0.090	1.43	22.45	BHPS-MP-124-A	87	16.1	Ind	Low	None	2 -> 3
SG-48	9.1	14.48	60	17.1	431	Pass	0.264	0.134	2.69	8.53	BHPS-MP-131-C	114	18.8	Ind	Low	1	3
Inner Harbor																	
SG-08	3.86	6.45	0	3.04	105	NA	0.031	0.524	5.04	1.13	BHPS-80-A	162	10	2.7	None	None	2
SG-09	0.73	2.41	0	0.45	1.18	NA	0.003	0.010	0.13	256.52	BHPS-MP-126-B	128	Ind	Ind	None	1	Ind
SG-10	0.24	2.16	0	0.47	1.13	NA	0.002	1.688	21.78	195.75	BHPS-MP-125-B	106	10.5	Ind	Low	None	Ind
SG-10A	0.15	1.36	5	0.66	1.03	Pass	0.004	0.008	0.08	79.85	BHPS-MP-125-B	99	10.5	Ind	Low	None	Ind
SG-11	0.77	2.86	5	0.47	1.36	NA	0.004	0.039	0.45	134.92	BHPS-94-B	35	0.3	Ind	None	None	Ind
SG-11A	0.72	2.56	0	3.18	1.05	Pass	0.004	0.030	0.28	127.65	BHPS-94-C	36	0.2	Ind	None	None	Ind
SG-13	1.26	3.31	22.5	3.63	28.1	NA	0.024	0.080	0.97	2.87	BHPS-80-B	7	9.1	2.9	None	None	2
SG-15	2.15	5.47	7.5	12.7	383	Pass	0.085	0.088	0.98	5.39	BHPS-81-B	111	19.1	2.9	None	2	3
SG-18	4.2	8.64	0	10.3	196	NA	0.040	0.144	1.59	NA	BHPS-68-C	56	12	2.8	None	1	3
SG-19	0.49	1.85	0	7.59	182	NA	0.010	0.019	0.24	NA	BHPS-69-C	35	4.1	1.6	None	None	1
SG-22	20.7	26.51	80	14.5	245	Pass	0.080	1.441	14.56	5.97	BHPS-83-B	51	9.4	2.5	None	1	3
SG-23	19.4	29.85	20	18.3	1020	NA	0.137	4.261	45.12	10.51	BHPS-112-A	66	16.1	Ind	None	None	Ind
SG-25	0.24	2.73	0	0.45	1.18	NA	0.005	0.042	0.36	1.88	BHPS-112-A	124	16.1	Ind	None	None	Ind
SG-26	0.8	2.41	5	6.51	133	NA	0.016	0.038	0.42	NA	BHPS-70-A	44	5.7	1.9	None	None	1
SG-27	2.56	4.75	5	9.23	211	Pass	0.027	0.133	1.52	2.75	BHPS-84-B	40	12.5	1.9	None	None	2
Outer Harbor																	
SG-28	2.05	4.36	10	7.79	427	NA	0.016	0.045	0.47	NA	BHPS-57-A	57	9.2	1.9	None	None	1
SG-30	1.66	3.87	17.5	10.4	134	NA	0.014	0.043	0.58	NA	BHPS-73-B	33	12.4	1.4	None	None	1 -> 2
SG-31	1.07	3.5	10	6.18	150	Pass	0.011	0.076	0.88	NA	BHPS-73-C	97	10.9	2.5	None	None	1 -> 2
SG-33	2.54	8.23	12.9	20.5	871	Pass	0.030	1.208	10.98	4.31	BHPS-114-C	64	Ind	Ind	None	None	Ind
SG-35	3.11	6.06	50	5.54	131	Pass	0.012	0.251	2.79	4.15	BHPS-89-A	59	8	2.3	None	None	Ind
SG-36	4.43	11.28	10	14.1	728	Pass	0.022	1.019	10.61	4.71	BHPS-104-B	67	7.7	2.6	None	None	2
SG-37	0.62	2.05	15	3.88	53.7	Pass	0.008	0.047	0.48	1.96	BHPS-91-B	22	5.8	Ind	None	None	1
SG-39	1.6	5.43	52.5	15.4	951	Pass	0.011	0.382	3.60	2.83	BHPS-118-A	23	18.5	Ind	None	None	Ind
SG-41	6.83	11.17	12.5	12.2	785	Pass	0.035	0.806	7.67	NA	BHPS-119-A	39	13.3	Ind	None	None	Ind
SG-42	0.66	2.58	5	3.64	46.4	Pass	0.014	0.063	0.65	NA	BHPS-122-A	41	7.5	1.5	None	None	1 -> 2
SG-49	0.35	1.85	8.33	14.9	22.3	Pass	0.407	0.021	0.19	5.07	BHPS-94-C	114	0.2	Ind	None	None	Ind
SG-53	0.41	4.83	0	4.4	13.7	NA	0.010	0.011	0.10	0.86	BHPS-120-A	200	2.7	Ind	None	None	Ind
SG-54	1.62	5.59	35	8.84	378	NA	0.028	0.109	1.20	3.34	BHPS-122-A	301	7.5	1.5	None	None	1 -> 2
SG-55	1.07	3.68	10	20.4	387	NA	0.040	0.168	1.66	2.74	BHPS-120-A	465	2.7	Ind	None	None	Ind
SG-56	5.25	7.35	3	26.7	560	NA	0.033	0.949	11.17	5.64	BHPS-122-A	586	7.5	1.5	None	None	1 -> 2
SG-57	1.18	4.69	2.6	7.84	164	NA	0.009	0.117	1.38	1.66	BHPS-122-A	415	7.5	1.5	None	None	1 -> 2

Acronyms:

ID = identification
cPAH = carcinogenic polycyclic aromatic hydrocarbon
cm = centimeters
ft = feet
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
Ind = indetermined
NA = not available or not performed
PAH = polycyclic aromatic hydrocarbon
RPD = redox potential discontinuity
SPI = sediment profile imaging
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = toxicity equivalent
TOC = total organic carbon
TVS = total volatile solids

Table 7-10. Correlation between Percent Wood Debris and Other Wood Indicators and Chemicals in Surface Sediment

Analyte (N=43)	p-value	Spearman's Correlation (with % Wood Debris)	Strength of Correlation
Ammonia	**0.0005**	0.486	Moderate
Sulfide	**0.003**	0.420	Moderate
Total volatile solids	**0.01**	0.396	Moderate
Total organic carbon	**0.0004**	0.491	Moderate
Phenol	**0.0001**	0.530	Moderate
cPAH TEQ (ND=1/2 MDL/PQL)	**0.03**	0.313	weak
Total PAH (ND=1/2 MDL/PQL)	**0.02**	0.348	weak
TCDD TEQ (ND=1/2 MDL/PQL)	0.31	0.165	n/a

Bold text indicates statistically significant correlation with % wood debris (p=<0.05)
Light green filled cell indicates highest positive correlation

Notes
1. The dataset used for this analysis includes surface sediment grab samples collected between 2019 and 2023 field investigations (43 samples).
2. The correlation among concentrations of cPAH TEQ (calculated by using half of the MDL or PQL for ND) and other organic analytes was evaluated by computing the Spearman's coefficient and respective p-values.
3. Thresholds to characterize the Spearman's correlation as either very strong (>0.89), strong (>0.68), moderate (>0.38) and weak (<0.38) were used according to literature references (Shoeber et al., 2018).
4. The p-values indicate the statistical significance of the correlation as follow: p-values < 0.1 indicate statistical significance with a confidence of 90%, p-values < 0.05 indicate statistical significance with a confidence of 95%, p-values < 0.01 indicate statistical significance with a confidence of 99%.

Acronyms:
cPAH = carcinogenic PAH
HPAH = high molecular weight PAH
LPAH = light molecular weight PAH
MDL = method detection limit
ND = non detected
PAH = polycyclic aromatic hydrocarbons
PQL = practical quantitation limit
TEQ = toxicity equivalents

References:
Schober, P., C. Boer, and L.A. Schwarte. 2018. "Correlation coefficients: appropriate use and interpretation." Anesthesia & analgesia, 126(5), pp.1763-1768.

Table 7-11. Exceedances at Depth in Soil and Sediment

Location ID	Drive Depth (ft bgs/bml)	Hit Refusal?	% Recovery	Sample at Core End	Exceedances of Applicable Thresholds (MTCA or AET SCO)	Rationale
Soil						
SB-17	12	No	--	BH-SB-17-10to12	No	Analyte exceeds background but not MTCA thresholds
SB-18	11	Yes	--	BH-SB-18-9to11	No	Analyte exceeds background but not MTCA thresholds
SB-19	10	Yes	--	BH-SB-19-8to10	No	Analyte exceeds background but not MTCA thresholds
SB-20	9	Yes	--	BH-SB-20-5to9	No	Analyte exceeds background but not MTCA thresholds
SB-21	12	No	--	BH-SB-21-10to12	No	Analyte exceeds background but not MTCA thresholds
SB-22	12	No	--	BH-SB-22-10to12	cPAH TEQ, HxCDD, TCDD & TCDD TEQ	Upland area above MTCA thresholds
SB-23	10	No	--	BH-SB-23-7to10	No	Analyte exceeds background but not MTCA thresholds
SB-24	15	No	--	BH-SB-24-14to15	No	Analyte exceeds background but not MTCA thresholds
SB-25	15	No	--	BH-SB-25-10to12	No	Analyte exceeds background but not MTCA thresholds
SB-26	10	No	--	BH-SB-26-9to10	No	Analyte exceeds background but not MTCA thresholds
SB-27	20	No	--	BH-SB-27-14to16 BH-SB-27-18to20	No	Analyte exceeds background but not MTCA thresholds
SB-28	14	No	--	BH-SB-28-12to14	No	Upland core in area to be considered for removal
SB-29	24	No	--	BH-SB-29-13to15 BH-SB-29-23to24	No	Analyte exceeds background but not MTCA thresholds
SB-30	14	No	--	BH-SB-30-12to14	No	Analyte exceeds background but not MTCA thresholds
SB-38	20	No	--	BH-SB-38-18to20	No	No exceedances

Table 7-11. Exceedances at Depth in Soil and Sediment

Location ID	Drive Depth (ft bgs/bml)	Hit Refusal?	% Recovery	Sample at Core End	Exceedances of Applicable Thresholds (MTCA or AET SCO)	Rationale
Sediment Cores						
SC-03	10	No	99%	BH-SC-03-7to10	No	No exceedances
SC-04	10	No	42%	BH-SC-04-3to4.2	No	No exceedances
SC-05	6.2	Yes	84%	BH-SC-05-3.2to5.2	No	Only arsenic exceeds NB with EF=1.13
SC-07	6.5	Yes	92%	BH-SC-07-4.2to6.2	No	Only arsenic exceeds NB with EF=1.1
SC-10	10	No	80%	BH-SC-10-8to10	No	Upland core in area to be considered for removal
SC-11	10	No	80%	BH-SC-11-8to10	2-Methylphenol and 4-Methylphenol, Dimethylphthalate above SCO	Upland core in area to be considered for removal
SC-12	3.23	Yes	50%	BH-SC-12-0to1.4	Lead, cPAH TEQ, BEHP and TCDD TEQ	Core not driven at depth - Only surface sample available
SC-14	5.9	Yes	51%	BH-SC-14-1.3to2.6	TCDD TEQ	Core not driven at depth
SC-17	10	No	50%	BH-SC-17-9to10	cPAH TEQ and TCDD TEQ	Upland core in area to be considered for removal
SC-20	10.1	No	92%	BH-SC-20-7to9	No	No exceedances
SC-21	10	No	99%	BH-SC-21-8to10	No	Only arsenic exceeds NB with EF=1.17
SC-24	8.5	Yes	94%	BH-SC-24-5.9to7.7	No	No exceedances
SC-26	10	No	91%	BH-SC-26-6to7.9	No	No exceedances
SC-27	8.9	Yes	81%	BH-SC-27-5.2to6.7	No	No exceedances
SC-29	10.1	No	79%	BH-SC-29-6to7.9	No	No exceedances
SC-32	7.8	Yes	73%	BH-SC-32-4to5.5	No	No exceedances
SC-34	7	Yes	84%	BH-SC-34-4.8to5.6	No	No exceedances
SC-37	10.7	No	78%	BH-SC-37-6to8	No	No exceedances
SC-38	8.7	Yes	89%	BH-SC-38-5.8to7.9	No	No exceedances
SC-40	11	No	81%	BH-SC-40-8to9	No	No exceedances
SC-49	4	Yes	70%	BH-SC-49-0.7to2.8	cPAH TEQ	Core was not driven at depth

Table 7-11. Exceedances at Depth in Soil and Sediment

Location ID	Drive Depth (ft bgs/bml)	Hit Refusal?	% Recovery	Sample at Core End	Exceedances of Applicable Thresholds (MTCA or AET SCO)	Rationale
SC-51	8.7	Yes	116%	BH-SC-51-7.2to9.4	No	No exceedances
SC-52	4.4	Yes	64%	BH-SC-52-1.8to2.8	Lead and Mercury (74.1 and 0.436 mg/kg) cPAH TEQ (0.48mg/kg) and TCDD TEQ (5.79ng/kg)	Core not driven at depth
SC-53	3.8	Yes	116%	BH-SC-53-2.4to4.4	Mercury (0.244 mg/kg) cPAH TEQ (0.028 mg/kg)	Core not driven at depth
SC-54	10	No	88%	BH-SC-54-6.6to8.8	No	No exceedances

Notes:

1. Exceedances of preliminary screening levels are reported.
2. Additional samples were collected at depth and analyzed for dioxin only at soil borings SB-27 and SB-29.
3. Sediment cores SC-10, SC-11, and SC-17 were collected by direct push drill rigging form the upland shore.

Acronyms:

BEHP = bis(2-Ethylhexyl)phthalate
bgs = below ground surface
bml = below mudline
cPAH = carcinogenic PAH
EF = exceedance factor
ft = feet
ID = Identification
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
HxCDD = 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin

Table 7-12. Summary of CSM and COC

COC	Risk Threshold Exceeded	Area/Location of Elevated Concentration (max)	Depth of Elevated Concentration (max) (bgs or bml)	Transport Pathway
Soil				
Arsenic	HH	North Upland	0-2 ft	Soil Erosion
Copper	Eco (SB)	North Upland	0-2 ft	Soil Erosion
Lead	Eco (P/W)	North Upland	0-2 ft	Soil Erosion
Zinc	Eco(P)	North Upland	2-6 ft	Soil Erosion
Total cPAH TEQ	HH	North Upland	1-2 ft	Soil Erosion
Total TCDD TEQ	HH/Eco(W)	North Upland	4-6 ft	Soil Erosion
Sediment				
Arsenic	HH/BAC	Inner Harbor (SED-5, SG-23)	0-2 ft	Erosion/Deposition, Bioturbation, Natural Attenuation
Lead	BAC	Inner Harbor (SED-5, SG-22)	0-2 ft	Erosion/Deposition, Bioturbation
Mercury	Benthic	Inner Harbor (BH2-20), Outer Harbor (SG-54)	0-10 cm	Erosion/Deposition, Bioturbation
HPAH	BAC	Inner Harbor (SG-23), Outer Harbor (BH2-32)	0-10 cm	Erosion/Deposition, Bioturbation
Total cPAH TEQ	HH/BAC	Inner Harbor(SG-23), Outer Harbor (BH-32)	0-10 cm	Erosion/Deposition, Bioturbation, Natural Attenuation
Total TCDD TEQ	HH/BAC	Inner Harbor (SG-09)	0-10 cm	Erosion/Deposition, Bioturbation

Acronyms:
BAC = Bioaccumulative SCO; Benthic = Benthic SCO; bgs = below ground surface; bml = below mudline; cm = centimeters; cPAH = carcinogenic PAH; COC = chemical of concern; CSM = conceptual site model; Eco = ecological; ft = feet; HH = Human Health; HPAH = high molecular weight PAH; SB = soil biota; P = plant; TCDD = 2,3,7,8 Tetrachlorodibenzodioxin; TEQ = toxicity equivalents; W = wildlife

Table 8-1. Correlation of Sediment Organic Compounds with Total cPAH TEQ

Analyte	Sediment Cores	RI Surface Sediment	Historical Surface Sediment
Low Molecular Polycyclic Aromatic Hydrocarbons			
Phenanthrene	**0.894**	**0.984**	**0.985**
High Molecular Polycyclic Aromatic Hydrocarbons			
Benzo(g,h,i)perylene	**0.918**	**0.983**	**0.993**
Chrysene	**0.918**	**0.997**	**0.995**
Fluoranthene	**0.895**	**0.994**	**0.995**
Indeno(1,2,3-c,d)pyrene	**0.949**	**0.991**	**0.994**
Pyrene	**0.901**	**0.991**	**0.994**
Total Benzofluoranthenes	**0.976**	**0.999**	**0.928**
HPAH (ND=1/2 MDL/PQL)	**0.898**	**0.997**	**0.997**
HPAH (ND=0)	**0.907**	**0.997**	**0.997**
Organic Chemicals/Phenols			
Phenol	**0.638**	**0.493**	**0.346**
Phthalates			
Butyl benzyl phthalate	**0.278**	-0.181	**0.655**

Light grey filled cells indicated positive moderate correlation (above 0.38)
Grey filled cells indicated positive strong and very strong correlation (above 0.68 and 0.89)
Bold indicates the correlation is significant with a 95% confidence.

Notes

1. The dataset used for this analysis included dry weight results for organic analytes. The RI dataset was divided in 3 subsets based on sampling methodology (surface grabs or sediment cores) and collection date (historical samples collected in 2019 and RI samples collected between 2021 and 2023).
2. The correlation among concentrations of cPAH TEQ (calculated by using half of the MDL or PQL for ND) and other organic analytes was evaluated by computing the Spearman's coefficient and respective p-values.
3. Thresholds to characterize the Spearman's correlation were either very strong (>0.89), strong (>0.68), and moderate (<0.38) according to literature references (Shoeber et al., 2018).

Acronyms:

cPAH = carcinogenic PAH
HPAH = high molecular weight PAH
LPAH = light molecular weight PAH
MDL = method detection limit
ND = non detected
PAH = polycyclic aromatic hydrocarbons
PQL = practical quantitation limit
TEQ = toxicity equivalents

References:

Schober, P., C. Boer, and L.A. Schwarte. 2018. "Correlation coefficients: appropriate use and interpretation." Anesthesia & analgesia, 126(5), pp.1763-1768.

Table 8-2. Proposed Cleanup Levels for Identified Soil COCs with Risk

COCs with Risk [a]	Units	Human Health (direct contact)		Ecological (direct contact/bioaccumulation)	
		Cleanup Level	Basis	Cleanup Level	Basis
Spatial Scale:		**Site-Wide[b]**		**Site-Wide[b]**	
Point of Compliance:		**0 to 15 feet bgs**		**0 to 6 feet bgs**	
Cleanup Levels [c]					
Arsenic	mg/kg	20	MTCA Method A	NA	Not exceeding risk threshold for ecological endpoints
Copper	mg/kg	3200	MTCA Method B-NC	50	Protection of Soil Invertebrates
Lead	mg/kg	250	MTCA Method A	50	Protection of Plants
Zinc	mg/kg	24000	MTCA Method B-NC	86	Protection of Plants
Total cPAH TEQ (ND = 1/2 MDL/PQL)	µg/kg	100	MTCA Method A	NA	Not applicable to ecological endpoints
Total TCDD TEQ (ND = 1/2 MDL/PQL)	ng/kg	5.2	Natural Background	5.2	Natural Background

Footnotes:

a. The basis of the selected CUL was the maximum between representative background, the minimum human health direct contact risk-based value, and the average PQL. If a specific endpoint evaluated in the risk screening did not exceed an acceptable threshold, a CUL was not selected for that endpoint. CULs were refenced from the following sources:

Human Health risk based values from Washington State Department of Ecology. Cleanup Levels and Risk Calculation (CLARC) Tables (Ecology, 2024)

Ecological risk based values from the Model Toxics Control Act (MTCA) Regulation, Chapter 173.340 WAC Table 749.3.

Background for TCDD TEQ from Implementation Memorandum #8 (Ecology, 2015)

b. Site-Wide cleanup levels are based on the exposure pathway complete site-wide which includes direct contact for human endpoints and direct contact and bioaccumulation for ecological endpoints. Site-Wide cleanup levels are evaluated on a point by point basis.

c. CULs based on the migration to groundwater pathway were not considered in the selection because the migration to groundwater pathway and migration to groundwater and then surface water/sediment pathway were determined to be incomplete due to no COCs identified in groundwater.

Acronyms:

-- = not applicable or not available
bgs = below ground surface
cm = centimeters
COC = chemical of concern
cPAH = carcinogenic polycyclic aromatic hydrocarbon
CUL = cleanup level
MDL = method detection limit
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
MTCA = Model Toxics Control Act
ng/kg = nanograms per kilogram
ND = no detection
NC = noncancer
PQL = practical quantitation limit
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = toxicity equivalent

References:

Washington State Department of Ecology (Ecology). 2010. Technical Memorandum #8 Natural Background for Dioxins/Furans in WA Soils. Toxics Cleanup Program. Publication #10-09-053. August.

Ecology. 2024. Cleanup Levels and Risk Calculation Tables. February update. Available at: https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/clarc/data-tables.

Table 8-3. Proposed Cleanup Levels for Identified Sediment COCs with Risk

COC with Risk [a]		Human Heath (Direct Contact and Consumption/Bioaccumulation)						Ecological	
		Seafood Consumption		Direct Contact				Benthic	
Spatial Scale: (Point of Compliance):		Site-Wide[b] (0 to 10 cm)		Intertidal Areas[c] (0 to 45 cm)		Site-Wide & Subtidal Areas[d] (0 to 10 cm)		Site-Wide[e] (0 to 10 cm)	
Analyte	**Units**	**Cleanup Level**	**Basis**	**Cleanup Level**	**Basis**	**Cleanup Level**	**Basis**	**Cleanup Level**	**Basis**
Arsenic	mg/kg	11	Bioaccumulative SCO (NB)	11	Natural Background	11	Natural Background	57	Benthic SCO
Lead	mg/kg	21	Bioaccumulative SCO (NB)	21	Natural Background	21	Natural Background	390	Benthic SCO
Mercury	mg/kg	0.2	Bioaccumulative SCO (NB)	0.2	Natural Background	0.2	Natural Background	0.41	Benthic SCO
Phenanthrene	µg/kg	NA	Not bioaccumulative	NA	Not exceeding risk threshold for human endpoints	NA	Not exceeding risk threshold for human endpoints	1500 µg/kg dw 100 mg/kg OC	Benthic SCO
Total HPAH	µg/kg	75.1	BOLD 90th Percentile[f]	NA	Not an endpoint for human health	NA	Not an endpoint for human health	12000 µg/kg dw 960 mg/kg OC	Benthic SCO
Total cPAH TEQ (ND = 1/2 MDL/PQL)	µg/kg	21	Bioaccumulative SCO (NB)	120	Subsistence Clam Digging (Adult)	150	Subsistence Net Fishing (Adult)	NA	Not applicable to benthic endpoints
Phenol	µg/kg	NA	Not bioaccumulative	NA	Not exceeding risk threshold for human endpoints	NA	Not exceeding risk threshold for human endpoints	420	Benthic SCO
Butyl Benzyl Phthalate	µg/kg	NA	Not bioaccumulative	NA	Not exceeding risk threshold for human endpoints	NA	Not exceeding risk threshold for human endpoints	63	Benthic SCO
Total TCDD TEQ (ND = 1/2 MDL/PQL)	ng/kg	4	Bioaccumulative SCO (NB)	12	Subsistence Clam Digging (Adult)	29	Subsistence Net Fishing (Adult)	NA	Not applicable to benthic endpoints

Footnotes:

a. COCs with risk are identified based on frequency of detection, correlations, SL Exceedances, and bioassay results.

b. Site-Wide cleanup levels are based on the exposure pathway complete site-wide which includes benthic community ingestion of sediment and direct contact. These cleanup levels correspond to the natural background (which is the bioaccumulative SCO) since the risk drivers are bioaccumulative and are applicable to the surface sediment interval (0 to 10 cm bml). Site-Wide cleanup levels are evaluated on a point by point basis.

c. Intertidal cleanup levels are based on the exposure pathways complete in intertidal areas which include direct contact for beach play and subsistence clam digging. The cleanup level for each analyte is identified as the minimum among the human health risk-based concentration for ingestion of sediment and direct contact for the beach play and subsistence clam digging scenarios adjusted to the natural background if higher (Ecology, 2021). These cleanup levels are applicable to the sediment interval between 0 and 45 cm bml and are evaluated on the average area-wide basis.

d. Subtidal cleanup levels are identified based on the exposure pathways complete in subtidal areas which include direct contact for subsistence net fishing. The cleanup level for each analyte is identified as the human health risk-based concentration for subsistence net fishing adjusted to the natural background (Ecology, 2021). These cleanup levels are applicable to the sediment interval between 0 and 10 cm bml and are evaluated on the average area-wide basis.

e. Benthic cleanup levels are identified based on the sediment cleanup objectives (Ecology, 2021) or natural background when those are not available. These cleanup levels are applicable to the sediment interval between 0 and 10 cm bml and are evaluated on a point by point basis.

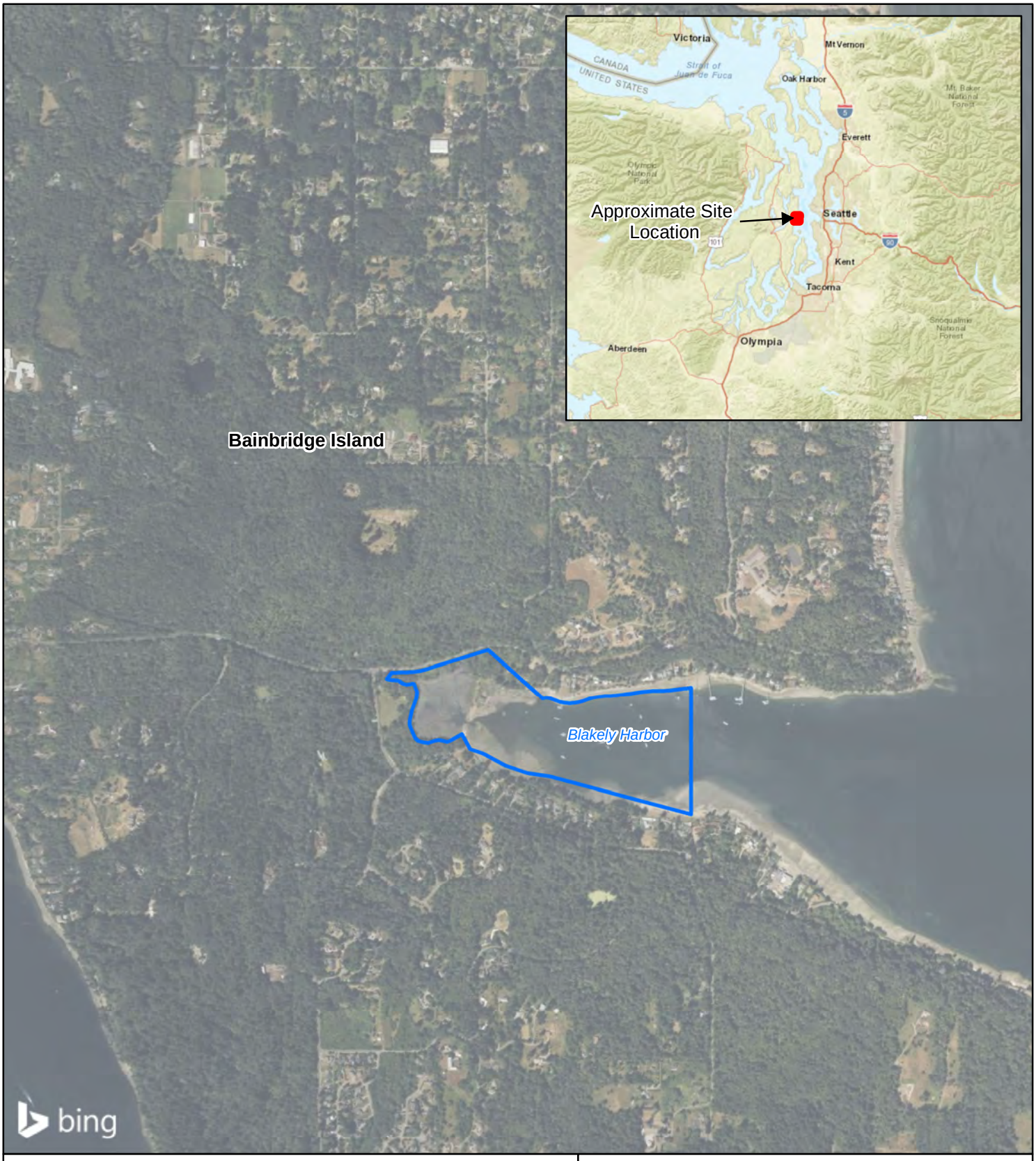
f. A natural background value was not available within SCUM for total HPAHs; therefore, the 90th percentile for HPAH from the BOLD Survey is presented (DMMP, 2009).

Acronyms:

-- = not applicable or not available
bml = below mudline
cm = centimeters
COC = chemical of concern
cPAH = carcinogenic polycyclic aromatic hydrocarbon
MDL = method detection limit
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
NB = natural background
ND = non detected result
ng/kg = nanograms per kilogram
PQL = practical quantitation limit
SCO = sediment cleanup objective
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = toxicity equivalent

References:

Washington State Department of Ecology (Ecology). 2021. *Sediment Cleanup User's Manual (SCUM)*. Toxics Cleanup Program. Publication Number 12-09-057. December.



Legend

Approximate Study Area

Notes:
1. Approximate Study Area provided by Department of Ecology.

N

0 2,000 Feet

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

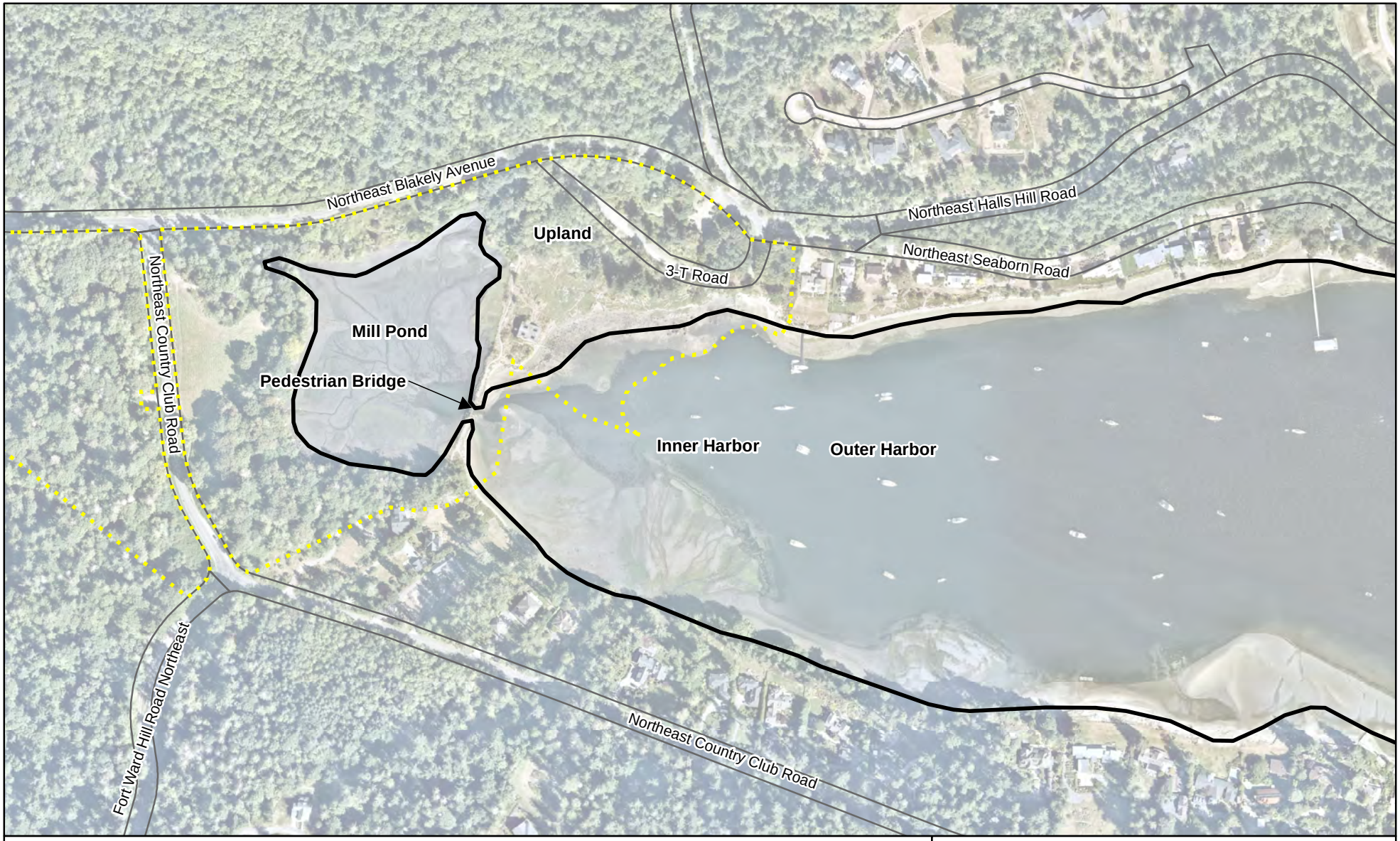
Vicinity Map
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

Figure 2-1

MVI/Sea | August 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Revisions05172023\Figure 2-1 Site Vicinity Map.mxd 8/14/2024 4:40:05 AM



Legend

- BI Parks Tax Lot Property Boundary and Blakely Harbor Public Park
- Shoreline
- Road

N

0 500 Feet

Blakely Harbor Site Layout

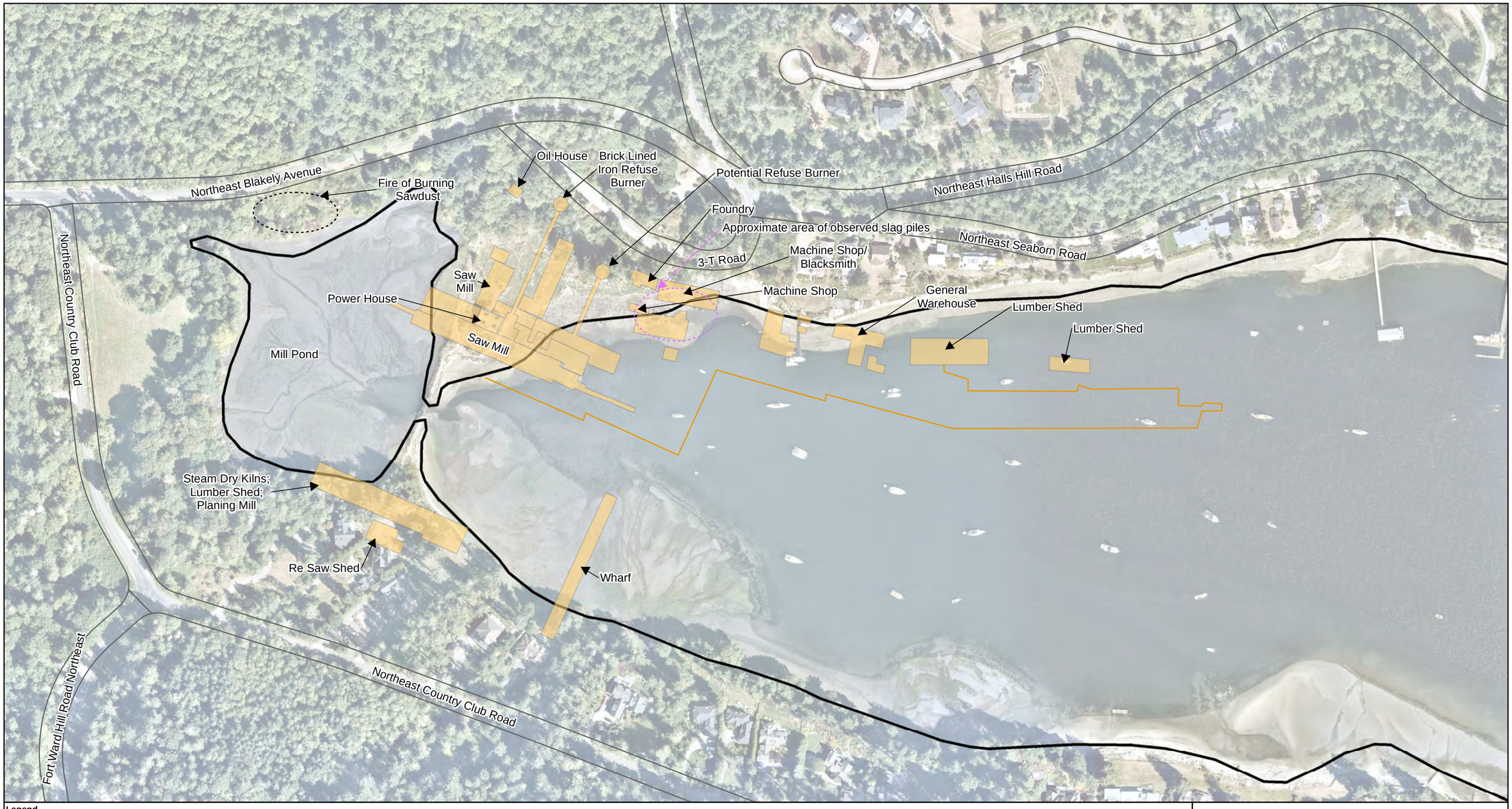
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea	August 2024

Figure 2-2

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Revisions05172023\Figure 2-2 Blakely Harbor Park Site.mxd 8/14/2024 4:30:22 AM



Legend

- Shoreline
- Historical Wharf Structure
- Structures from 1917 Map and Figure 2 in GeoEngineers, 2019
- Fire of Burning Sawdust (1893 Sanborn Fire Insurance Map from Seattle, King County)
- Approximate area of observed slag piles
- Road

Notes:
1. Shoreline boundary provided by Washington Department of Natural Resources.
2. Locations of historical buildings are approximate.
3. Acronyms: BI = Bainbridge Island.

N

0 300 Feet

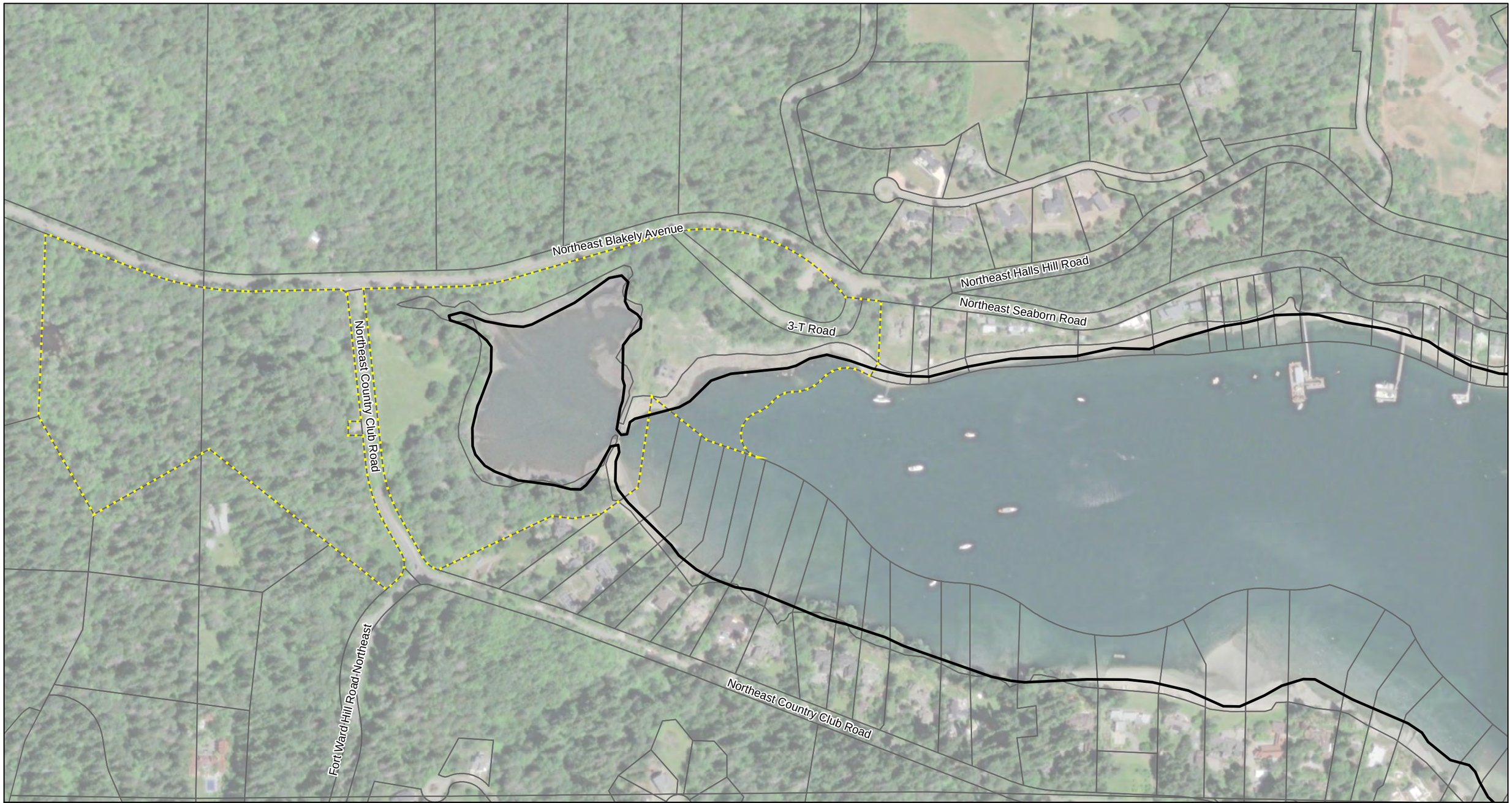
1917 Mill Structures and Historical Features
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | May 2024

Figure 2-3

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Revisions05172023\Figure 2-3 Former Mill Structures and Historical Features.mxd 5/28/2024 5:41:53 AM



Legend

- Shoreline
- BI Parks Tax Lot Property Boundary
- Tax Lot

Notes:
1. Taxlot boundary provided by Kitsap County.
2. Waters of the State provided by Department of Natural Resources (Last updated 2001).
3. Approximate Site Boundry provided by Department of Ecology.
4. Acronyms: BI = Bainbridge Island.

N

0 300 Feet

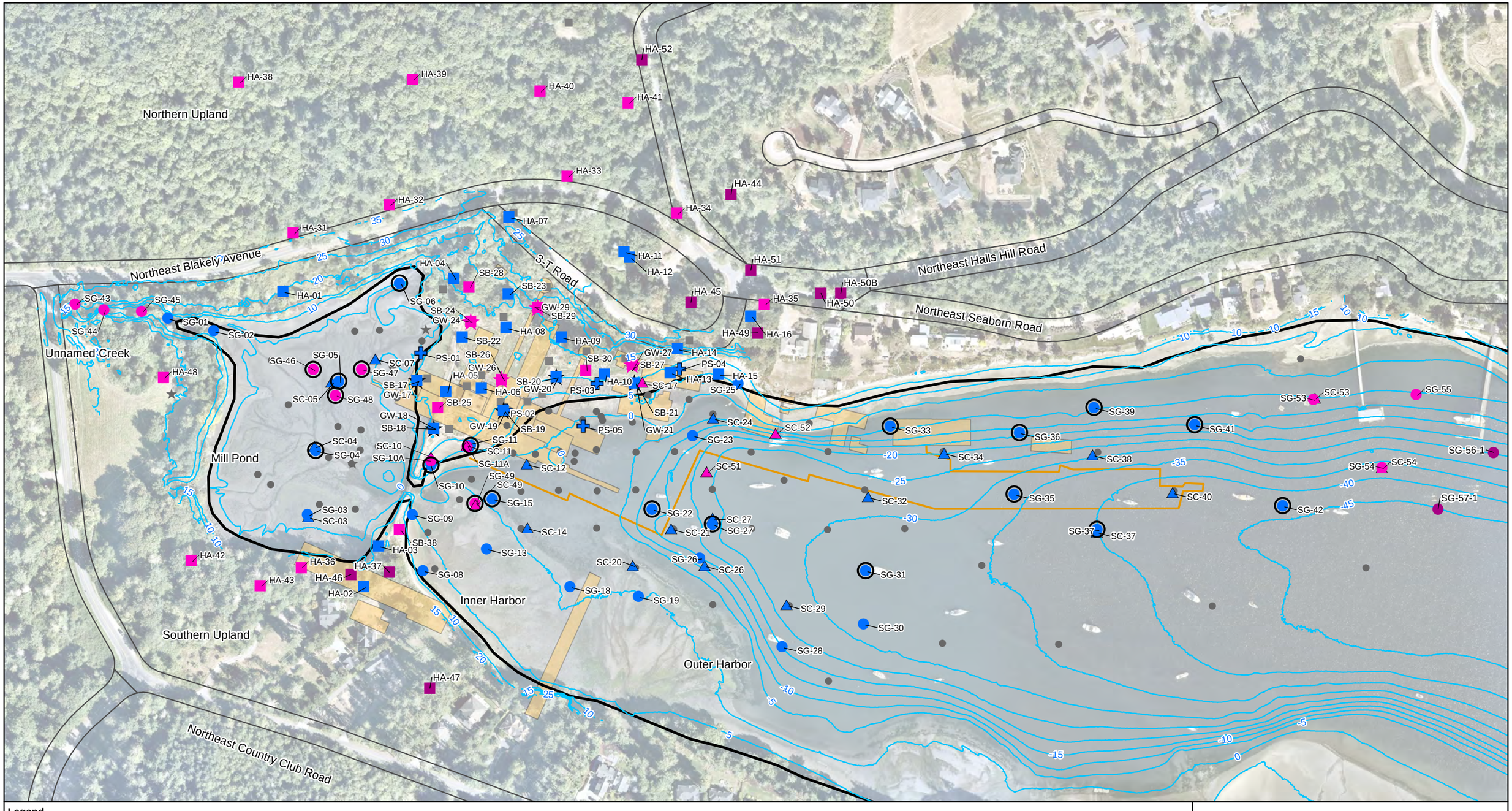
Blakely Harbor Park Site Tax Lot Parcels

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea	May 2024	**Figure 2-4**

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Revisions05172023\Figure 2-4 Blakely Harbor Taxlot Parcels.mxd 5/28/2024 5:43:29 AM



Legend

2023 Sample Location
- Sediment Core
- Sediment Grab
- Soil
- Water

2022 Sample Location
- Sediment Core

- Sediment Grab
- Soil

2021 Sample Location
- Sediment Core
- Sediment Grab
- Soil

- Water
- Pile Scraping

Historical Sample Location
- Soil
- Sediment
- Water
- Bioassay Sample Location

- Shoreline
- Contour (5 foot MLLW)
- Historical Wharf Structure
- Road
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

N

0 260 Feet

Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.
4. Background soil sample locations are approximate and may be adjusted based on field conditions.

RI Sampling Locations

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

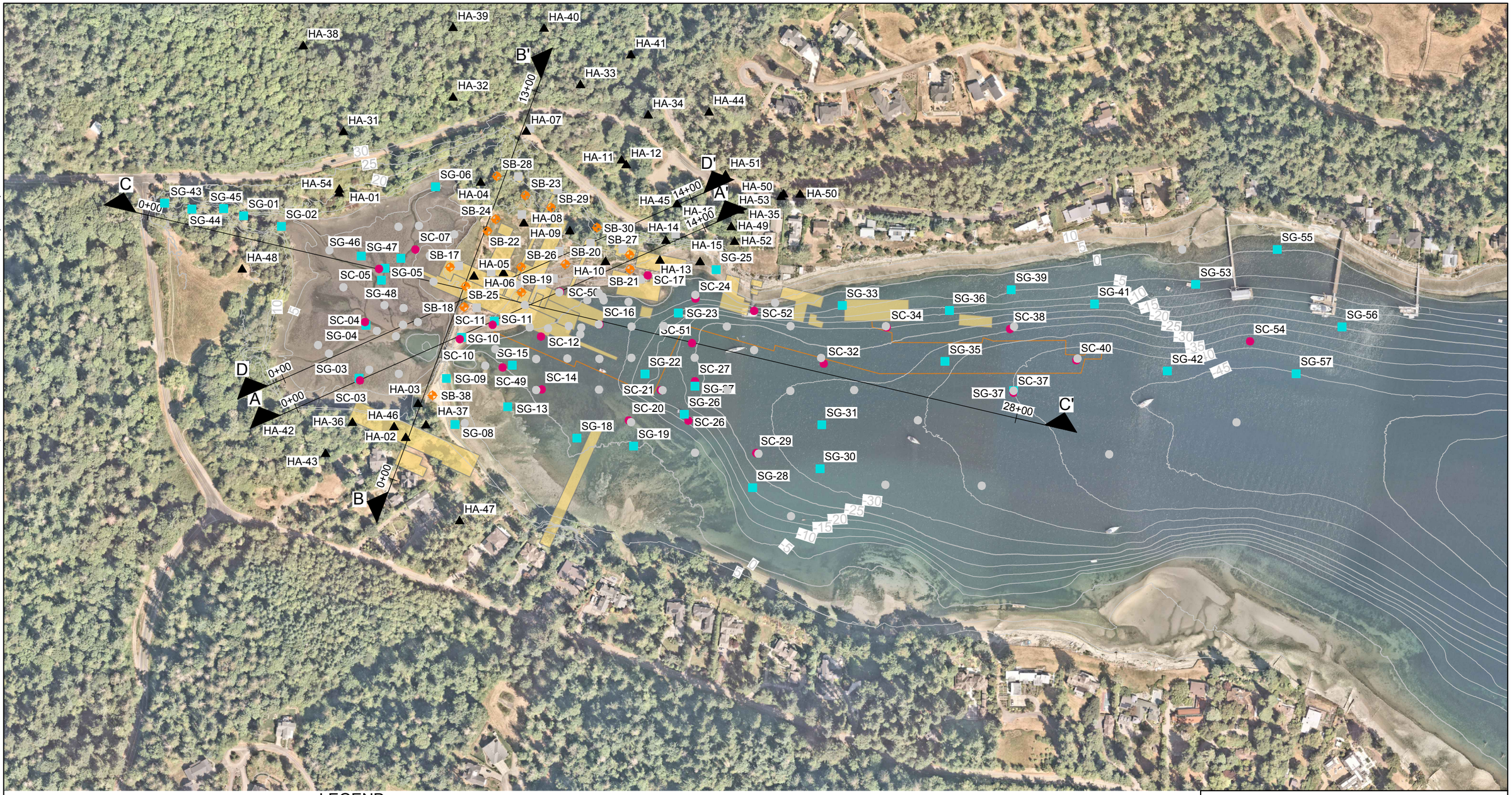
Geosyntec consultants

MVI/Sea | April 2024

Figure 3-1

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Figure J-1 2023 Sample Locations.mxd 4/23/2024 6:06:32 AM

C:_GEO-ACC\ACCDOCS\GEOSYNTEC-SD\BLAKELY HARBOR\PROJECT FILES\CAD\CROSS SECTIONS\FIG\PNG0900.01 F01 (PLAN VIEW AND CROSS SECTIONS) - Last Saved by: SBerdy on 3/15/24



LEGEND

- 10 — EXISTING GROUND MAJOR CONTOUR (25)
- EXISTING GROUND MINOR CONTOUR (5')
- HISTORICAL WHARF STRUCTURE
- STRUCTURES (1917 MAP)
- HAND AUGER (HA)
- SEDIMENT (SG)
- SEDIMENT CORE (SC)
- SOIL BORING (SB)
- HISTORICAL SOIL
- HISTORICAL SEDIMENT

NOTES:

1. LOCATIONS OF HISTORICAL BUILDING ARE APPROXIMATE.
2. SHORELINE BOUNDARY PROVIDED BY WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES.
3. ELEVATION DATA FROM DAVID EVANS AND ASSOCIATES, 2020.
4. BACKGROUND SOIL SAMPLE LOCATIONS ARE APPROXIMATE AND MAY BE ADJUSTED BASED ON FIELD CONDITIONS.

N

0 300

SCALE IN FEET

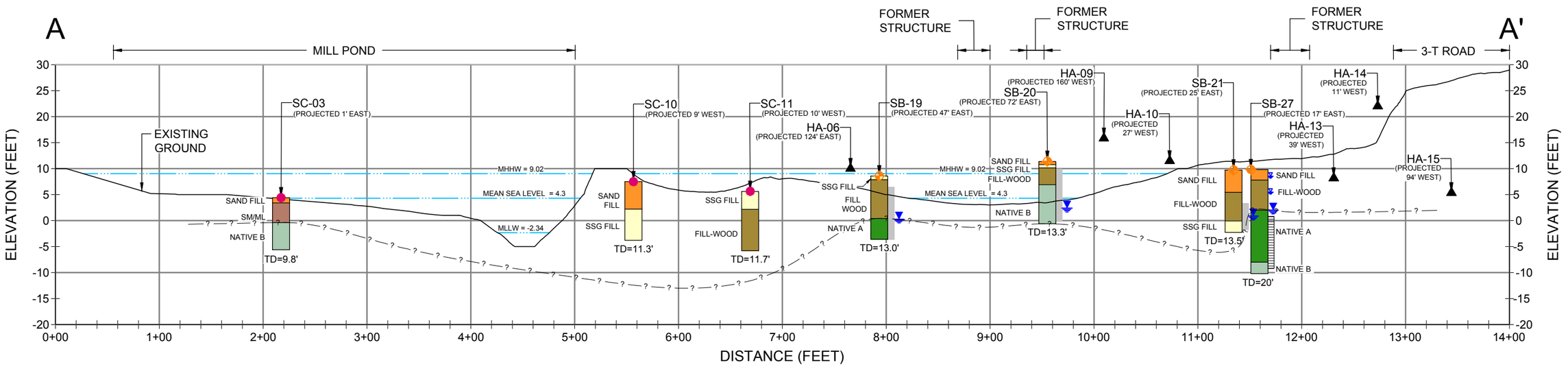
Cross Section Plain View

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

FIGURE 3-2

PROJECT NO: PNG0900 | MARCH 2024

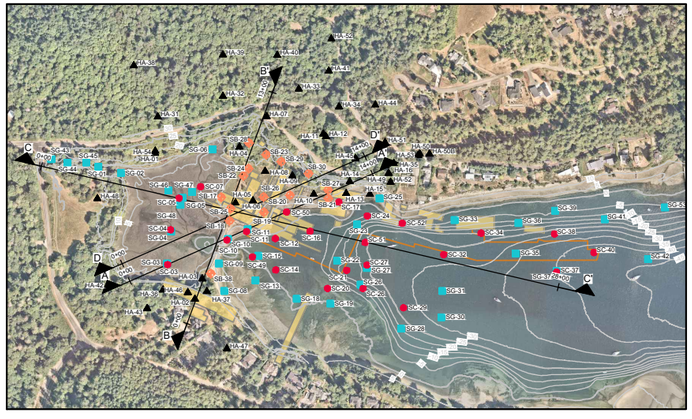


LEGEND

- PROJECTED LOCATION OF HAND AUGER, SEDIMENT CORE, AND SOIL BORING
- SURFICIAL TOPSOIL/SAND; SOME FILL; OR SOIL/SAND MIXED WITH FILL - **(SAND FILL)**
- WOOD DEBRIS (SAWDUST, DIMENSIONAL LUMBER, CHIPS) - **(FILL-WOOD)**
- BUILDING/WOOD DEBRIS (SLAG, BRICKS, GLASS) - **(DEBRIS FILL)**
- FILL WITH SAND/SILT/GRAVEL MIXED IN - **(SSG FILL)**
- SILTY SAND/SANDY SILT - WITH NO FILL MATERIAL - **(SM/ML)**
- GRAVEL WITH SILT AND/OR SAND; WITH NO SHELLS - **(NATIVE A)**
- GRAVELLY SILT WITH SAND/GRAVELY SAND; WITH SILT AND SHELLS - **(NATIVE B)**
- STATIC GROUNDWATER LEVEL
- WATER LEVEL RANGES (HIGH AND LOW)
- PERMANENT WELL SCREENED INTERVAL
- TEMPORARY WELL SCREENED INTERVAL

NOTE:

1. BASIS FOR VERTICAL DATUM: NAVD88.



KEYMAP

0 100
HORIZONTAL SCALE

0 20
VERTICAL SCALE

Cross Section A-A'

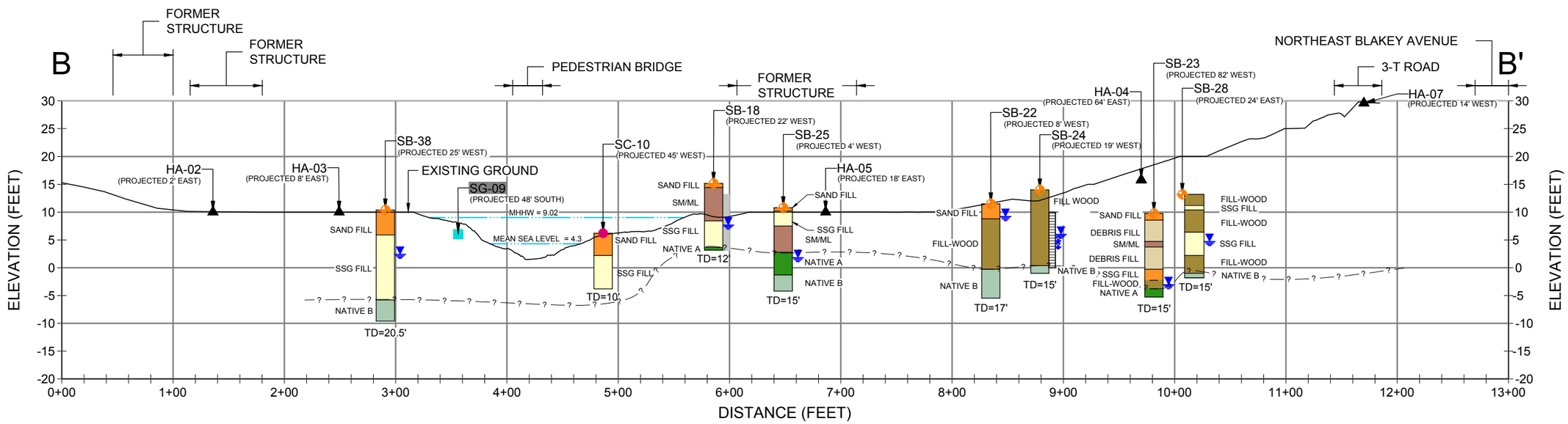
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

PROJECT NO: PNG0900 | MARCH 2024

FIGURE 3-3a

C:_GEO-ACC\ACCDOCS\GEOSYNTEC-SD\BLAKELY HARBOR\PROJECT FILES\CAD\CROSS SECTIONS\FIG\PNG0900.01 F01 (PLAN VIEW AND CROSS SECTIONS) - Last Saved by: SBerdy on 3/15/24

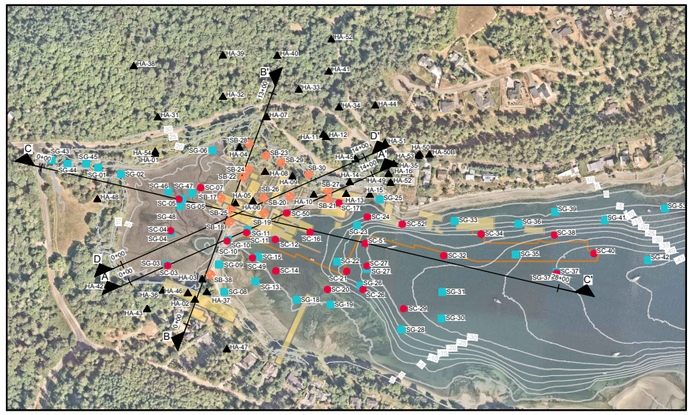


LEGEND

- PROJECTED LOCATION OF HAND AUGER, SEDIMENT CORE, AND SOIL BORING
- SURFICIAL TOPSOIL/SAND; SOME FILL; OR SOIL/SAND MIXED WITH FILL - **(SAND FILL)**
- WOOD DEBRIS (SAWDUST, DIMENSIONAL LUMBER, CHIPS) - **(FILL-WOOD)**
- BUILDING/WOOD DEBRIS (SLAG, BRICKS, GLASS) - **(DEBRIS FILL)**
- FILL WITH SAND/SILT/GRAVEL MIXED IN - **(SSG FILL)**
- SILTY SAND/SANDY SILT - WITH NO FILL MATERIAL - **(SM/ML)**
- GRAVEL WITH SILT AND/OR SAND; WITH NO SHELLS - **(NATIVE A)**
- GRAVELLY SILT WITH SAND/GRAVELY SAND; WITH SILT AND SHELLS - **(NATIVE B)**
- STATIC GROUNDWATER LEVEL
- WATER LEVEL RANGES (HIGH AND LOW)
- PERMANENT WELL SCREENED INTERVAL
- TEMPORARY WELL SCREENED INTERVAL

NOTE:

1. BASIS FOR VERTICAL DATUM: NAVD88.



KEYMAP

0 100
HORIZONTAL SCALE

0 20
VERTICAL SCALE

Cross Section B-B'

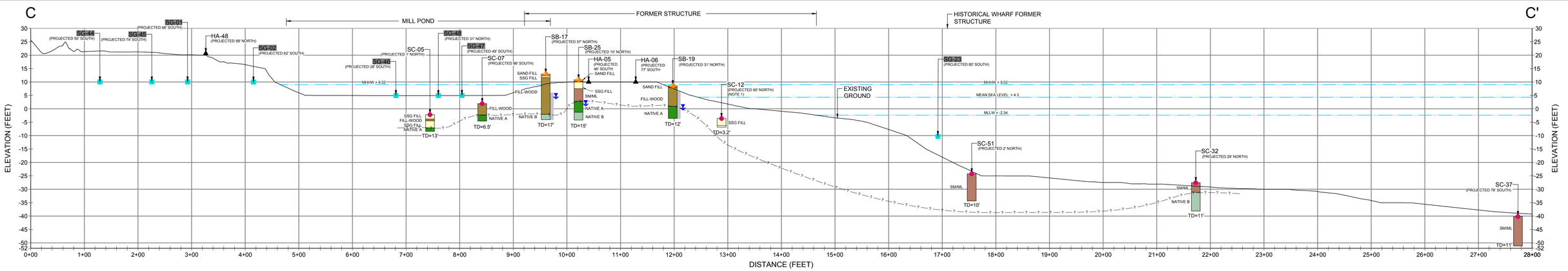
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

PROJECT NO: PNG0900 | MARCH 2024

FIGURE 3-3b

C:_GEO-ACC\ACCDOCS\GEOSYNTEC-SD\BLAKELY HARBOR\PROJECT FILES\CAD\CROSS SECTIONS\FIG\PNG0900.01 F01 (PLAN VIEW AND CROSS SECTIONS) - Last Saved by: SBerdy on 3/15/24

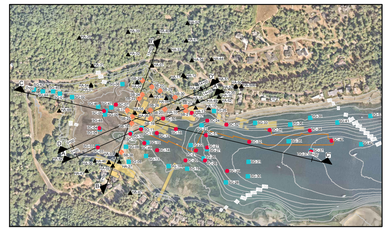


LEGEND

- PROJECTED LOCATION OF HAND AUGER, SEDIMENT CORE, AND SOIL BORING
- SURFICIAL TOPSOIL/SAND; SOME FILL; OR SOIL/SAND MIXED WITH FILL - **(SAND FILL)**
- WOOD DEBRIS (SAWDUST, DIMENSIONAL LUMBER, CHIPS) - **(FILLWOOD-)**
- BUILDING/WOOD DEBRIS (SLAG, BRICKS, GLASS) - **(DEBRIS FILL)**
- FILL WITH SAND/SILT/GRAVEL MIXED IN - **(SSG FILL)**
- SILTY SAND/SANDY SILT - WITH NO FILL MATERIAL - **(SM/ML)**
- GRAVEL WITH SILT AND/OR SAND; WITH NO SHELLS - **(NATIVE A)**
- GRAVELLY SILT WITH SAND/GRAVELY SAND; WITH SILT AND SHELLS - **(NATIVE B)**
- STATIC GROUNDWATER LEVEL
- WATER LEVEL RANGES (HIGH AND LOW)
- PERMANENT WELL SCREENED INTERVAL
- TEMPORARY WELL SCREENED INTERVAL

NOTES:

1. SEDIMENT CORE SC-12 COMPLETED TO A TOTAL DEPTH OF 3.2 FEET BELOW GROUND SURFACE WITH FINAL 0.3 MISSING FROM THE END OF THE CORE.
2. BASIS FOR VERTICAL DATUM: NAVD88.



KEYMAP

HORIZONTAL SCALE 0 100

VERTICAL SCALE 0 20

Cross Section C-C'

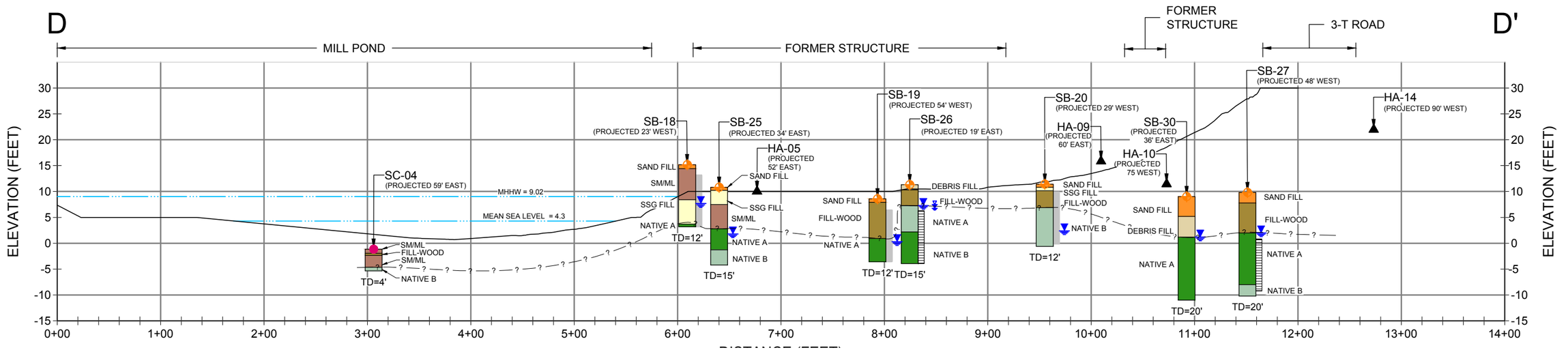
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

FIGURE 3-3c

PROJECT NO: PNG0900 | MARCH 2024

C:_GEO-ACCACCDOCS\GEOSYNTEC-SI\BLAKELY HARBOR\PROJECT FILES\CAD\CROSS SECTIONS\FIG\PNG0900.01 F01 (PLAN VIEW AND CROSS SECTIONS) - Last Saved by: SBlatty on 3/15/24

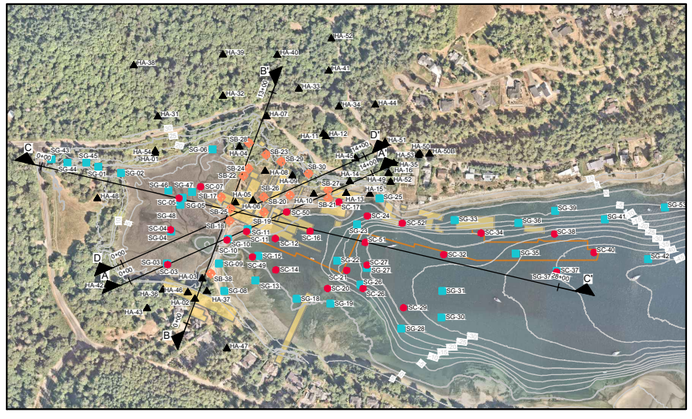


LEGEND

- PROJECTED LOCATION OF HAND AUGER, SEDIMENT CORE, AND SOIL BORING
- SURFICIAL TOPSOIL/SAND; SOME FILL; OR SOIL/SAND MIXED WITH FILL - **(SAND FILL)**
- WOOD DEBRIS (SAWDUST, DIMENSIONAL LUMBER, CHIPS) - **(FILL-WOOD)**
- BUILDING/WOOD DEBRIS (SLAG, BRICKS, GLASS) - **(DEBRIS FILL)**
- FILL WITH SAND/SILT/GRAVEL MIXED IN - **(SSG FILL)**
- SILTY SAND/SANDY SILT - WITH NO FILL MATERIAL - **(SM/ML)**
- GRAVEL WITH SILT AND/OR SAND; WITH NO SHELLS - **(NATIVE A)**
- GRAVELLY SILT WITH SAND/GRAVELY SAND; WITH SILT AND SHELLS - **(NATIVE B)**
- STATIC GROUNDWATER LEVEL
- WATER LEVEL RANGES (HIGH AND LOW)
- PERMANENT WELL SCREENED INTERVAL
- TEMPORARY WELL SCREENED INTERVAL

NOTE:

1. BASIS FOR VERTICAL DATUM: NAVD88.



KEYMAP

0 100
HORIZONTAL SCALE

0 20
VERTICAL SCALE

Cross Section D-D'

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

PROJECT NO: PNG0900 | MARCH 2024

FIGURE 3-3d

C:_GEO-ACC\ACCDOCS\GEOSYNTEC-SD\BLAKELY HARBOR\PROJECT FILES\CAD\CROSS SECTIONS\FIG\PNG0900.01 F01 (PLAN VIEW AND CROSS SECTIONS) - Last Saved by: SBerdy on 3/15/24



Legend

- Groundwater Well Location
- Groundwater Elevation (ft NAVD88)
- Shoreline
- Historical Wharf Structure
- Tax Lot
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Locations sampled on 10/7/2022.

N

0 80 Feet

October 2022 Groundwater Contour Map

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

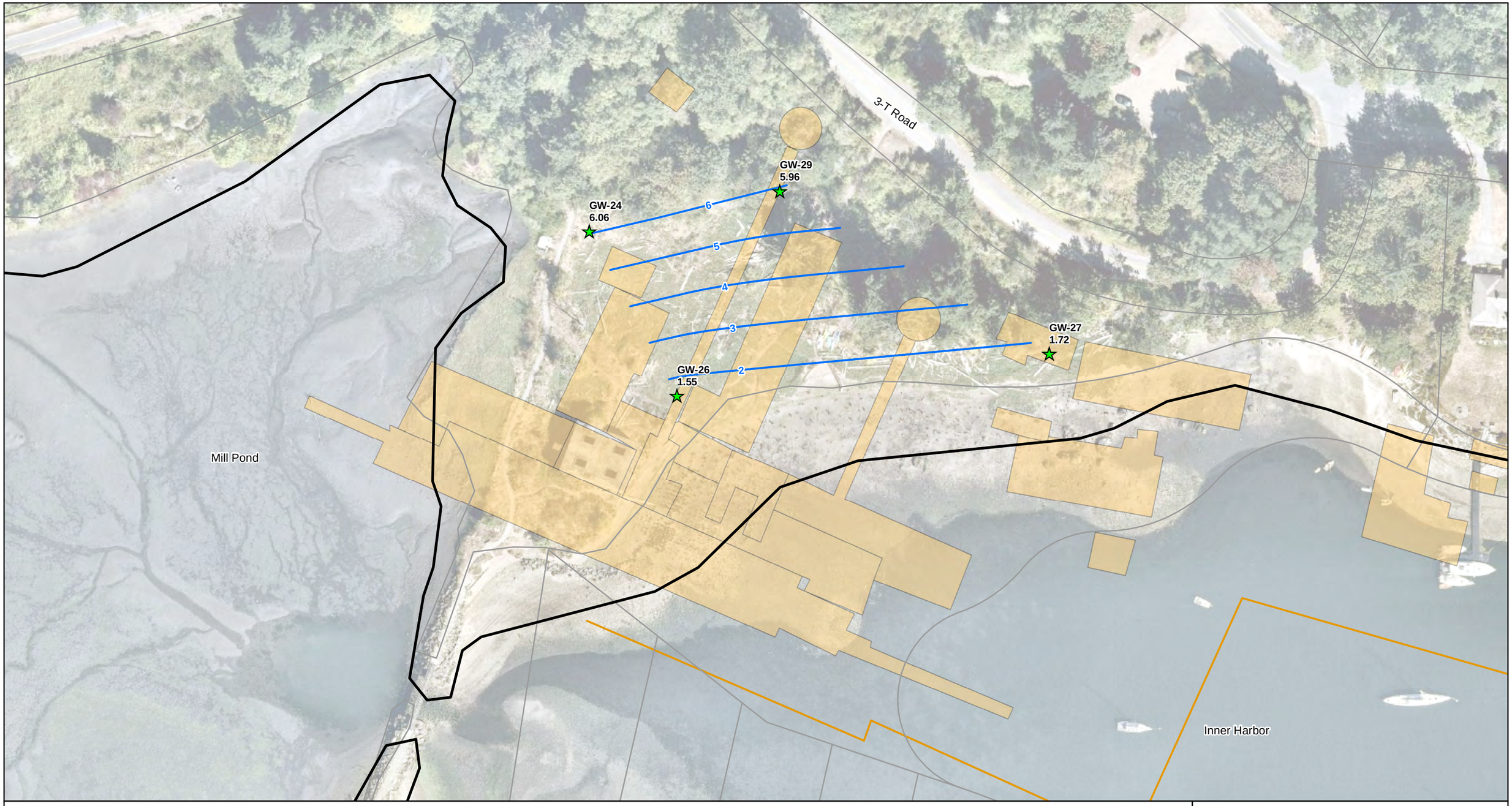
Geosyntec consultants

Figure 3-4a

MVI/Sea | April 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Figure 3-4a October 2022 Groundwater Contours.mxd 4/17/2024 4:31:47 AM

DRAFT



Legend

- Groundwater Well Location
- Groundwater Elevation (ft NAVD88)
- Shoreline
- Historical Wharf Structure
- Tax Lot
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Locations sampled on 1/31/2023.

N

0 80 Feet

January 2023 Groundwater Contour Map

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

Figure 3-4b

MVI/Sea | April 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Figure 3-4b January 2023 Groundwater Contours.mxd 4/17/2024 4:32:33 AM

DRAFT



Legend

- Groundwater Well Location
- Groundwater Elevation (ft NAVD88)
- Shoreline
- Historical Wharf Structure
- Tax Lot
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Locations sampled on 4/24/2023.

N

0 80 Feet

April 2023 Groundwater Contour Map

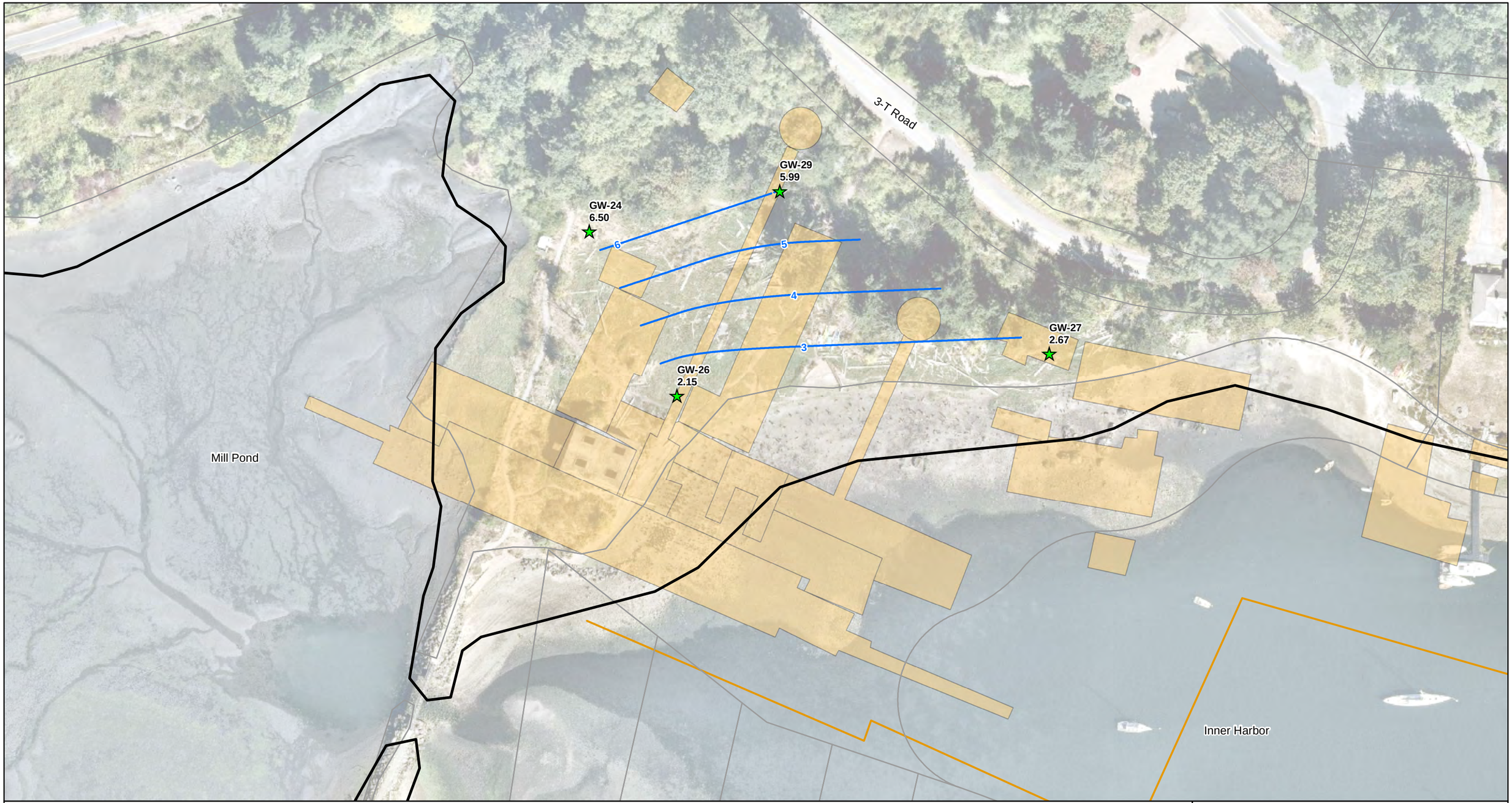
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

Figure 3-4c

MVI/Sea | April 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Figure 3-4c April 2023 Groundwater Contours.mxd 4/17/2024 4:33:22 AM



Legend

- Groundwater Well Location
- Groundwater Elevation (ft NAVD88)
- Shoreline
- Historical Wharf Structure
- Tax Lot
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Locations sampled on 8/01/2023.

N

0 80 Feet

August 2023 Groundwater Contour Map

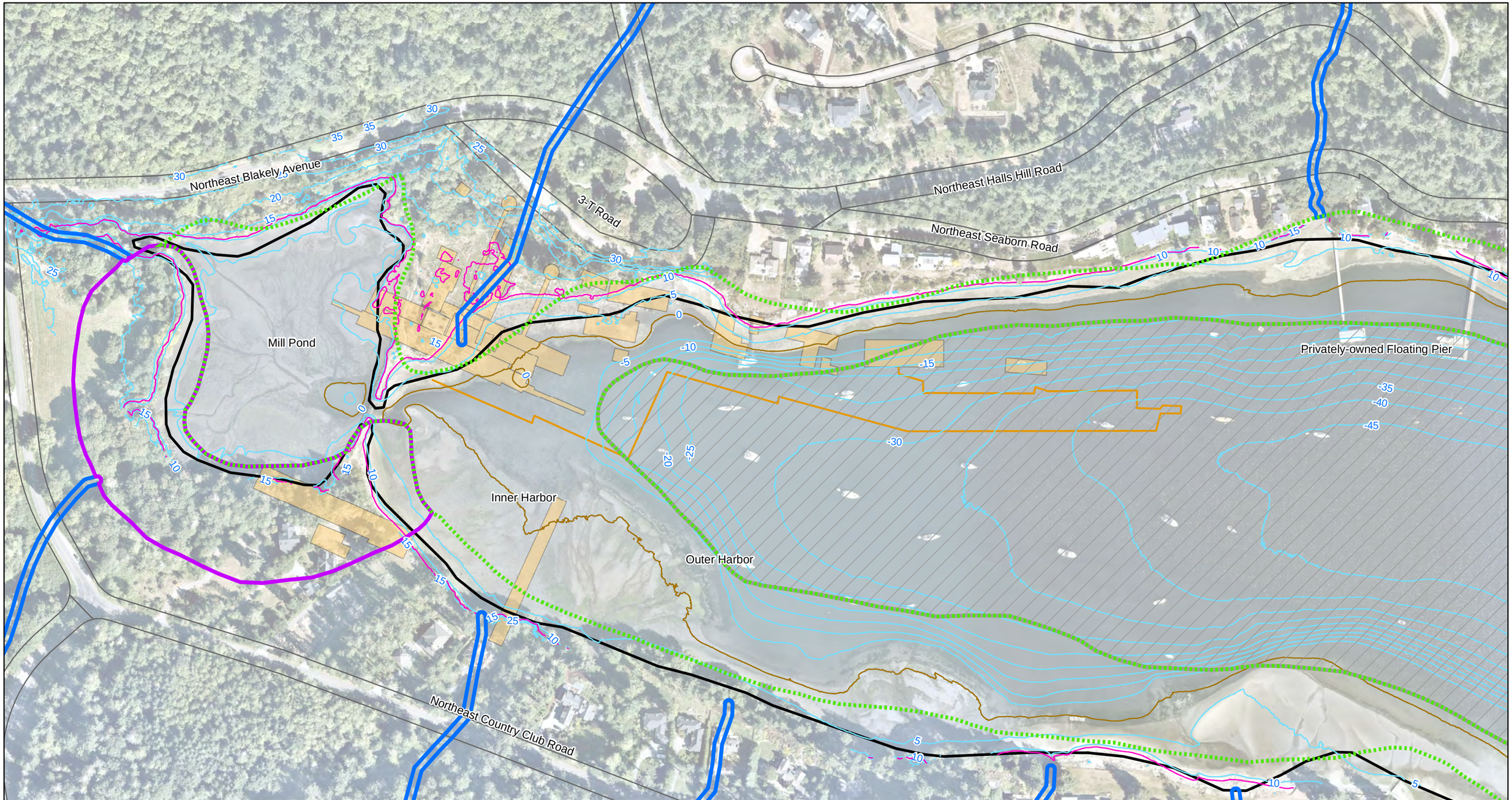
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

Figure 3-4d

MVI/Sea | April 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Figure 3-4d August 2023 Groundwater Contours.mxd 4/17/2024 4:33:59 AM



Legend

Habitat Type

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Forested/Shrub Wetland
- Riverine
- MHHW Contour
- MLLW Contour
- Contour (5 foot MLLW)
- Shoreline
- Historical Wharf Structure
- Road
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.

N

0 240 Feet

Shoreline Habitats

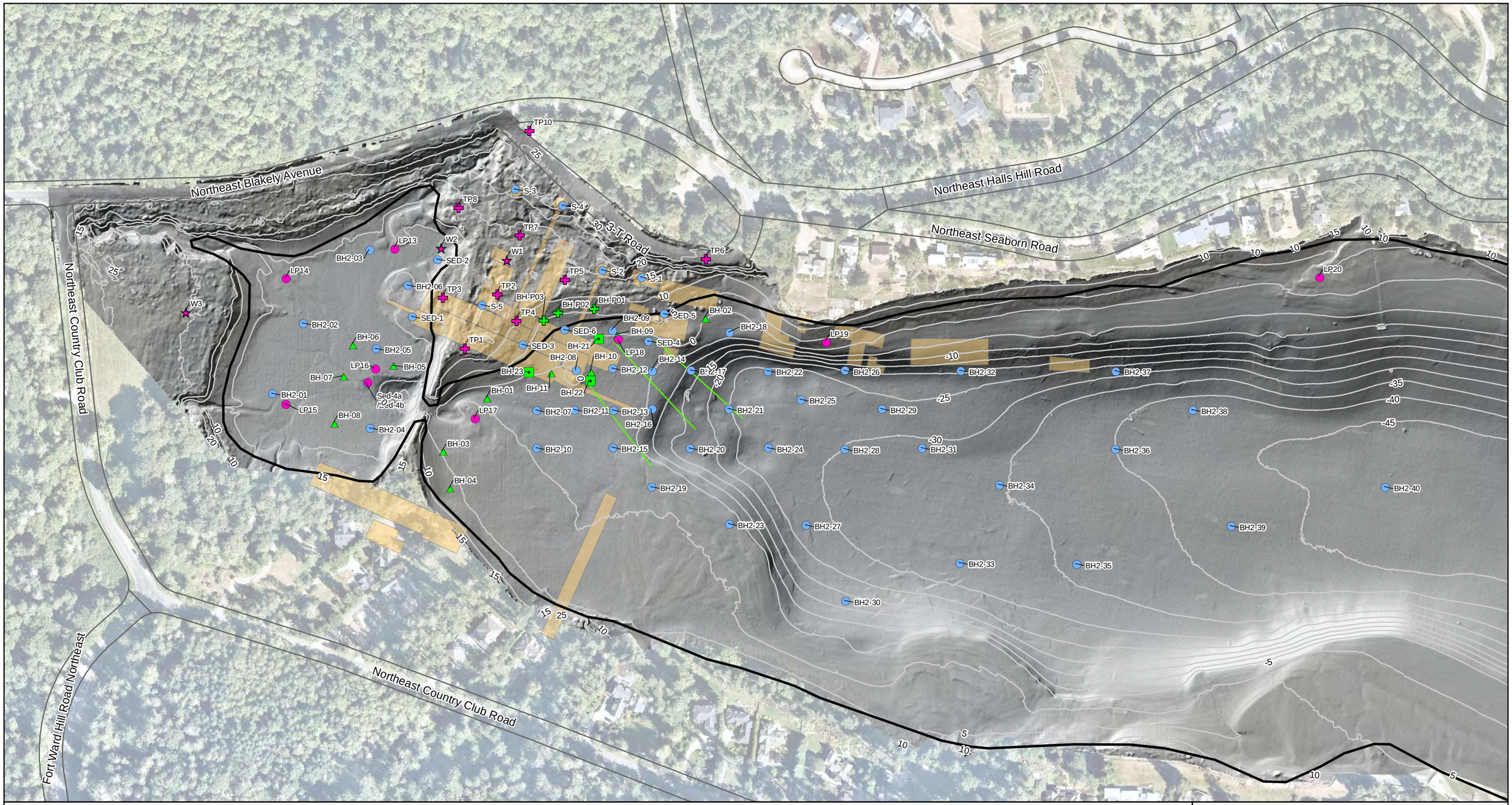
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | April 2024

Figure 3-5

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Figure 3-5 Shoreline Habitats.mxd 4/23/2024 6:40:15 AM



Legend

Historical Studies

Shannon & Wilson 1990 and 1992

- Groundwater Sample
- Sediment Grab Sample
- Test Pit

Anchor 2009

- Sediment Core
- Seep Sample
- Test Pit

- 2019 Sample Location (GeoEngineers, Leidos and NewFields)
- Diver Survey Transect
- Contour (5 feet MLLW)
- Shoreline
- Road
- Structures from 1917 Map and Figure 2 in GeoEngineers, 2019

Notes:
1. Shoreline boundary provided by Washington Department of Natural Resources.
2. Acronyms: BI = Bainbridge Island, MLLW = Mean Lower Low Water.
3. Bathymetry courtesy of David Evans and Associates, Inc.2020.

N

0 240 Feet

Historical Sample Locations

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | May 2023

Figure 4-1

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Revisions05172023\Figure 2-3 Historical Sample Locations.mxd 5/17/2023 6:28:17 AM

Legend

- Slag Pile Location
- Assumed Cable Crossing Alignment
- Contour (5 foot MLLW)
- Debris Pile
- Rectangular Concrete Block
- Riprap
- Approximate Extents of Wood Planks Overlain by Rocks
- Scattered Bricks
- Approximate Extent of Large Wood Debris
- Overwater Structure
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.

N

0 60 Feet

Shoreline Structures

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea	May 2023

Figure 4-2a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Revisions05172023\Figure 5-2a Shoreline Structures.mxd 5/17/2023 10:27:13 AM

Legend

- Seep Location
- Shoreline
- Historical Wharf Structure
- Contour (5 foot MLLW)
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.

N

0 100 Feet

Location of Seeps along the Shoreline

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea	May 2023	**Figure 4-2b**

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\Preliminary Results\Shoreline Survey\Figure 5-2b Seep Locations.mxd 5/17/2023 10:31:53 AM



Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Data points collected during the 2022 shoreline slag survey represent a visual assessment of slag percentage on a 10 by 10 feet area.
4. Data points collected during 2022 soil and sediment sampling represent a visual assessment of slag percentage of approximately 15 cubic inches volume.
5. Maximum percentage of slag at any depth showed.
6. Locations with slag observations were from the surface of the soil or sediment except for SC-51 (5% from 6.7 to 8.7 ft bml), SC-17 (22% from 0 to 2 ft bml), SB/GW-24 (5% from 0 to 2 ft bgs), SB/GW-27 (10% from 2.5 to 3.5 ft bgs), SB-25 (9% from 0 to 2 & 6% from 2 to 4 ft bgs), SB-28 (19% from 2 to 4 ft bgs), and SB-38 (5% from 10 to 12 ft bgs).
BGS = Below ground surface
BML = Below mud line

Legend

Slag Percentage
- < 1 %
- 1 - 10 %
- 10 - 20 %
- 20 - 30 %
- 30 - 40 %
- > 40 % (max = 48%)

Sample Type
- Slag Survey
- Subsurface Sediment
- Subsurface Soil
- Surface Sediment
- Surface Soil
- Shoreline Extent of Slag Observed on Surface

- Shoreline
- Historical Wharf Structure
- Approximate Extent of Large Slag Piles Surveyed During the 2021 Field Investigation
- Road
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

0 120 Feet

N

Extent of Slag
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

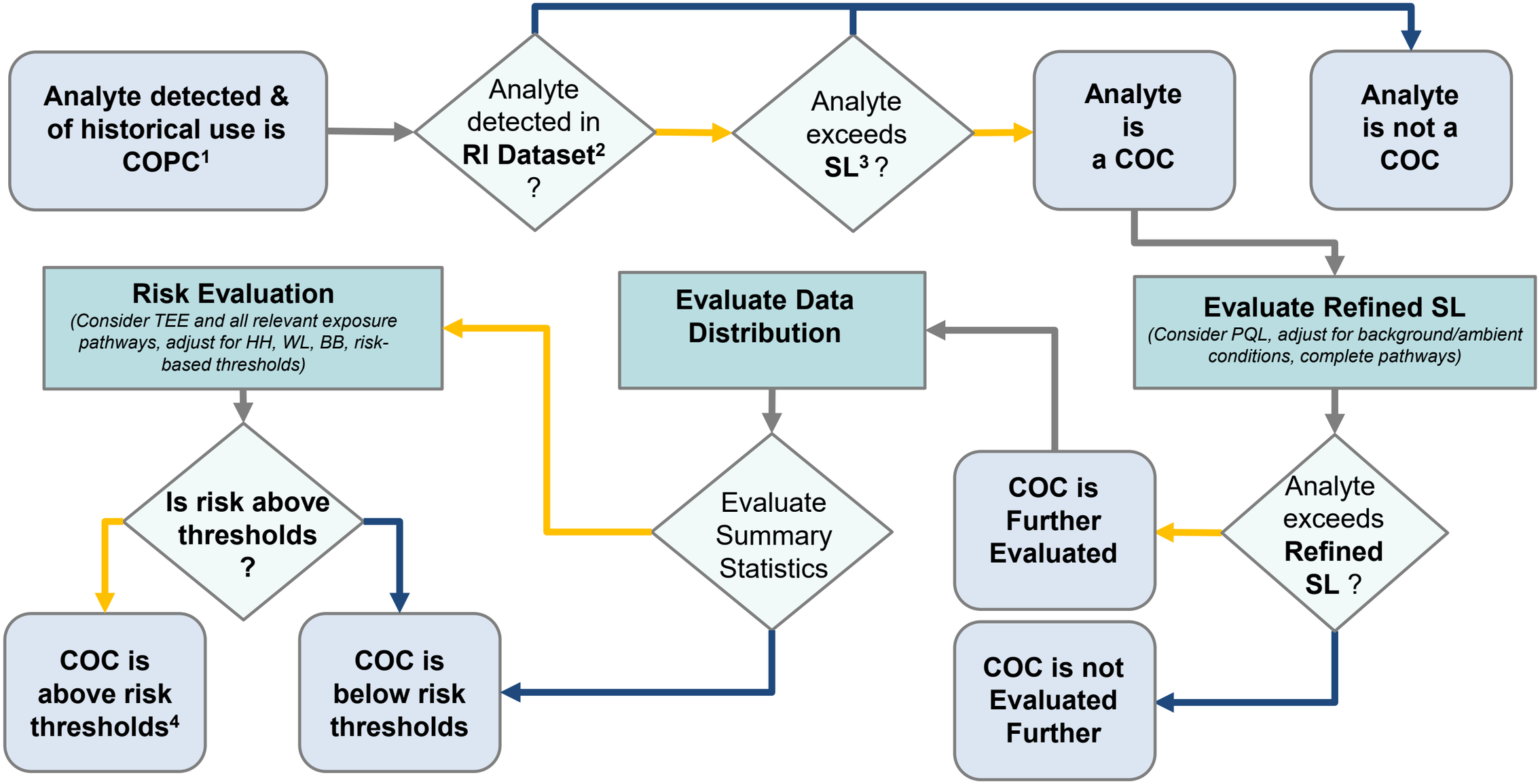
Geosyntec consultants

MVI/Sea | May 2023

Figure 4-3

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Revisions05172023\Figure 5-8 Extent of Slag.mxd 5/17/2023 9:52:30 AM

Version 4



Driving Data Analysis Step

Final Determination

Evaluation Step

YES

NO

Procedural

Notes:

1. COPCs were identified in the RI/FS Work Plan (Geosyntec, 2022).
2. The RI Dataset includes the RI Phase 1 through 3 and historical data up to 10 years old (Geosyntec, 2022).
3. Screening levels refer to Preliminary SL as identified in the RI/FS Work Plan Addendum (Geosyntec, 2023).
4. Proposed cleanup levels will be developed for Site COC.

Acronyms:

BB = benthic biota; COPC = contaminant of potential concern; COC = Contaminant of Concern; HH = Human Health; SL = Screening Level; MTCA = model toxic control act; TEE = terrestrial ecological evaluation; RI = remedial investigation; WL = wildlife

Decision Flowchart for Identifying COCs
RI Report

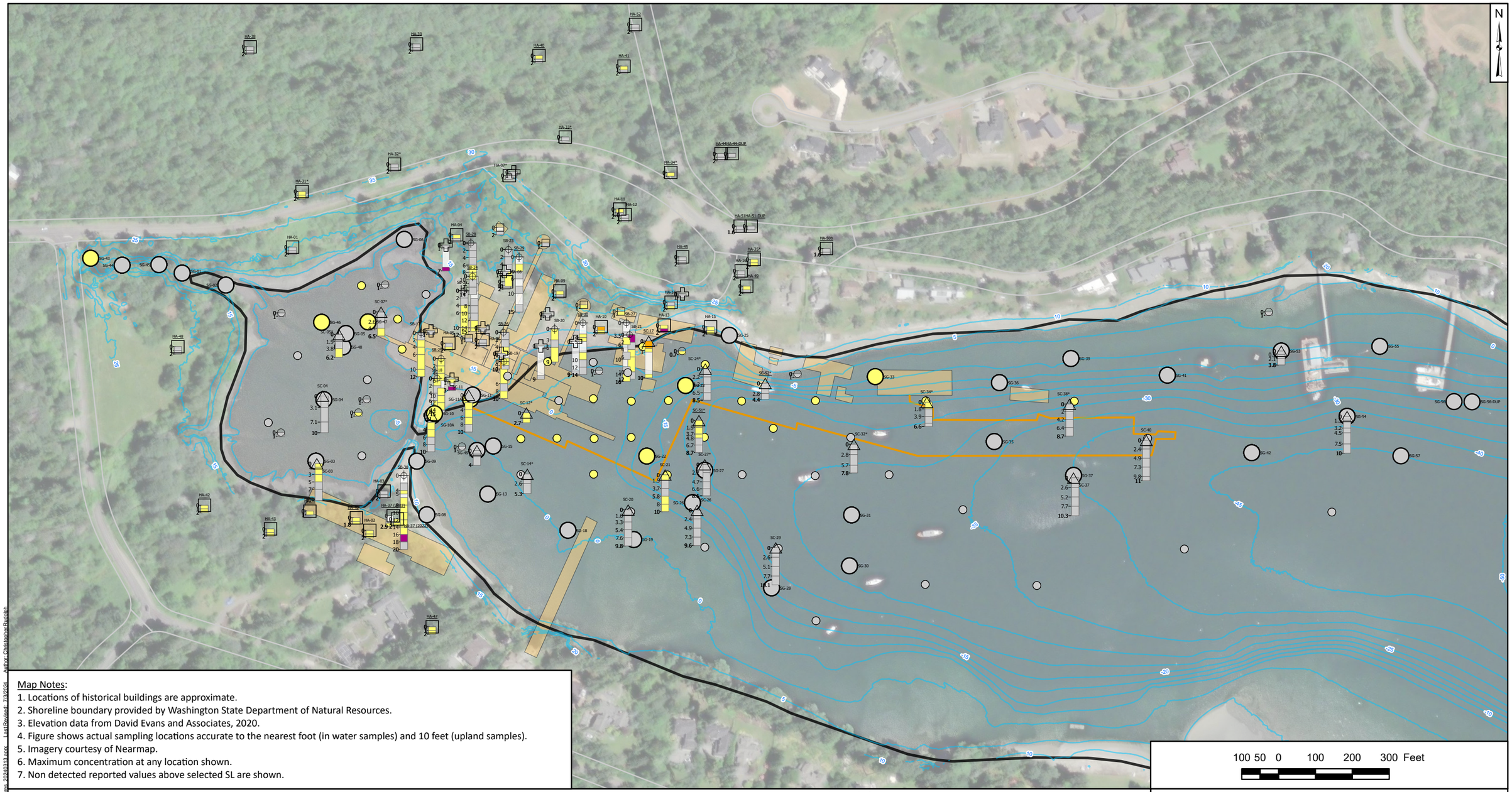
Blakely Harbor Park Site
Bainbridge Island, WA

Geosyntec consultants

GP/SEA | June 2024

Figure
5-1

P:\Projects\Blakely Harbor\600 Deliverables \RI Report (wip)\Figures



Map Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.
4. Figure shows actual sampling locations accurate to the nearest foot (in water samples) and 10 feet (upland samples).
5. Imagery courtesy of Nearmap.
6. Maximum concentration at any location shown.
7. Non detected reported values above selected SL are shown.

100 50 0 100 200 300 Feet

Concentration in Soil
- <7 mg/kg (SNB)
- > 7 to 20 mg/kg (Method A)
- > 20 to 40 mg/kg (2xMethod A)
- > 40 mg/kg

Concentration in Sediment
- < 11 mg/kg (MNB)
- > 11 to 57 mg/kg (SCO)
- > 57 to 93 mg/kg (CSL)
- > 93 mg/kg

(white) Result or sample unavailable at interval

- Historical Sediment Sample Location
- Historical Test Pit Location
- Historical Soil Sample Location
- Modern Soil Hand Auger Location
- Modern Soil Boring Location
- Modern Sediment Grab Location
- Modern Sediment Core Location
- Bathymetric Contour (5 foot MLLW)
- Shoreline
- Historical Wharf Structure
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes and Abbreviations:
SNB - Puget Sound 90% Soil Background Value, Method A - MTCA Method A.
MNB - SCUM Marine Sediment Natural Background, SCO - Benthic Sediment Cleanup Objective, CSL - Benthic Sediment Cleanup Screening Level.

Depths in feet.
*Boring hit refusal.
All data shown in dry weight.
Historical samples shown without location labels

Arsenic Concentrations in Soil/Sediment

Blakely Harbor Park Site

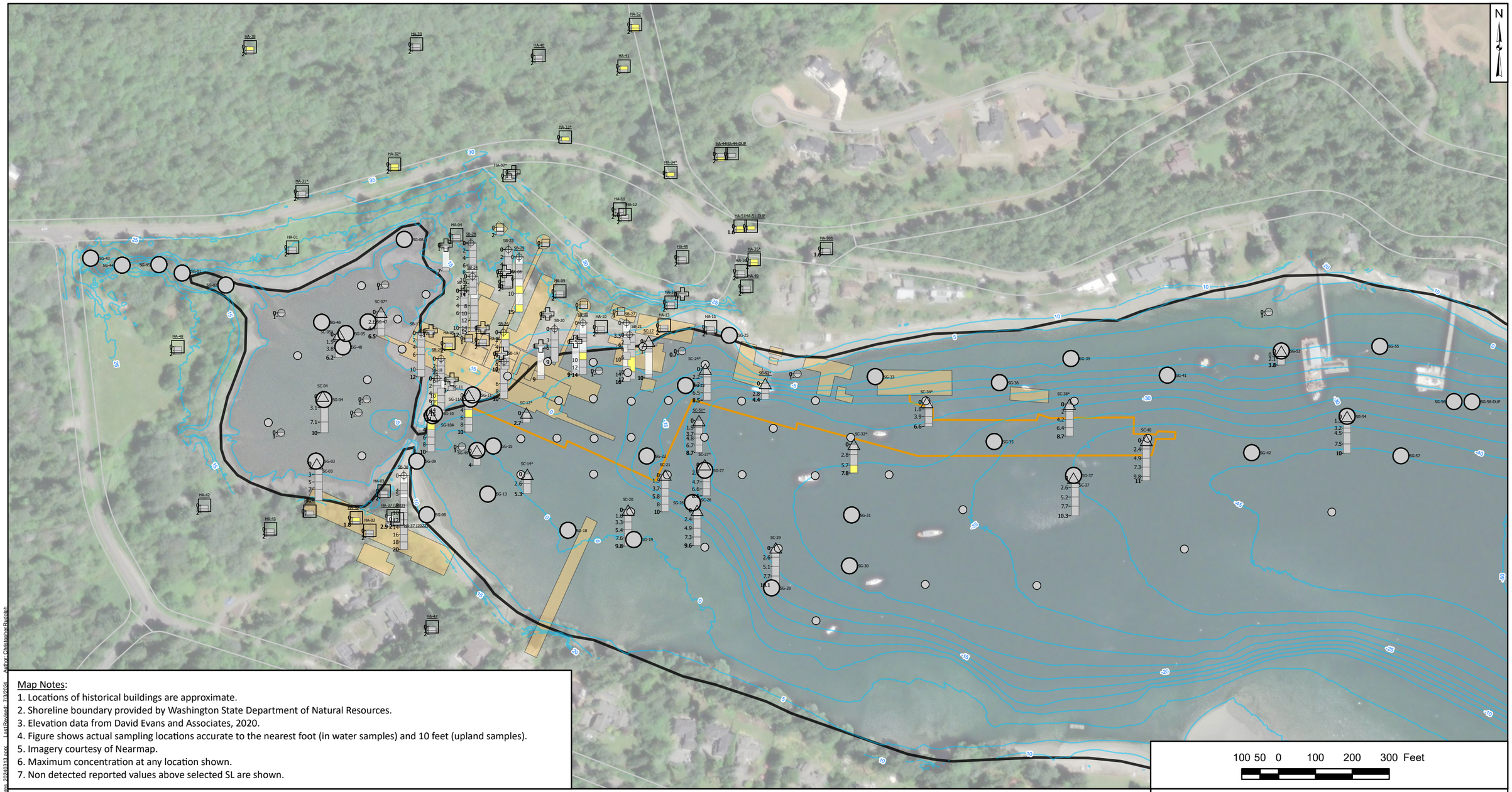
Geosyntec consultants

PNG0900 | 03-Jul-2024

Figure 6-1

Path: P:\GIS\Blakely\Harbor\GIS\Blakely_SedFigures\Blakely_SedFigures_20240313.aprx Last Revised: 7/3/2024 Author: ChristocherRudolph

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet; Units in Foot US Bin File: ScreeningBins_MultiBinFigures_GW_GP_Phenanthrene_Updated



Map Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.
4. Figure shows actual sampling locations accurate to the nearest foot (in water samples) and 10 feet (upland samples).
5. Imagery courtesy of Nearmap.
6. Maximum concentration at any location shown.
7. Non detected reported values above selected SL are shown.

Concentration in Soil
- < 48 mg/kg (SNB)
- > 48 to 480 mg/kg (10xSNB)
- > 480 to 2000 mg/kg (Method A)
- > 2000 mg/kg

Concentration in Sediment
- < 62 mg/kg (MNB)
- > 62 to 260 mg/kg (SCO)
- > 260 mg/kg

(white) Result or sample unavailable at interval

- Historical Sediment Sample Location
- Historical Test Pit Location
- Historical Soil Sample Location
- Modern Soil Hand Auger Location
- Modern Soil Boring Location
- Modern Sediment Grab Location
- Modern Sediment Core Location
- Bathymetric Contour (5 foot MLLW)
- Shoreline
- Historical Wharf Structure
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes and Abbreviations:
SNB - Puget Sound 90% Soil Background Value, Method A - MTCA Method A.
MNB - SCUM Marine Sediment Natural Background; SCO - Benthic Sediment Cleanup Objective.

Depths in feet.
*Boring hit refusal.
All data shown in dry weight.
Historical samples shown without location labels

Chromium Concentrations in Soil/Sediment

Blakely Harbor Park Site

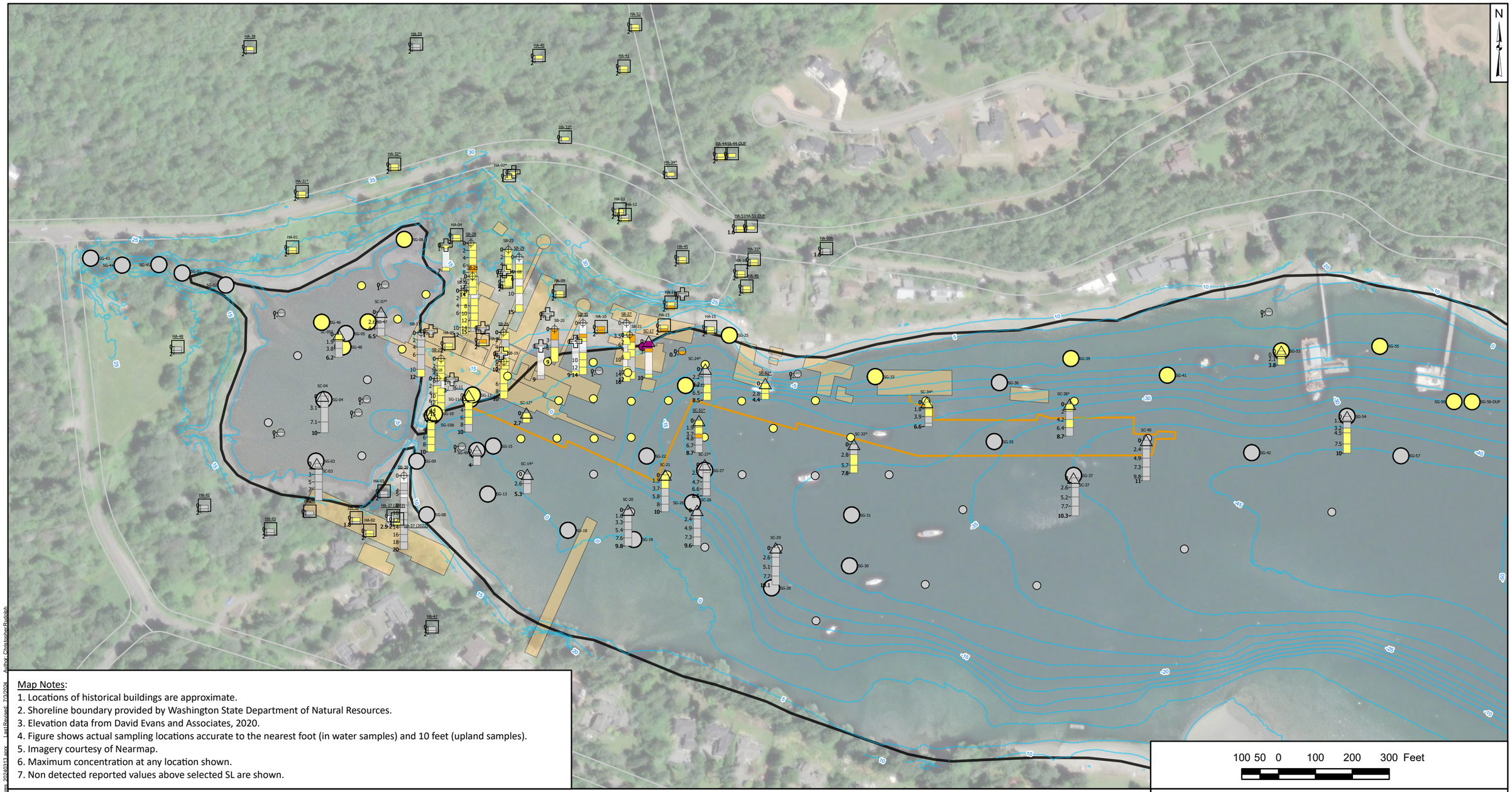
Geosyntec consultants

PNG0900 | 03-Jul-2024

Figure 6-2

Path: P:\GIS\Blakely\Habitat\GIS\Blakely_SedFigures\Blakely_SedFigures_20240313.aprx Last Revised: 7/3/2024 Author: Christocher Rudolph

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet; Units in Foot US Bin File: ScreeningBins_MultiBinFigures_GW_GP_Phenanthrene_Updated



Map Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.
4. Figure shows actual sampling locations accurate to the nearest foot (in water samples) and 10 feet (upland samples).
5. Imagery courtesy of Nearmap.
6. Maximum concentration at any location shown.
7. Non detected reported values above selected SL are shown.

Concentration in Soil
- < 36 mg/kg (SNB)
- > 36 to 180 mg/kg (5XSNB)
- 180 to 3,200 mg/kg (Method B NC)
- > 3,200 mg/kg

Concentration in Sediment
- < 45 mg/kg (MNB)
- > 45 to 390 mg/kg (SCO/CSL)
- > 390 to 780 mg/kg (2xSCO/CSL)
- > 780 mg/kg

(white) Result or sample unavailable at interval

- Historical Sediment Sample Location
- Historical Test Pit Location
- Historical Soil Sample Location
- Modern Soil Hand Auger Location
- Modern Soil Boring Location
- Modern Sediment Grab Location
- Modern Sediment Core Location
- Bathymetric Contour (5 foot MLLW)
- Shoreline
- Historical Wharf Structure
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes and Abbreviations:
SW - Soil Protective of Groundwater to Marine Surface Water, SNB - Puget Sound 90% Soil Background Value, Method B NC - MTCA Method B Non-cancer.
MNB - SCUM Marine Sediment Natural Background, SCO - Benthic Sediment Cleanup Objective, CSL - Benthic Sediment Cleanup Screening Level.

Depths in feet.
*Boring hit refusal.
All data shown in dry weight.
Historical samples shown without location labels

100 50 0 100 200 300 Feet

Copper Concentrations in Soil/Sediment

Blakely Harbor Park Site

Geosyntec consultants

PNG0900 | 03-Jul-2024

Figure 6-3

Path: P:\GIS\Blakely\Habitat\GIS\Blakely_SedFigures\Blakely_SedFigures_20240313.aprx Last Revised: 7/3/2024 Author: Christocher Rudolph

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet; Units in Foot US Bin File: ScreeningBins_MultiBinFigures_GW_GP_Phenanthrene_Updated

Map Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.
4. Figure shows actual sampling locations accurate to the nearest foot (in water samples) and 10 feet (upland samples).
5. Imagery courtesy of Nearmap.
6. Maximum concentration at any location shown.
7. Non detected reported values above selected SL are shown.

Concentration in Soil
- <24 mg/kg (SNB)
- > 24 to 250 mg/kg (Method A)
- > 250 to 750 mg/kg (3xMethod A)
- > 750 mg/kg

Concentration in Sediment
- < 21 mg/kg (MNB)
- > 21 to 450 mg/kg (SCO)
- > 450 to 530 mg/kg (CSL)
- > 530 mg/kg

(white) Result or sample unavailable at interval

- Historical Sediment Sample Location
- Historical Test Pit Location
- Historical Soil Sample Location
- Modern Soil Hand Auger Location
- Modern Soil Boring Location
- Modern Sediment Grab Location
- Modern Sediment Core Location
- Bathymetric Contour (5 foot MLLW)
- Shoreline
- Historical Wharf Structure
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes and Abbreviations:
SNB - Puget Sound 90% Soil Background Value, Method A - MTCA Method A.
MNB - SCUM Marine Sediment Natural Background, SCO - Benthic Sediment Cleanup Objective, CSL - Benthic Sediment Cleanup Screening Level.

Depths in feet.
*Boring hit refusal.
All data shown in dry weight.
Historical samples shown without location labels

100 50 0 100 200 300 Feet

Lead Concentrations in Soil/Sediment

Blakely Harbor Park Site

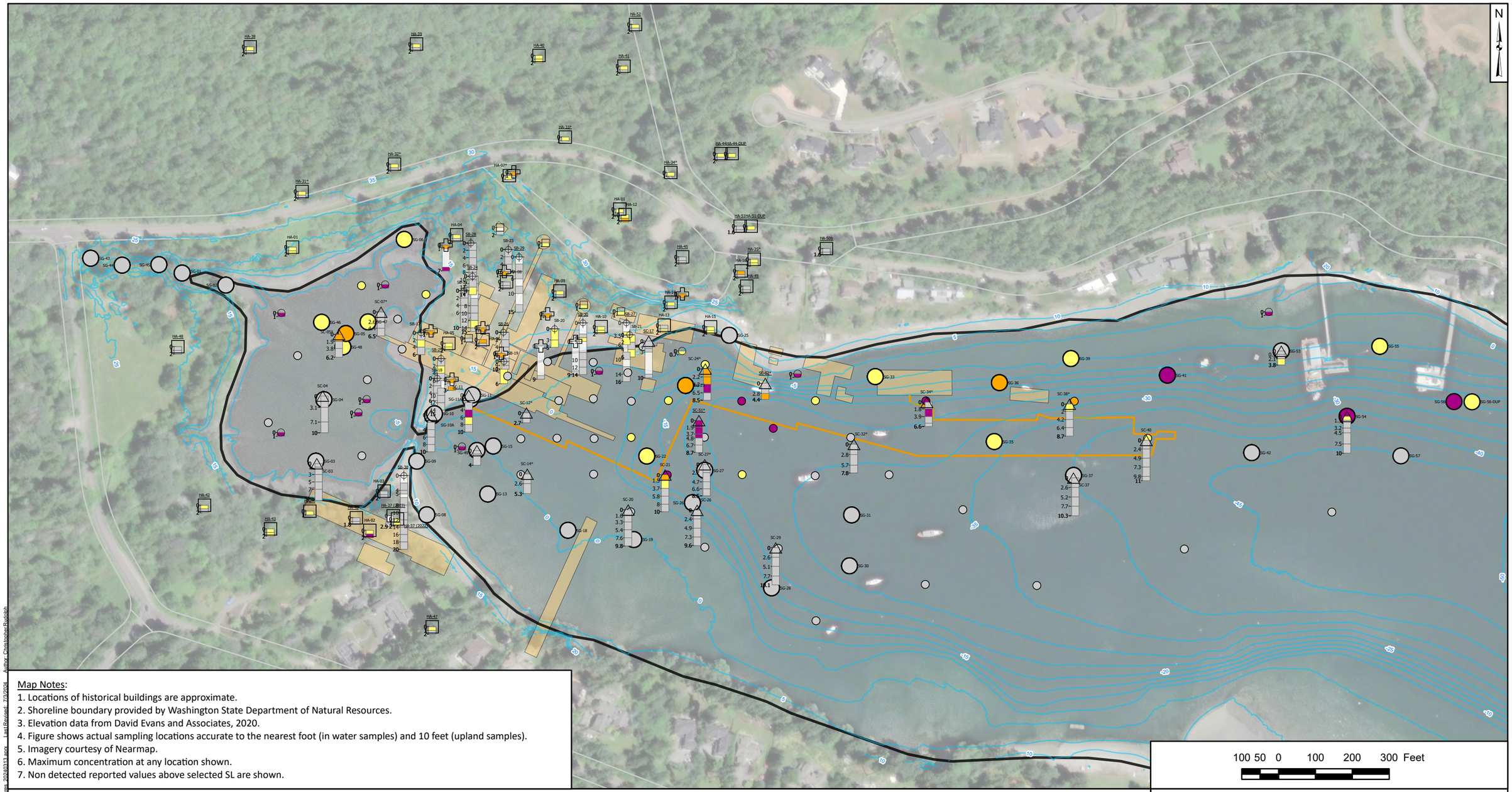
Geosyntec consultants

PNG0900 | 03-Jul-2024

Figure 6-4

Path: P:\GIS\Bakely\Harbor\GIS\Blakely_SedFigures\Blakely_SedFigures_20240313.aprx Last Revised: 7/3/2024 Author: Christocher Rudolph

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet; Units in Foot US Bin File: ScreeningBins_MultiBinFigures_GW_GP_Phenanthrene_Updated



Map Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.
4. Figure shows actual sampling locations accurate to the nearest foot (in water samples) and 10 feet (upland samples).
5. Imagery courtesy of Nearmap.
6. Maximum concentration at any location shown.
7. Non detected reported values above selected SL are shown.

Concentration in Soil
- < 0.07 mg/kg (SNB)
- > 0.07 to 0.7 mg/kg (10xSNB)
- > 0.7 to 2 mg/kg (Method A)
- > 2 mg/kg

Concentration in Sediment
- < 0.2 mg/kg (MNB)
- > 0.2 to 0.41 mg/kg (SCO)
- > 0.41 to 0.59 mg/kg (CSL)
- > 0.59 mg/kg

(white) Result or sample unavailable at interval

- Historical Sediment Sample Location
- Historical Test Pit Location
- Historical Soil Sample Location
- Modern Soil Hand Auger Location
- Modern Soil Boring Location
- Modern Sediment Grab Location
- Modern Sediment Core Location
- Bathymetric Contour (5 foot MLLW)
- Shoreline
- Historical Wharf Structure
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes and Abbreviations:
SNB - Puget Sound 90% Soil Background Value, Method A - MTCA Method A.
MNB - SCUM Marine Sediment Natural Background, SCO - Benthic Sediment Cleanup Objective, CSL - Benthic Sediment Cleanup Screening Level.

Depths in feet.
*Boring hit refusal.
All data shown in dry weight.
Historical samples shown without location labels

100 50 0 100 200 300 Feet

Mercury Concentrations in Soil/Sediment

Blakely Harbor Park Site

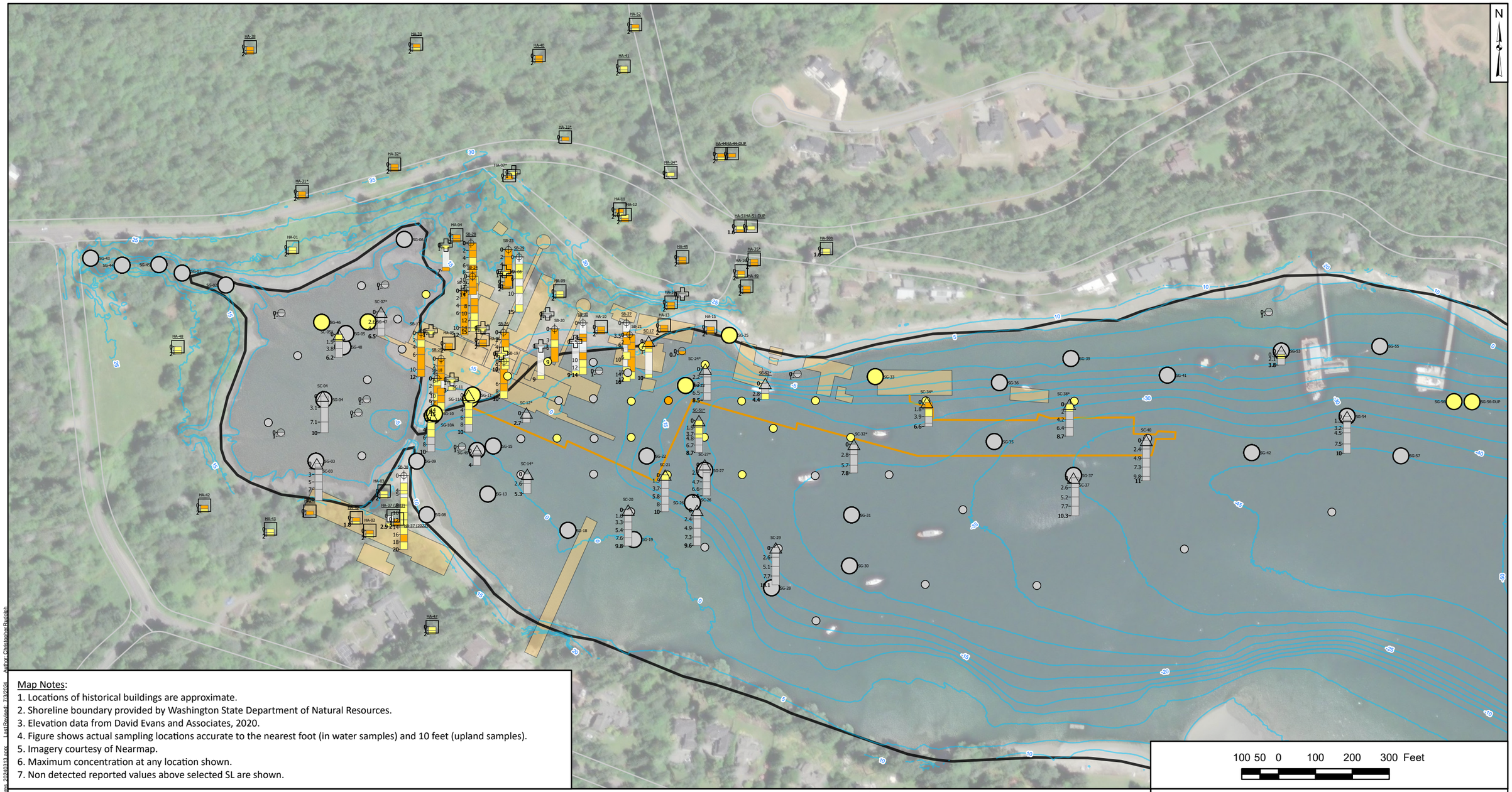
Geosyntec consultants

PNG0900 | 03-Jul-2024

Figure 6-5

Path: P:\GIS\Blakely\Bathtub\GIS\Blakely_SedFigures\Blakely_SedFigures_20240313.aprx Last Revised: 7/3/2024 Author: ChristocherRudolph

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet; Units in Foot US Bin File: ScreeningBins_MultiBinFigures_GW_GP_Phenanthrene_Updated



Map Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.
4. Figure shows actual sampling locations accurate to the nearest foot (in water samples) and 10 feet (upland samples).
5. Imagery courtesy of Nearmap.
6. Maximum concentration at any location shown.
7. Non detected reported values above selected SL are shown.

Concentration in Soil
- <5 mg/kg (SW)
- > 5 to 85 mg/kg (SNB)
- > 85 to 24,000 mg/kg (Method B)
- > 24,000 mg/kg

Concentration in Sediment
- < 93 mg/kg (MNB)
- > 93 to 410 mg/kg (SCO)
- > 410 to 960 mg/kg (CSL)
- > 960 mg/kg

(white) Result or sample unavailable at interval

- Historical Sediment Sample Location
- Historical Test Pit Location
- Historical Soil Sample Location
- Modern Soil Hand Auger Location
- Modern Soil Boring Location
- Modern Sediment Grab Location
- Modern Sediment Core Location
- Bathymetric Contour (5 foot MLLW)
- Shoreline
- Historical Wharf Structure
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes and Abbreviations:
SW - Soil Protective of Groundwater to Marine Surface Water, SNB - Puget Sound 90% Soil Background Value, Method B - MTCA Method B Cancer.
SCO - Benthic Sediment Cleanup Objective, CSL - Benthic Sediment Cleanup Screening Level.

Depths in feet.
*Boring hit refusal.
All data shown in dry weight.
Historical samples shown without location labels

Zinc Concentrations in Soil/Sediment

Blakely Harbor Park Site

Geosyntec consultants

PNG0900 | 03-Jul-2024

Figure 6-6

Path: P:\GIS\Blakely\Illustrations\GIS\Blakely_SedFigures\Blakely_SedFigures_20240313.aprx Last Revised: 7/3/2024 Author: ChristocherRudolph

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet; Units in Foot US Bin File: ScreeningBins_MultiBinFigures_GW_GP_Phenanthrene_Updated

Map Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.
4. Figure shows actual sampling locations accurate to the nearest foot (in water samples) and 10 feet (upland samples).
5. Imagery courtesy of Nearmap.
6. Maximum concentration at any location shown.
7. Non detected reported values above selected SL are shown.

Concentration in Soil
- < 100 µg/kg (Method A)
- > 100 to 190 µg/kg (Method B)
- > 190 to 24,000 (Method B NC)
- > 24,000 µg/kg

Concentration in Sediment
- < 0.021 mg/kg (MNB)
- > 0.021 to 0.210 mg/kg (10xMNB)
- > 0.21 to 120 mg/kg (HH)
- > 120 mg/kg (HH)

(white) Result or sample unavailable at interval

- Historical Sediment Sample Location
- Historical Test Pit Location
- Historical Soil Sample Location
- Modern Soil Hand Auger Location
- Modern Soil Boring Location
- Modern Sediment Grab Location
- Modern Sediment Core Location
- Bathymetric Contour (5 foot MLLW)
- Shoreline
- Historical Wharf Structure
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes and Abbreviations:
Method A - MTCA Method A, Method B - MTCA Method B Cancer, Method B NC - MTCA Method B Non Cancer .
MNB - SCUM Marine Sediment Natural Background, HH - Human Health Direct Contact.

Depths in feet.
*Boring hit refusal.
Non-Detects set at half Detection Limit.
All data shown in dry weight.
Non-Detects set at half Detection Limit.
Historical samples shown without location labels

100 50 0 100 200 300 Feet

Total cPAH TEQ Concentrations in Soil/Sediment

Blakely Harbor Park Site

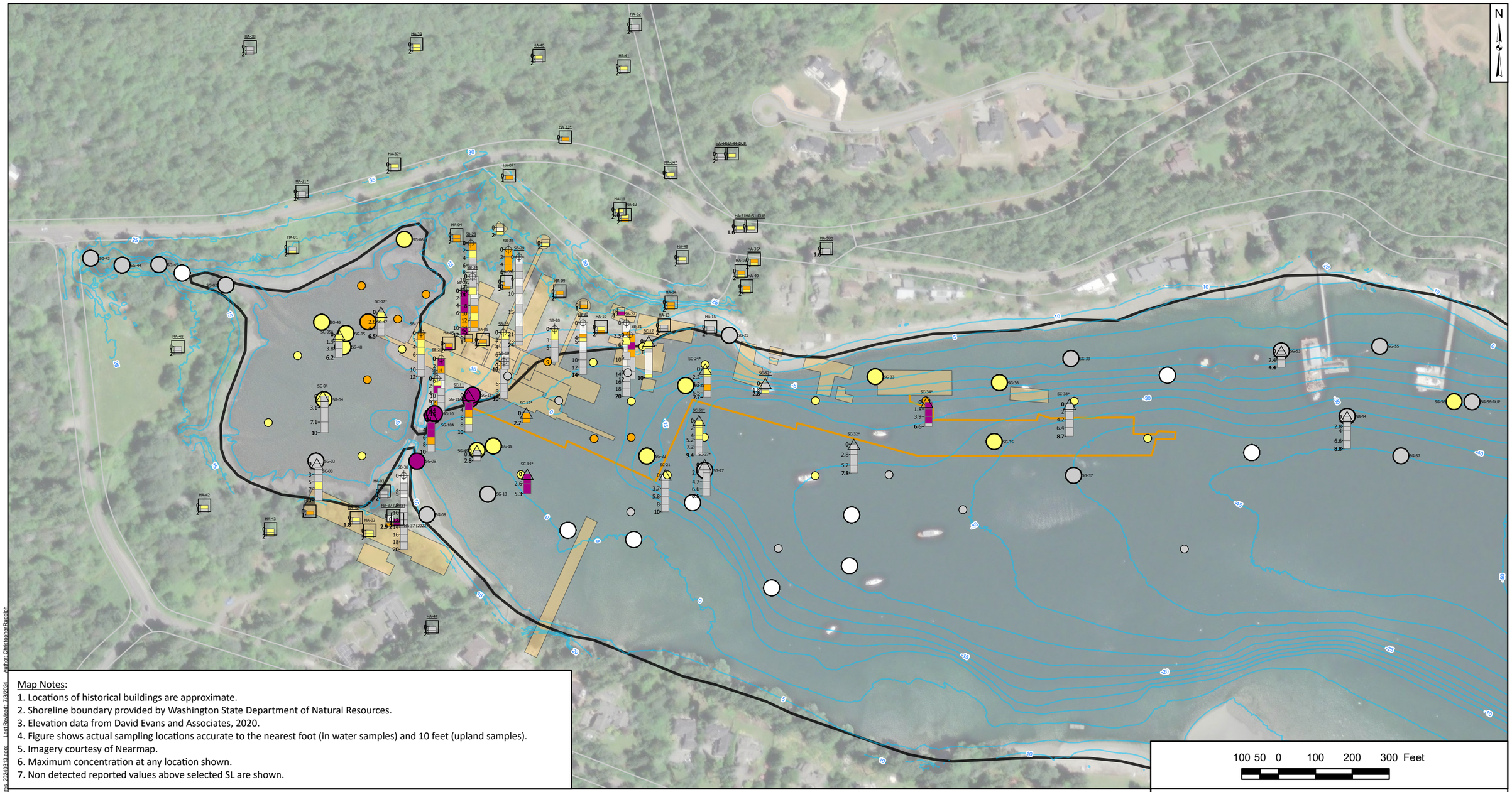
Geosyntec consultants

PNG0900	03-Jul-2024

Figure 6-7

Path: P:\GIS\Blakely\Harbor\GIS\Blakely_SedFigures\Blakely_SedFigures_20240313.aprx Last Revised: 7/3/2024 Author: Christopher.Rudolph

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet; Units in Foot US Bin File: ScreeningBins_MultiBinFigures_GW_GP_Phenanthrene_Updated



Map Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.
4. Figure shows actual sampling locations accurate to the nearest foot (in water samples) and 10 feet (upland samples).
5. Imagery courtesy of Nearmap.
6. Maximum concentration at any location shown.
7. Non detected reported values above selected SL are shown.

Concentration in Soil
- < 5.21 ng/kg (SNB)
- >5.21 to 13 ng/kg (Method B)
- > 13 to 93 ng/kg (Method B NC)
- > 93 ng/kg

Concentration in Sediment
- <4 ng/kg (MNB)
- > 4 to 12.1 ng/kg (HH)
- >15 to 24.2 ng/kg (2xHH)
- >24.2 ng/kg

- (white) Result or sample unavailable at interval

- Historical Sediment Sample Location
- Historical Test Pit Location
- Historical Soil Sample Location
- Modern Soil Hand Auger Location
- Modern Soil Boring Location
- Modern Sediment Grab Location
- Modern Sediment Core Location
- Bathymetric Contour (5 foot MLLW)
- Shoreline
- Historical Wharf Structure
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes and Abbreviations:
* -The total dioxin/furan TEQs were calculated by summing the product of the mammal Toxicity Equivalency referenced from the Van den Berg, et al. 2006 with the 17 Dioxin/Furan congener listed in the table; The SNB - Soil Natural Background, Method B - MTCA Method B Cancer, MTCA Method B NC - MTCA Method B noncarcinogenic direct contact screening level.
* -The total dioxin/furan TEQs were calculated by summing the product of the mammal Toxicity Equivalency referenced from the Van den Berg, et al. 2006 with the 17 Dioxin/Furan congener listed in the table; MNB - Marine Sediment Natural Background, HH - Human Health Direct Contact.

Depths in feet.

100 50 0 100 200 300 Feet

Total TCDD TEQ Concentrations in Soil/Sediment

Blakely Harbor Park Site

Geosyntec consultants

PNG0900	03-Jul-2024

Figure 6-8

Path: P:\GIS\Blakely\Hatton\GIS\Blakely_SedFigures\Blakely_SedFigures_20240313.aprx Last Revised: 7/3/2024 Author: Christocher Rudolph

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet; Units in Foot US Bin File: ScreeningBins_MultiBinFigures_GW_GP_Phenanthrene_Updated

Map Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.
4. Figure shows actual sampling locations accurate to the nearest foot (in water samples) and 10 feet (upland samples).
5. Imagery courtesy of Nearmap.
6. Maximum concentration at any location shown.
7. Non detected reported values above selected SL are shown.

Concentration in Soil
- < 0.055 mg/kg (SW)
- > 0.055 to 1 mg/kg (SNB)
- > 1 to 2 mg/kg (Method A)
- > 2 mg/kg

Concentration in Sediment
- < 0.8 mg/kg (MNB)
- > 0.8 to 1.6 mg/kg (2xMNB)
- > 1.6 to 5.1 mg/kg (SCO)
- > 5.1 mg/kg

(white) Result or sample unavailable at interval

- Historical Sediment Sample Location
- Historical Test Pit Location
- Historical Soil Sample Location
- Modern Soil Hand Auger Location
- Modern Soil Boring Location
- Modern Sediment Grab Location
- Modern Sediment Core Location
- Bathymetric Contour (5 foot MLLW)
- Shoreline
- Historical Wharf Structure
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes and Abbreviations:
SW - Soil Protective of Groundwater to Marine Surface Water; SNB - Puget Sound 90% Soil Background Value; Method A - MTCA Method A.
MNB - SCUM Marine Sediment Natural Background; SCO - Benthic Sediment Cleanup Objective.

Depths in feet.
*Boring hit refusal.
All data shown in dry weight.
Historical samples shown without location labels

N

100 50 0 100 200 300 Feet

Cadmium Concentrations in Soil/Sediment

Blakely Harbor Park Site

Geosyntec consultants

PNG0900 | 03-Jul-2024

Figure 6-9

Path: P:\GIS\Blakely\Harbor\GIS\Blakely_SedFigures\Blakely_SedFigures_20240313.aprx Last Revised: 7/3/2024 Author: Christocher Rudolph

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet; Units in Foot US Bin File: ScreeningBins_MultiBinFigures_GW_GP_Phenanthrene_Updated

Map Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.
4. Figure shows actual sampling locations accurate to the nearest foot (in water samples) and 10 feet (upland samples).
5. Imagery courtesy of Nearmap.
6. Maximum concentration at any location shown.
7. Non detected reported values above selected SL are shown.

Concentration in Sediment
- < 5.2 mg/kg (SCO/CSL)
- > 5.2 mg/kg

Historical Sediment Sample Location

Modern Sediment Grab Location

Modern Sediment Core Location

Bathymetric Contour (5 foot MLLW)

Shoreline

Historical Wharf Structure

Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

(white) Result or sample unavailable at interval

Notes and Abbreviations:

SCO - Benthic Sediment Cleanup Objective, CSL - Benthic Sediment Cleanup Screening Level.

Depths in feet.
*Boring hit refusal.
Non-Detects set at 0.
All data shown in dry weight.
Non-Detects set at 0.
Historical samples shown without location labels

100 50 0 100 200 300 Feet

Total LMW PAHs Concentrations in Soil/Sediment

Blakely Harbor Park Site

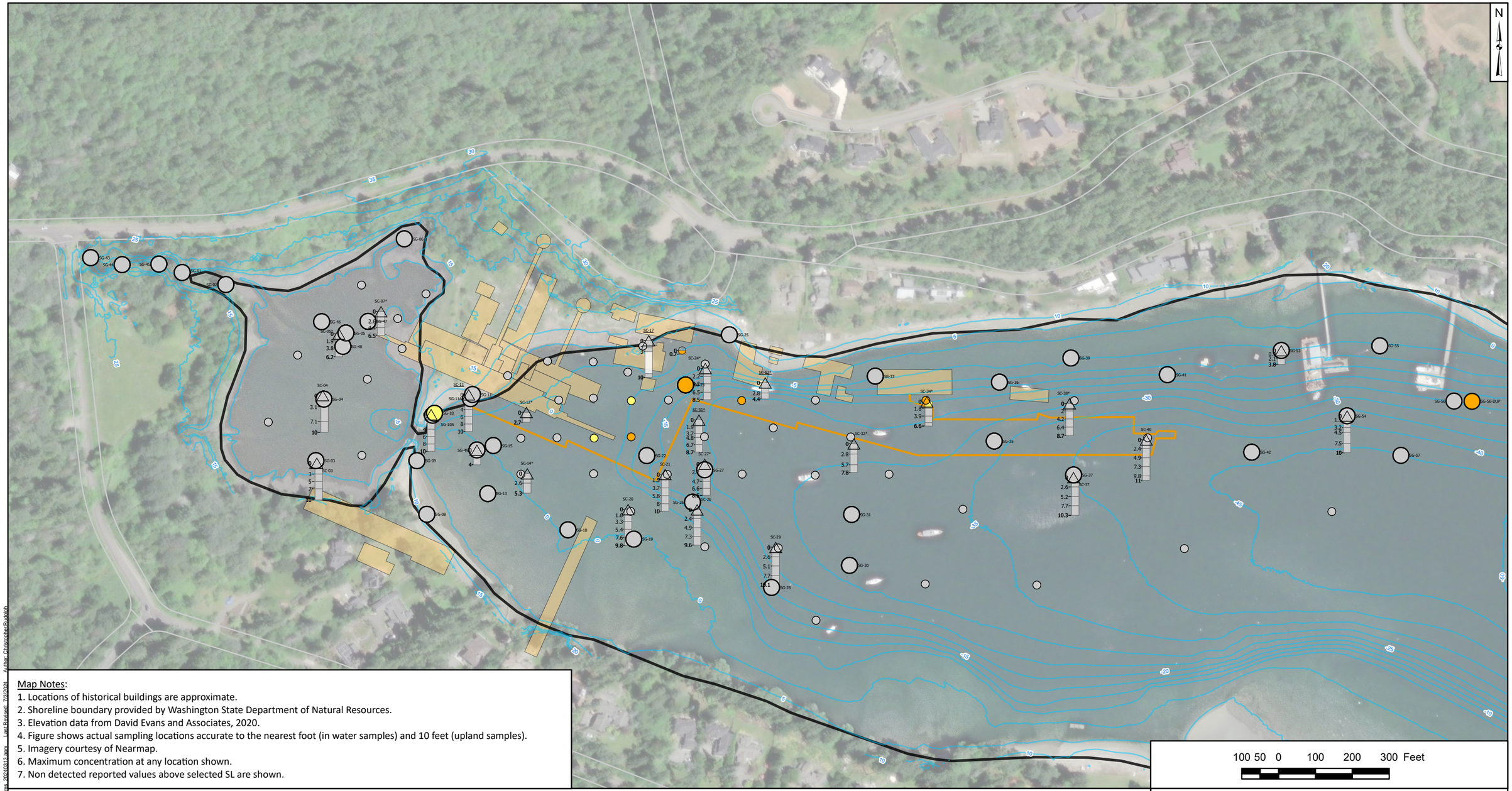
Geosyntec consultants

PNG0900	03-Jul-2024

Figure 6-10

Path: P:\GIS\BlakelyHarbor\GIS\Blakely_SedFigures\Blakely_SedFigures_20240313.aprx Last Revised: 7/3/2024 Author: ChristocherBuddish

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet; Units in Foot US Bin File: ScreeningBins_MultiBinFigures_GW_GP_Phenanthrene_Updated



Map Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.
4. Figure shows actual sampling locations accurate to the nearest foot (in water samples) and 10 feet (upland samples).
5. Imagery courtesy of Nearmap.
6. Maximum concentration at any location shown.
7. Non detected reported values above selected SL are shown.

Concentration in Sediment
- < 12 mg/kg (SCO)
- > 12 to 17 mg/kg (CSL)
- > 17 mg/kg
- (white) Result or sample unavailable at interval

- Historical Sediment Sample Location
- Modern Sediment Grab Location
- Modern Sediment Core Location
- Bathymetric Contour (5 foot MLLW)
- Shoreline
- Historical Wharf Structure
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes and Abbreviations:

SCO - Benthic Sediment Cleanup Objective, CSL - Benthic Sediment Cleanup Screening Level.

Depths in feet.
*Boring hit refusal.
Non-Detects set at half Detection Limit.
All data shown in dry weight.
Non-Detects set at half Detection Limit.
Historical samples shown without location labels

Total HMW PAHs Concentrations in Soil/Sediment

Blakely Harbor Park Site

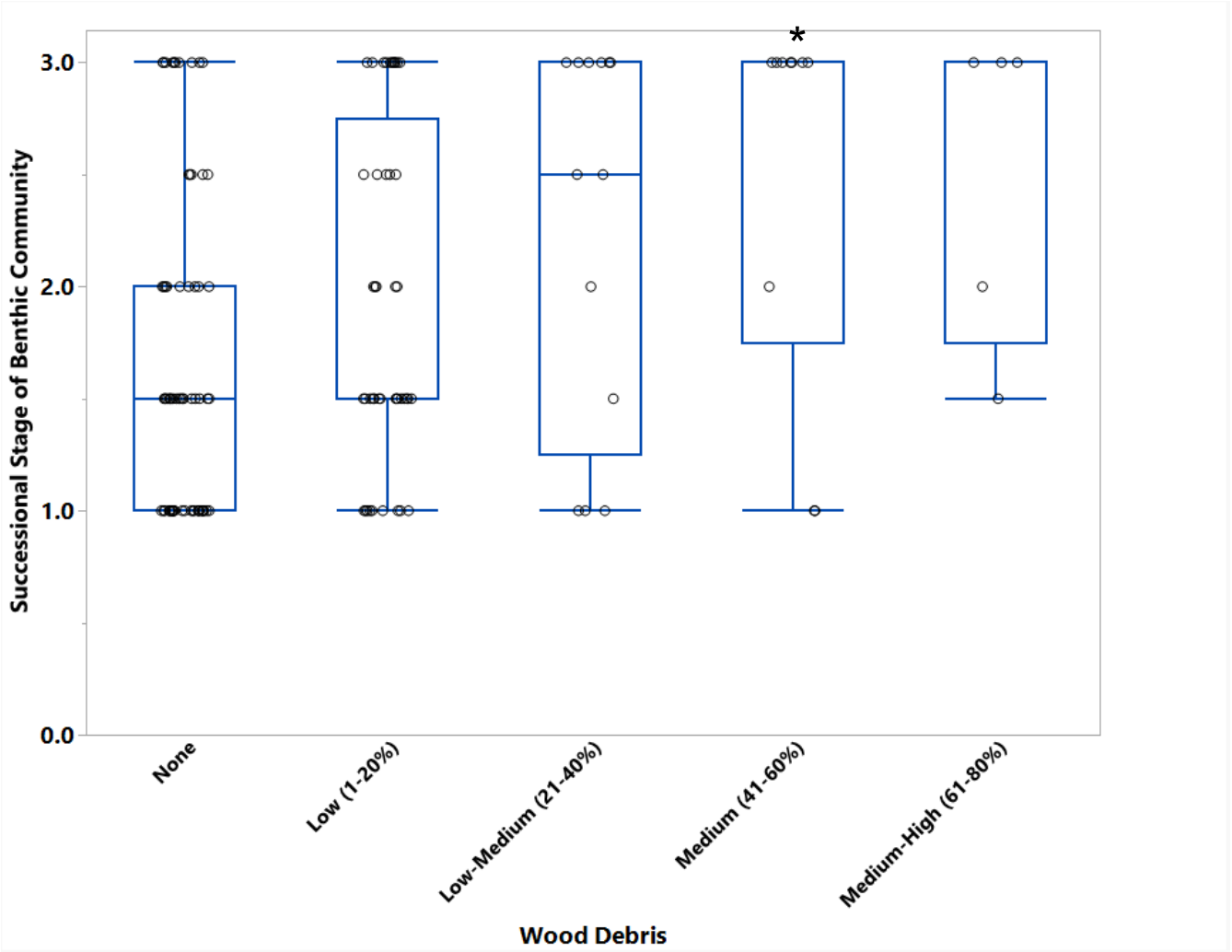
Geosyntec consultants

PNG0900	03-Jul-2024

Figure 6-11

Path: P:\GIS\BlakeyHarbor\GIS\Blakely_SedFigures\Blakely_SedFigures_20240313.aprx Last Revised: 7/3/2024 Author: ChristocherBudolph

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet; Units in Foot US Bin File: ScreeningBins_MultiBinFigures_GW_GP_Phenanthrene_Updated



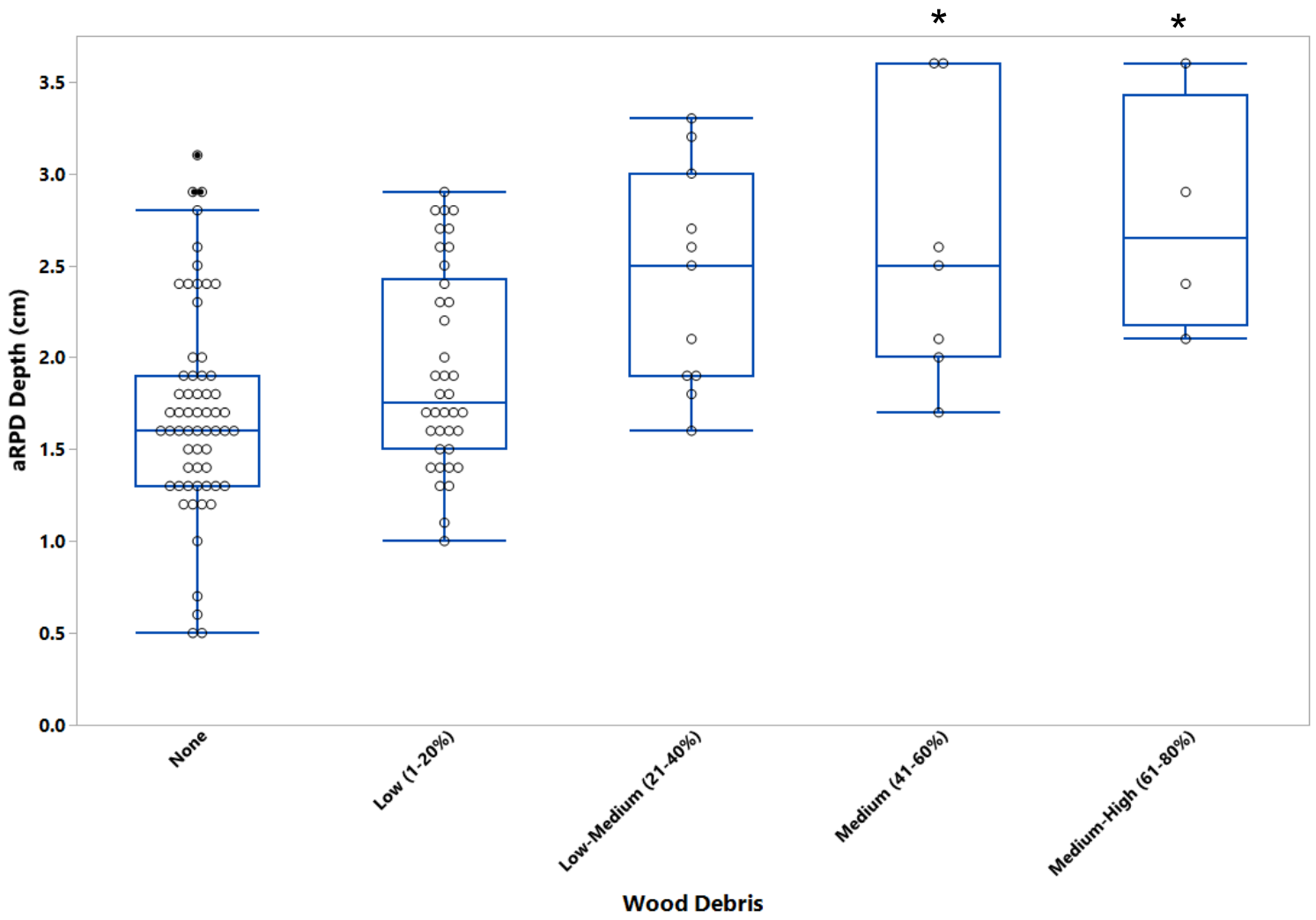
Notes:
Successional stages of benthic communities (succession after a disturbance) was measured using sediment profile imaging (SPI) as follows: Stage 0: sediment column that is largely devoid of macrofauna; Stage 1: community of tiny, densely populated, tubicolous, surface-dwelling polychaete assemblages; Stage 2: start of the transition to head-down deposit feeders, and other organisms (e.g., bivalves and amphipods); Stage 3: mature community of deep-dwelling, head-down deposit feeders with distinctive feeding voids and aerated burrows. Intermediate stages also occur (1 to 2, represented as 1.5 in this figure, and 2 to 3, represented as 2.5 in this figure). A single stage 1 on 3 was included in the stage 3 group as this is considered a mature community as well.
Wood debris in this figure was also measured by SPI as the percent area in each image.
Indeterminate stages occurred for some due to no or limited penetration (<9 cm) in hard sands and gravel cobble within some areas of the Harbor. * Indicates statistical significance relative to stations without wood debris (i.e., None).

Successional Stage of Benthic Infauna vs. Wood Debris
Remedial Investigation Report
Blakely Harbor Park Site
Bainbridge Island (WA)

Geosyntec consultants

Figure 6-12a

SEA/GP	July 2024



Notes:
Redox potential discontinuity (RPD) depth at which the sediment transitions from oxidizing to reducing conditions and can be measured using sediment profile imaging methods (SPI). RPD can be used in conjunction with other metrics to evaluate either the degree of sediment disturbances, or the recovery of sediments in an area following a disturbance.

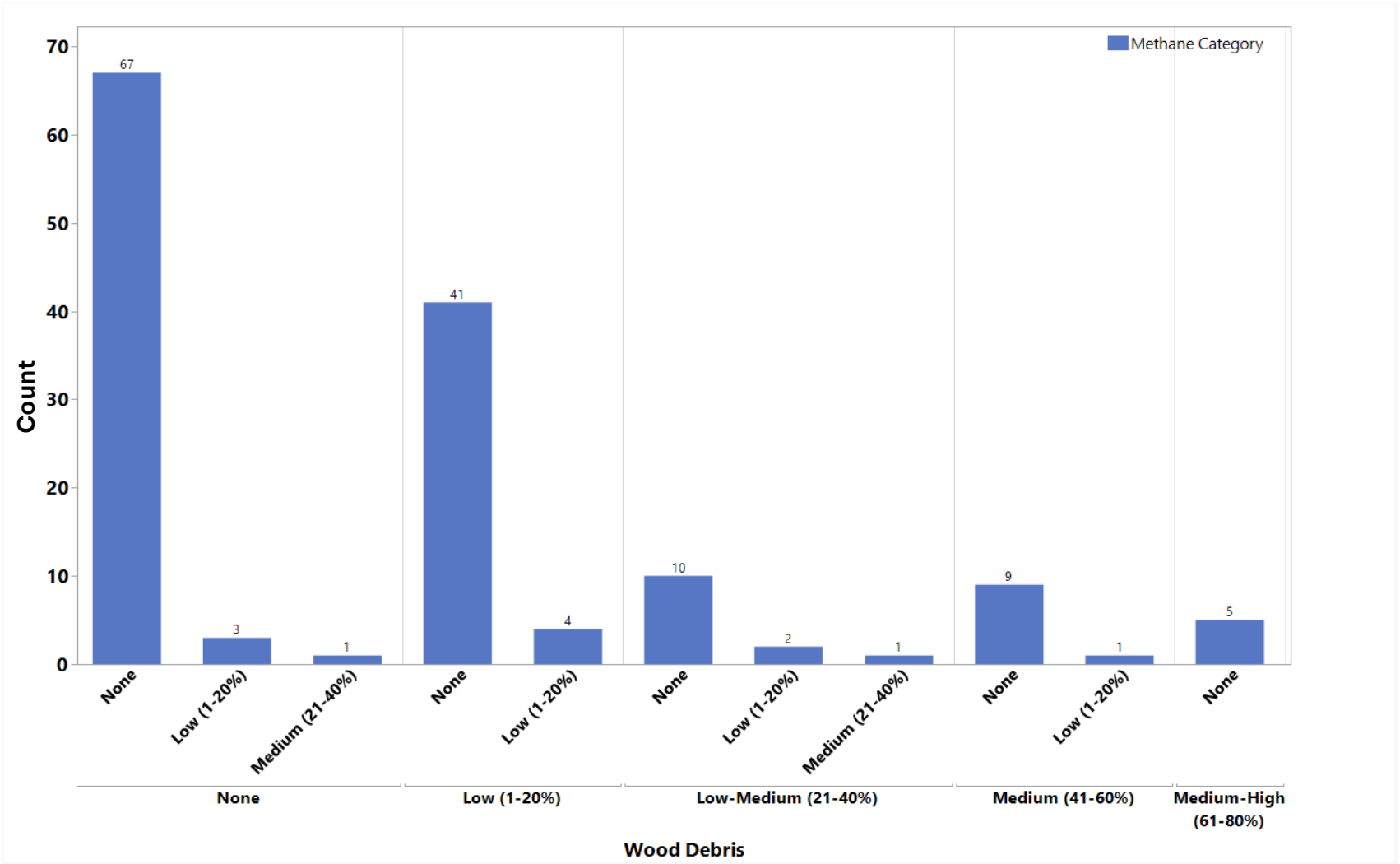
* Indicates statistical significance relative to stations without wood debris (i.e., None).

RPD Depth and Wood Debris Measurements via SPI
Remedial Investigation Report
Blakely Harbor Park Site
Bainbridge Island (WA)

Geosyntec consultants

Figure
6-12b

SEA/GP	July 2024



Notes:
Methane voids were measured using SPI by visually estimating the percent area of the gas-filled voids
Wood debris (sticks, chips, fragments, other) was also estimated using SPI as the approximate percentage area of wood debris in each image.

SPI = sediment profile imaging

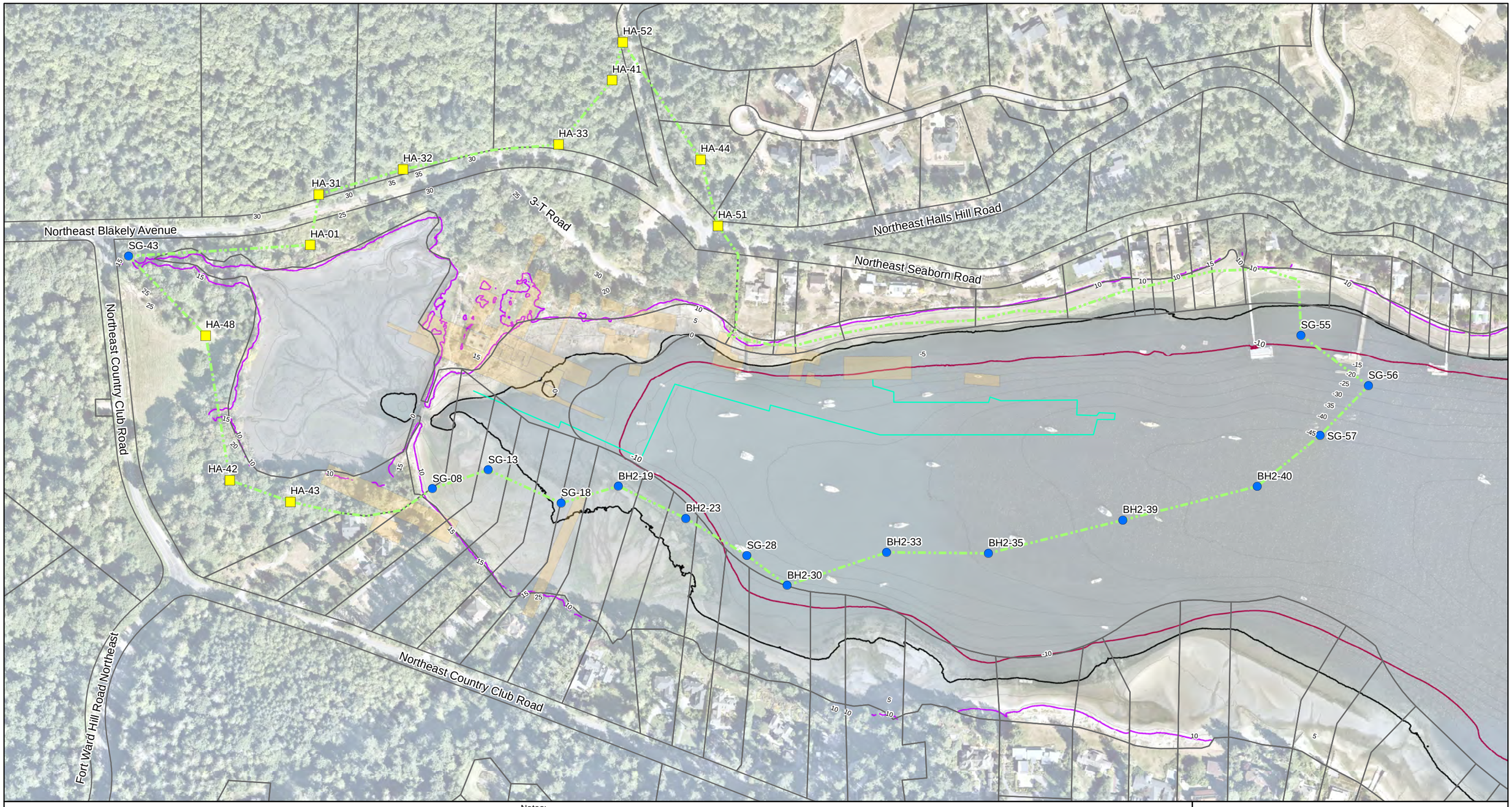
Methane Measurements and Wood Debris
Remedial Investigation Report
Blakely Harbor Park Site
Bainbridge Island (WA)

Geosyntec consultants

Figure
6-12c

SEA/GP	July 2024

DRAFT



Legend

- Proposed Remedial Investigation Boundary
- Parcel Boundary
- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour

Perimeter Sample Location

- Sediment Sample Location
- Soil Sample Location

Notes:
1. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Dataset includes surface sediment samples collected in 2019 (GeoEngineers, 2019; Leidos and NewFields. 2019), 2021 and 2022 (Geosyntec, 2022a and 2022b)
5. The RI boundary was established by connecting sample locations for which there was an exceedance of the refined SLs and the Park property line.

MLLW = Mean Lower Low Water
MHHW = Mean Higher High Water
SL = Screening Level

N

0 300 Feet

Proposed Remedial Investigation Boundary

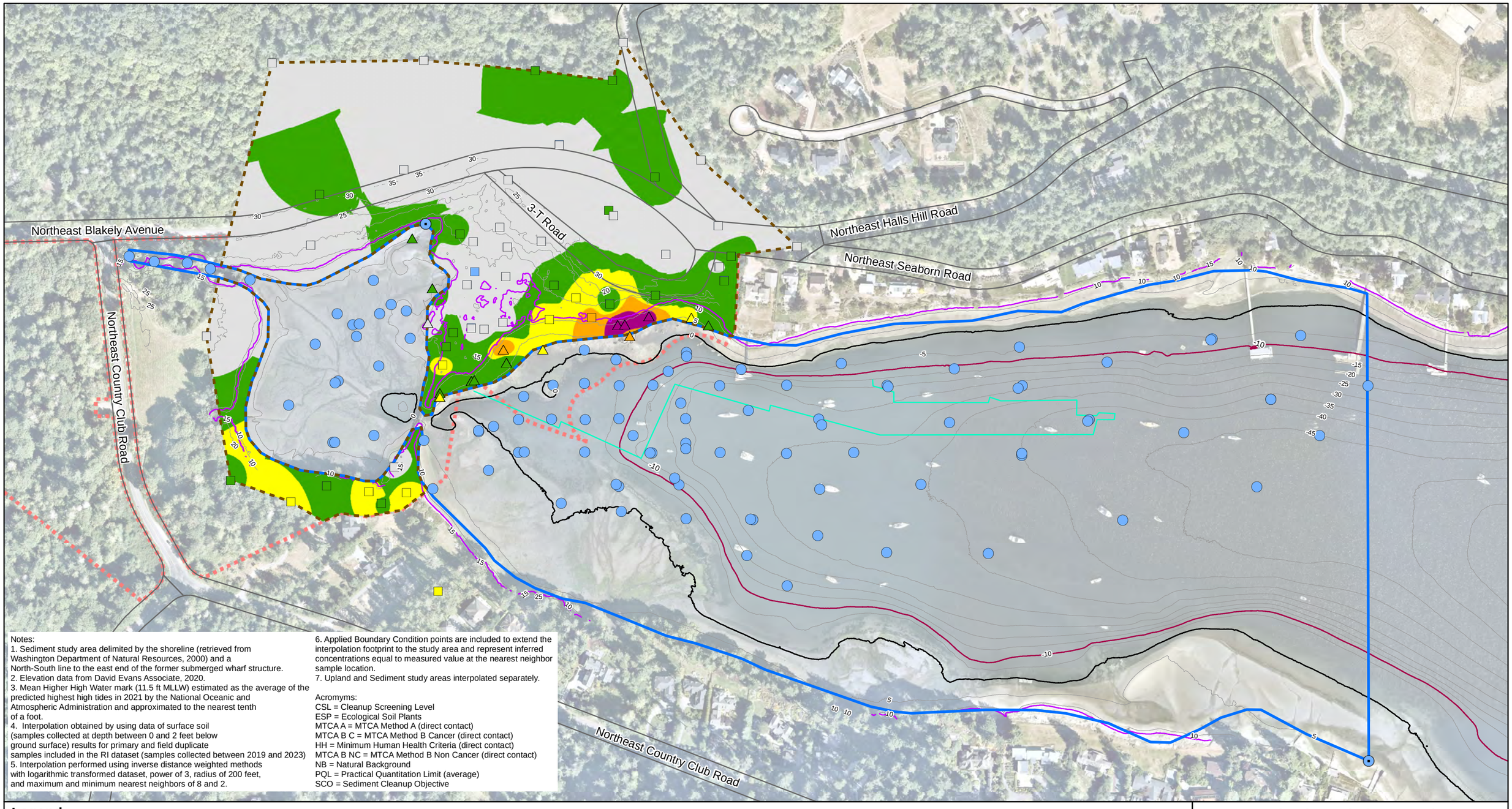
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | August 2024

Figure 6-13

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Figure 6-13 Proposed RI Boundary.mxd 8/14/2024 4:42:41 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Arsenic Concentration in Soil (mg/kg)
- <7 (NB)
- 7 to 14 (2 x NB)
- >14 (2 x NB) to 20 (MTCA A)
- > 20 to 40 (2x MTCA A)
- > 40

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Arsenic Concentrations in Surface Soil (0 to 2 feet)

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-14a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-13a Interpolated Arsenic Concentrations Surface Soil.mxd 7/5/2024 9:32:12 AM

Northeast Blakely Avenue

Northeast Country Club Road

3-T Road

Northeast Halls Hill Road

Northeast Seaborn Road

Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface soil (samples collected at depth between 0 and 6 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Arsenic Concentration in Soil (mg/kg)
- <7 (NB)
- 7 to 14 (2 x NB)
- >14 (2 x NB) to 20 (MTCA A)
- > 20 to 40 (2x MTCA A)
- > 40

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Arsenic Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-14b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-13b Interpolated ECO Arsenic Concentrations Surface Soil.mxd 7/5/2024 11:18:39 AM

Northeast Blakely Avenue

Northeast Country Club Road

3-T Road

Northeast Halls Hill Road

Northeast Seaborn Road

Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 15 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Arsenic Concentration in Soil (mg/kg)
- <7 (NB)
- 7 to 14 (2 x NB)
- >14 (2 x NB) to 20 (MTCA A)
- > 20 to 40 (2x MTCA A)
- > 40

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

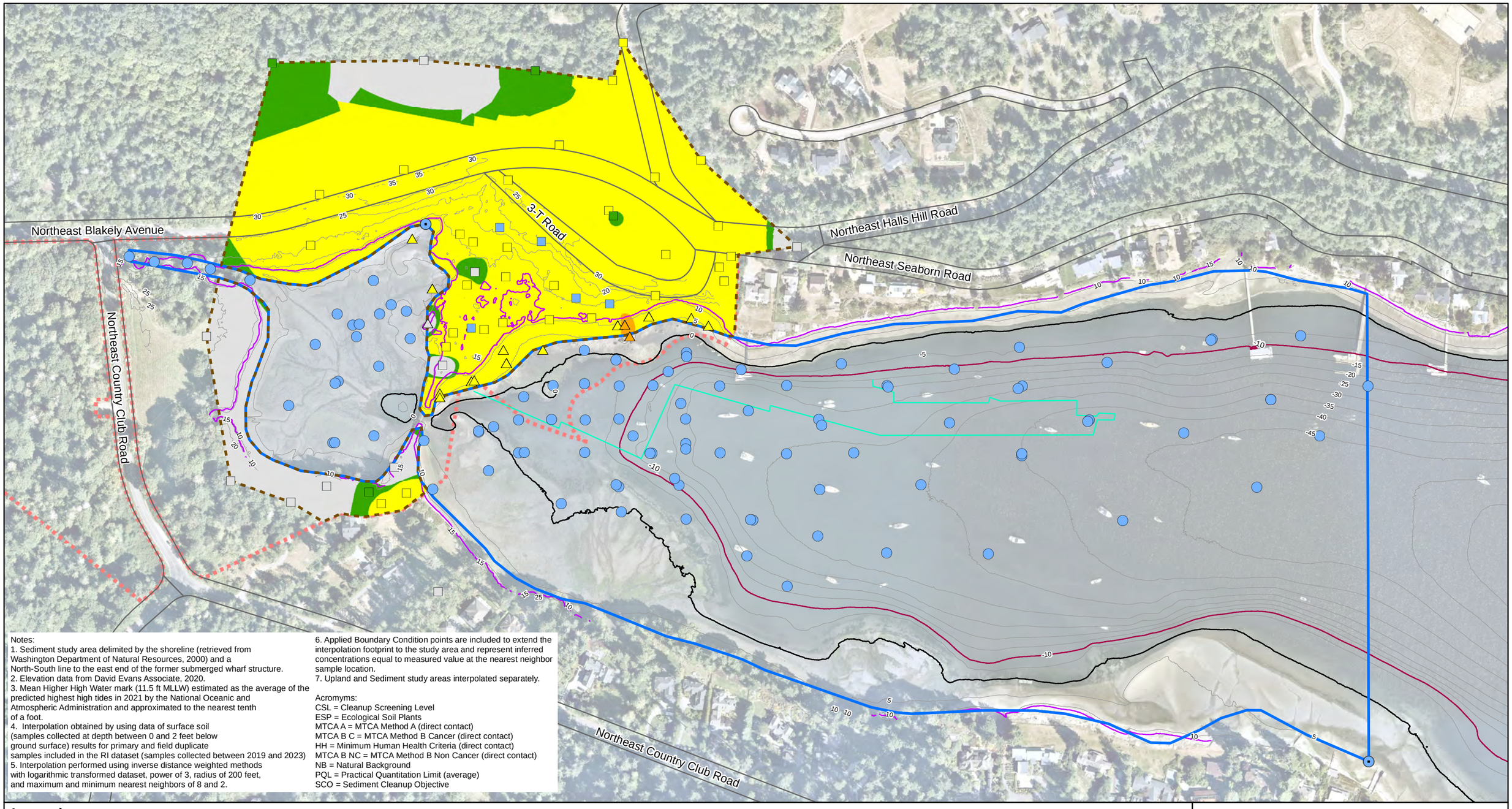
Interpolated Arsenic Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-14c

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-13c Interpolated HHRA Arsenic Concentrations Surface Soil.mxd 7/5/2024 11:29:51 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Copper Concentration in Soil (mg/kg)
- <36 (NB)
- >36 to 50 (ESP)
- >50 to 1,000 (20xESP)
- >1,000 to 3,200 (MTCA B NC)
- >3,200

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Copper Concentrations in Surface Soil (0 to 2 feet)

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-15a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-14a Interpolated Copper Concentrations Surface Soil.mxd 7/5/2024 9:40:39 AM

Northeast Blakely Avenue

Northeast Country Club Road

3-T Road

Northeast Halls Hill Road

Northeast Seaborn Road

Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface soil (samples collected at depth between 0 and 6 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Copper Concentration in Soil (mg/kg)
- <36 (NB)
- >36 to 50 (ESP)
- >50 to 1,000 (20xESP)
- >1,000 to 3,200 (MTCA B NC)
- >3,200

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

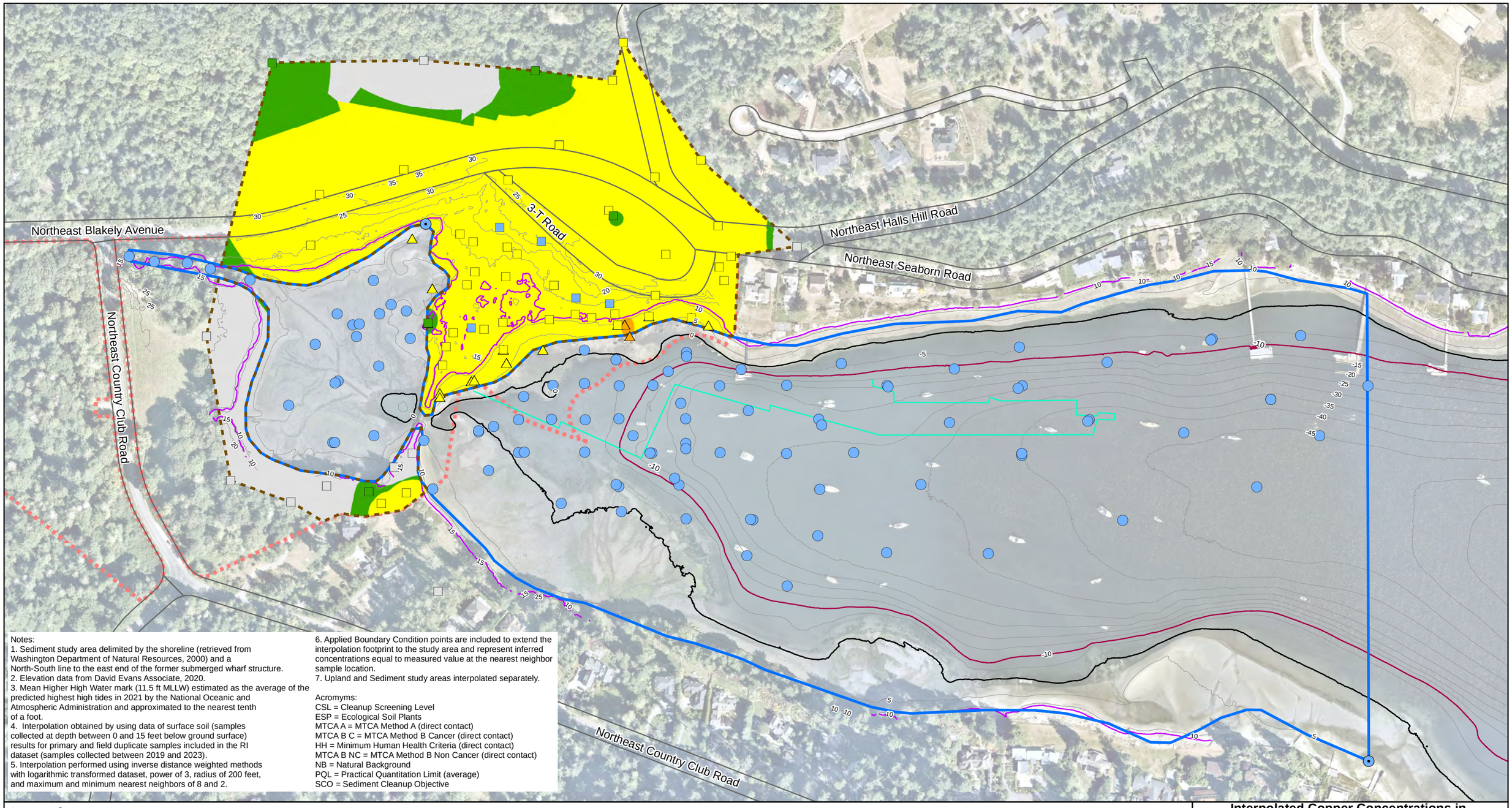
Interpolated Copper Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-15b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-14b Interpolated ECO Copper Concentrations Surface Soil.mxd 7/5/2024 11:19:48 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 15 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Copper Concentration in Soil (mg/kg)
- <36 (NB)
- >36 to 50 (ESP)
- >50 to 1,000 (20xESP)
- >1,000 to 3,200 (MTCA B NC)
- >3,200

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Copper Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-15c

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-14c Interpolated HHRA Copper Concentrations Surface Soil.mxd 7/5/2024 9:45:20 AM

Northeast Blakely Avenue

Northeast Country Club Road

3-T Road

Northeast Halls Hill Road

Northeast Seaborn Road

Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Lead Concentration in Soil (mg/kg)
- <24 (NB)
- >24 to 50 (ESP)
- > 50 to 250 (MTCA A)
- > 250 to 750 (3xMTCA A)
- > 750

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Lead Concentrations in Surface Soil (0 to 2 feet)

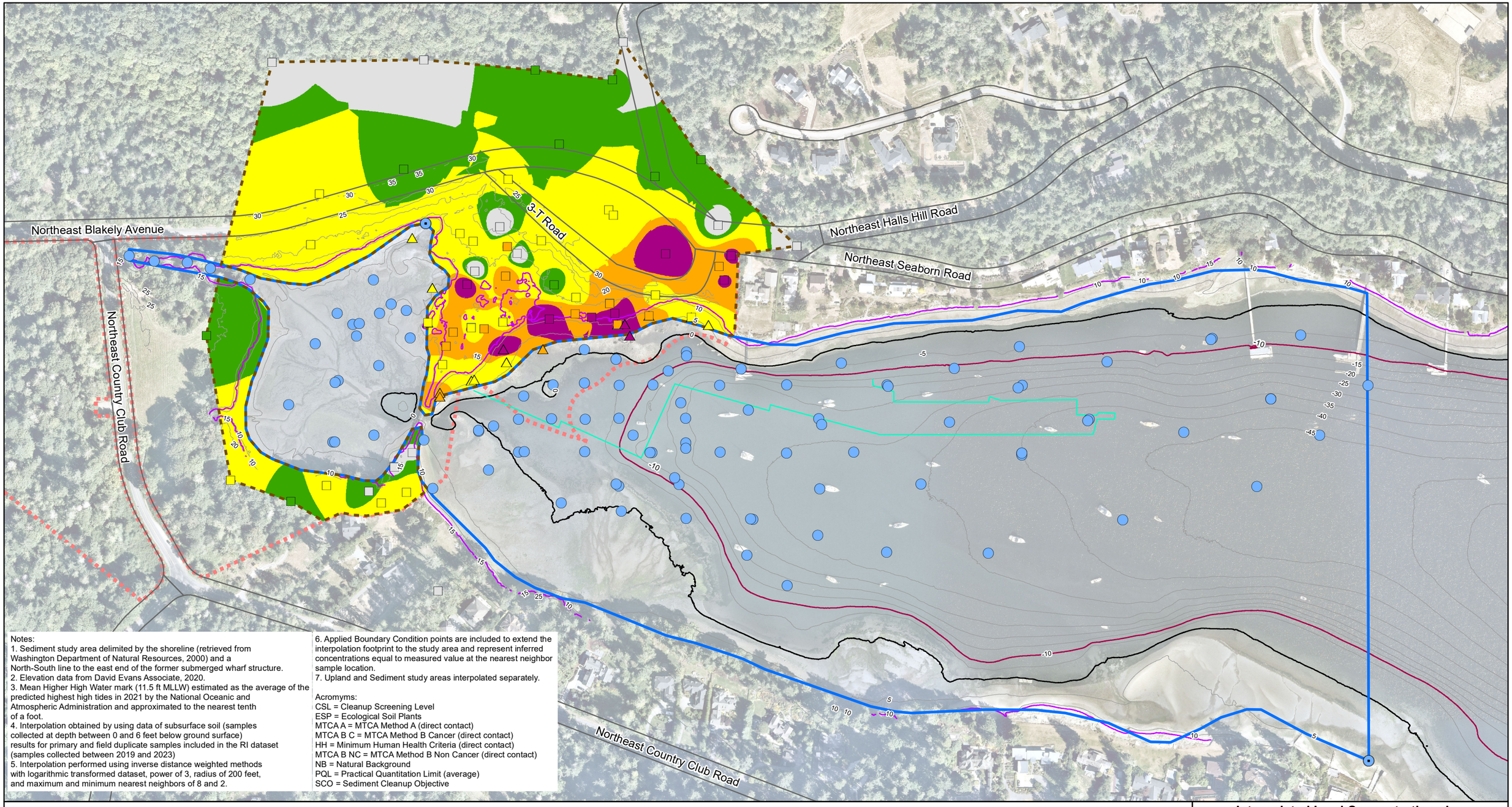
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

Figure 6-16a

MVI/Sea | July 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-15a Interpolated Lead Concentrations Surface Soil.mxd 7/5/2024 10:45:37 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface soil (samples collected at depth between 0 and 6 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Lead Concentration in Soil (mg/kg)
- <24 (NB)
- >24 to 50 (ESP)
- > 50 to 250 (MTCA A)
- > 250 to 750 (3xMTCA A)
- > 750

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Lead Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)

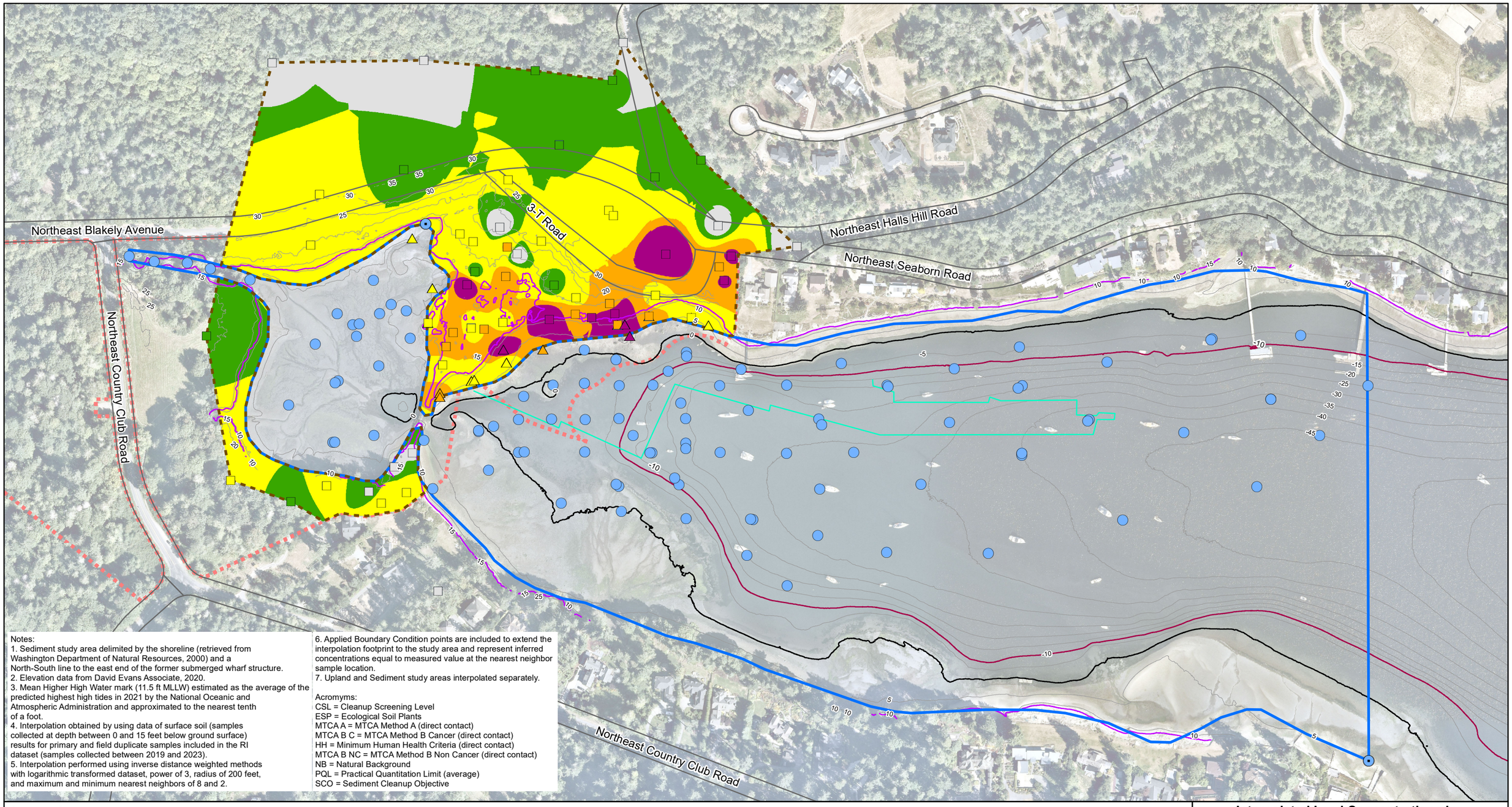
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-16b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-15b Interpolated ECO Lead Concentrations Surface Soil.mxd 7/5/2024 11:20:56 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 15 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Lead Concentration in Soil (mg/kg)
- <24 (NB)
- >24 to 50 (ESP)
- > 50 to 250 (MTCA A)
- > 250 to 750 (3xMTCA A)
- > 750

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Lead Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-16c

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-15c Interpolated HHRA Lead Concentrations Surface Soil.mxd 7/5/2024 11:31:04 AM

Northeast Blakely Avenue

Northeast Country Club Road

3-T Road

Northeast Halls Hill Road

Northeast Seaborn Road

Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Mercury Concentration in Soil (mg/kg)
- <0.07 (NB)
- >0.07 to 0.35 (5xNB)
- >0.35 to 0.7 (10xNB)
- >0.7 to 2 (MTCA A)
- >2

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Mercury Concentrations in Surface Soil (0 to 2 feet)

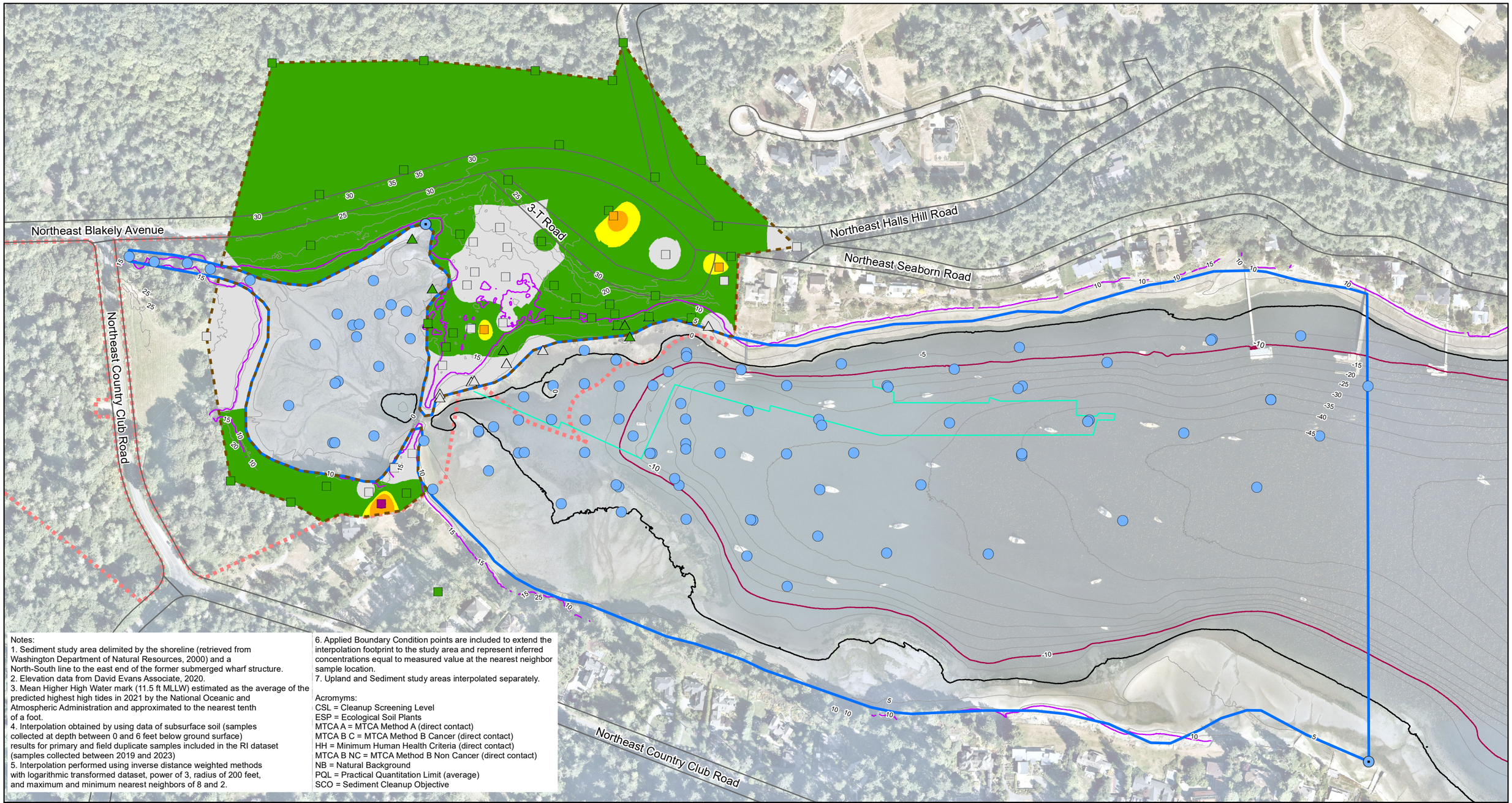
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-17a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-16a Interpolated Mercury Concentrations Surface Soil.mxd 7/5/2024 11:11:51 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface soil (samples collected at depth between 0 and 6 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Mercury Concentration in Soil (mg/kg)
- <0.07 (NB)
- >0.07 to 0.35 (5xNB)
- >0.35 to 0.7 (10xNB)
- >0.7 to 2 (MTCA A)
- >2

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Mercury Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-17b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-16b Interpolated ECO Mercury Concentrations Surface Soil.mxd 7/5/2024 11:25:08 AM

Northeast Blakely Avenue
Northeast Country Club Road
3-T Road
Northeast Halls Hill Road
Northeast Seaborn Road
Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 15 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Mercury Concentration in Soil (mg/kg)
- <0.07 (NB)
- >0.07 to 0.35 (5xNB)
- >0.35 to 0.7 (10xNB)
- >0.7 to 2 (MTCA A)
- >2

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Mercury Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

Figure 6-17c

MVI/Sea | July 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-16c Interpolated HHRA Mercury Concentrations Surface Soil.mxd 7/5/2024 11:28:35 AM

Northeast Blakely Avenue

Northeast Country Club Road

3-T Road

Northeast Halls Hill Road

Northeast Seaborn Road

Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Zinc Concentration in Soil (mg/kg)
- <85 (NB)
- 85 to 850 (10xNB)
- >850 to 8,500 (100xNB)
- >8,500 to 24,000 (MTCA B NC)
- >24,000

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Zinc Concentrations in Surface Soil (0 to 2 feet)

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-18a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-17a Interpolated Zinc Concentrations Surface Soil.mxd 7/5/2024 11:33:38 AM

Northeast Blakely Avenue
Northeast Country Club Road
3-T Road
Northeast Halls Hill Road
Northeast Seaborn Road
Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface soil (samples collected at depth between 0 and 6 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Zinc Concentration in Soil (mg/kg)
- <85 (NB)
- 85 to 850 (10xNB)
- >850 to 8,500 (100xNB)
- >8,500 to 24,000 (MTCA B NC)
- >24,000

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Zinc Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-18b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-17b Interpolated ECO Zinc Concentrations Surface Soil.mxd 7/5/2024 11:37:08 AM

Northeast Blakely Avenue
Northeast Country Club Road
3-T Road
Northeast Halls Hill Road
Northeast Seaborn Road
Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 15 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Zinc Concentration in Soil (mg/kg)
- <85 (NB)
- 85 to 850 (10xNB)
- >850 to 8,500 (100xNB)
- >8,500 to 24,000 (MTCA B NC)
- >24,000

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

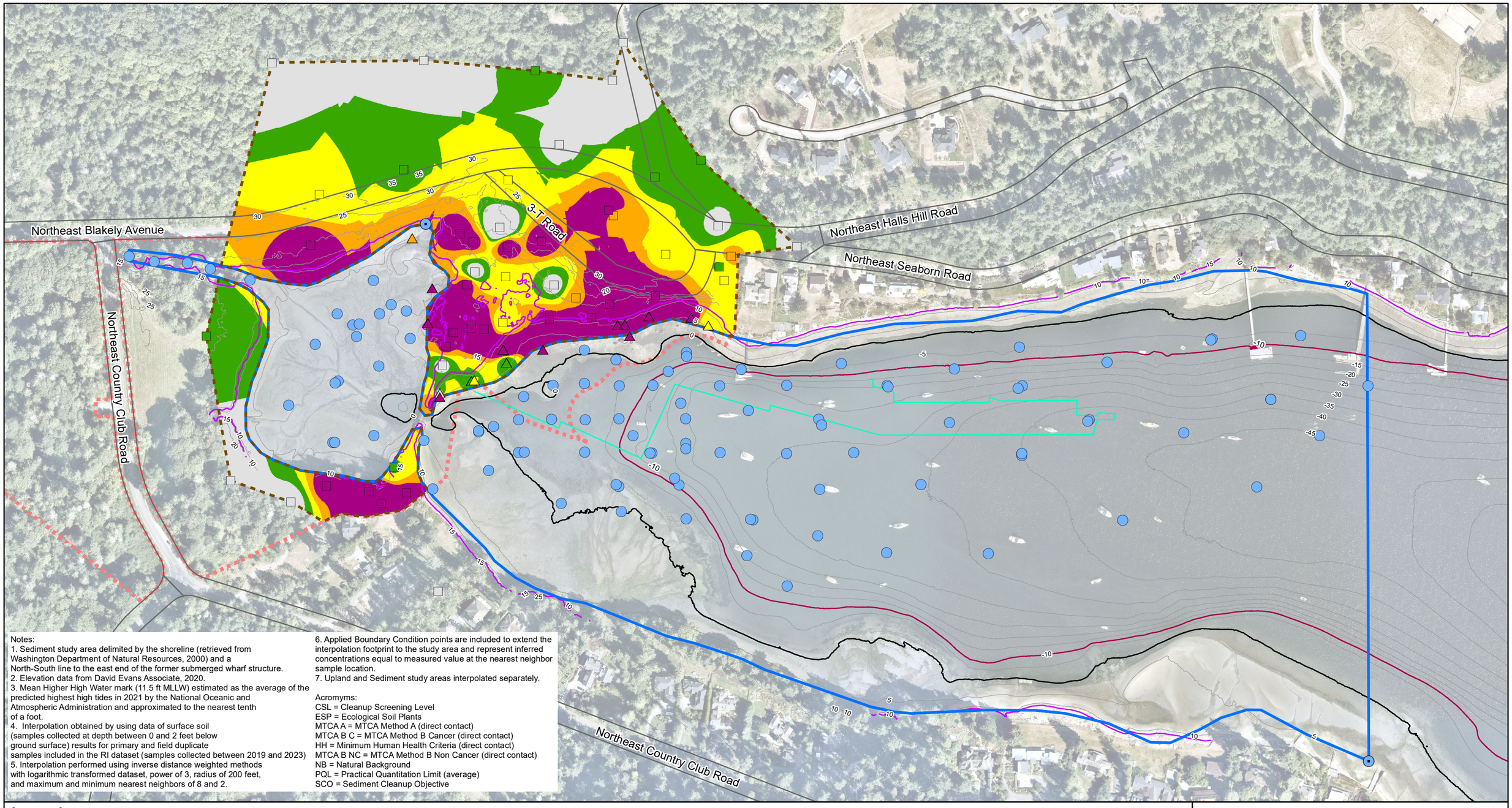
Interpolated Zinc Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-18c

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-17c Interpolated HHRA Zinc Concentrations Surface Soil.mxd 7/5/2024 11:39:05 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

cPAHs TEQ ND halfRL Concentration in Soil (mg/kg)
- <0.016 (PQL)
- >0.016 to 0.038 (2xPQL)
- 0.038 to 0.1 (MTCA A)
- >0.1 to 0.19 (MTCA B C)
- >0.19

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated cPAH TEQ Concentrations in Surface Soil (0 to 2 feet)

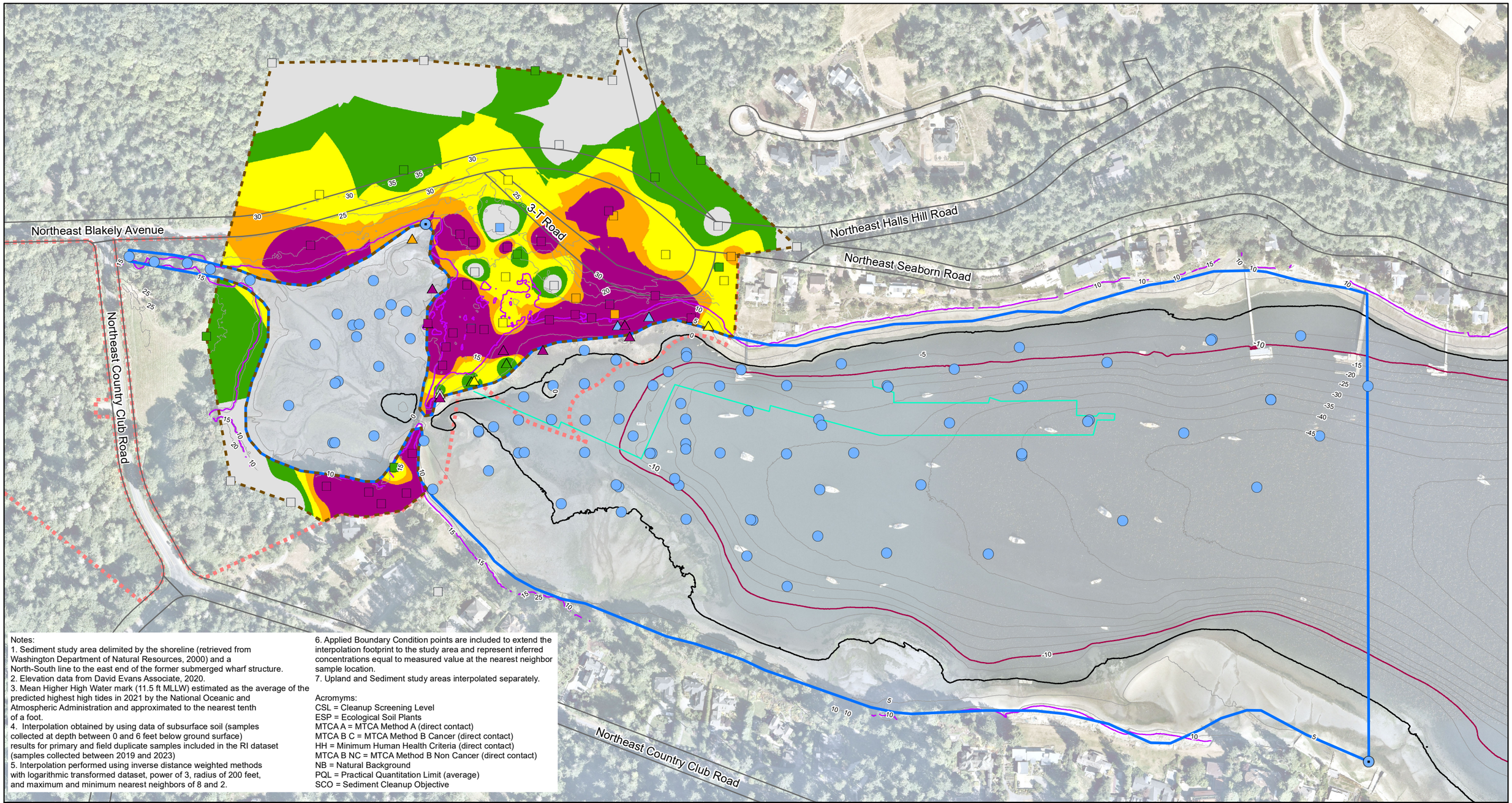
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-19a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-18a Interpolated cPAH Concentrations Surface Soil.mxd 7/5/2024 11:45:00 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface soil (samples collected at depth between 0 and 6 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

cPAHs TEQ ND halfRL Concentration in Soil (mg/kg)
- <0.016 (PQL)
- >0.016 to 0.038 (2xPQL)
- 0.038 to 0.1 (MTCA A)
- >0.1 to 0.19 (MTCA B C)
- >0.19

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

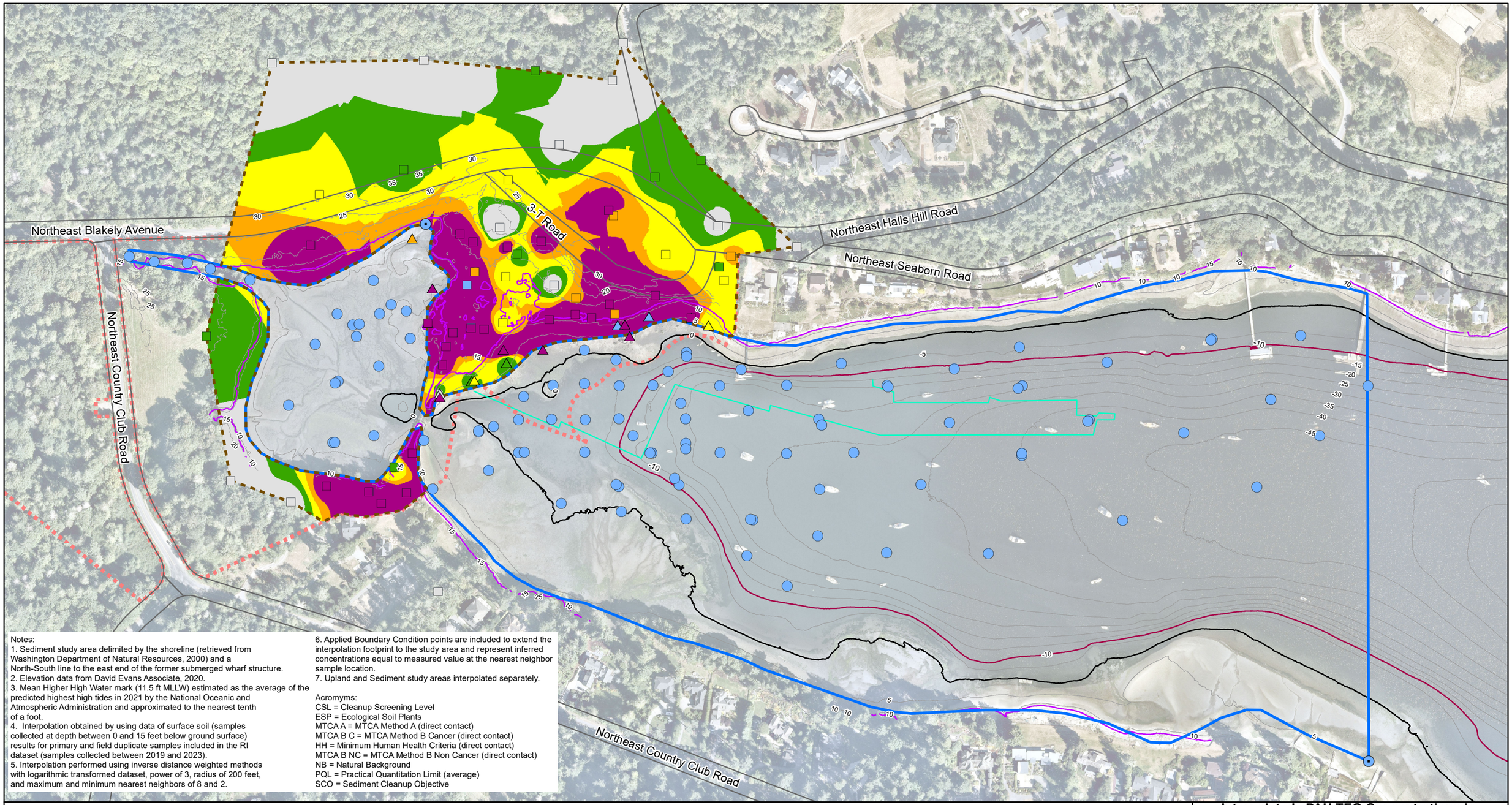
Interpolated cPAH TEQ Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-19b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-18b Interpolated ECO cPAH Concentrations Surface Soil.mxd 7/5/2024 11:46:33 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 15 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

cPAHs TEQ ND halfRL Concentration in Soil (mg/kg)
- <0.016 (PQL)
- >0.016 to 0.038 (2xPQL)
- 0.038 to 0.1 (MTCA A)
- >0.1 to 0.19 (MTCA B C)
- >0.19

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

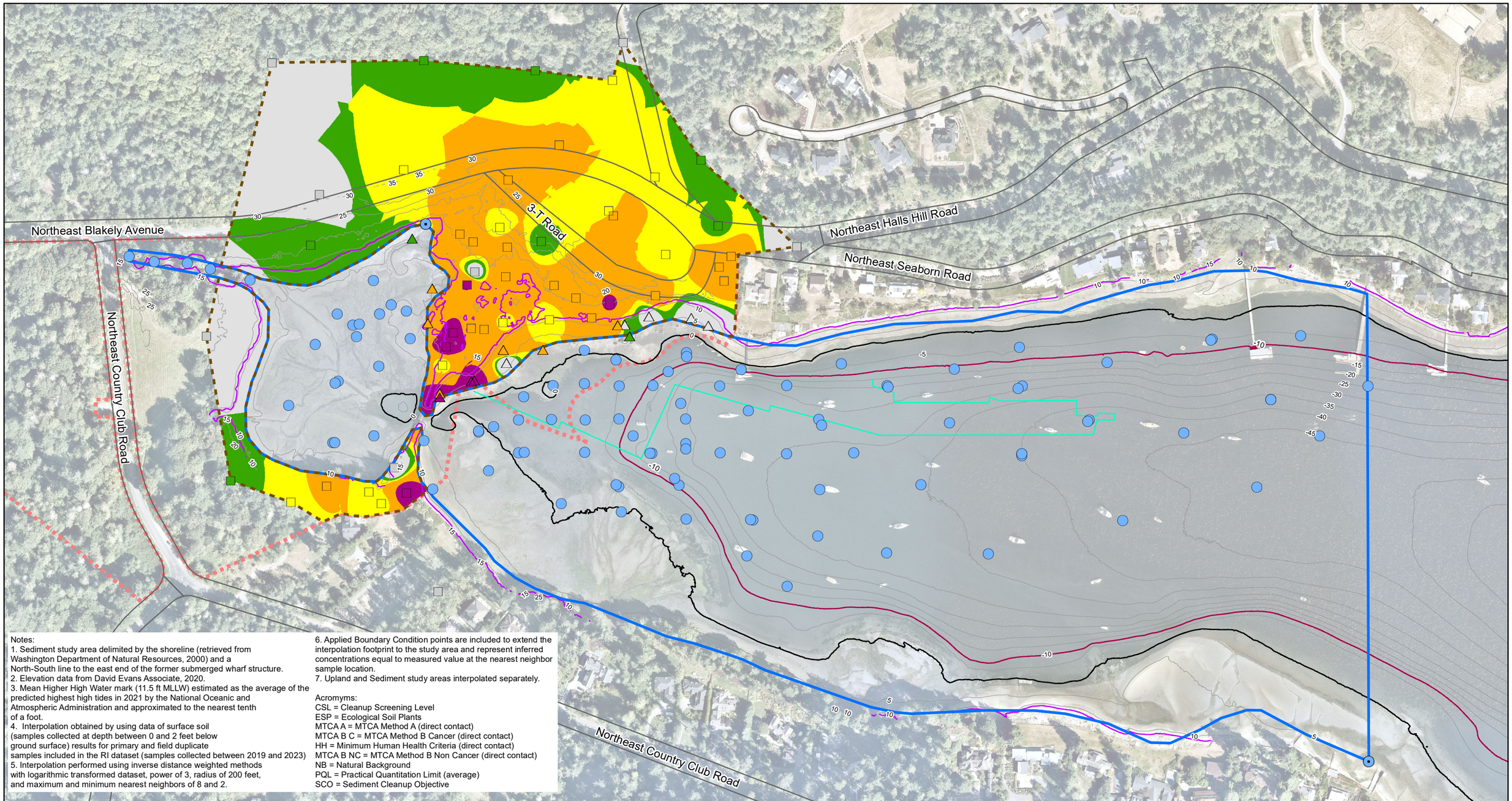
Interpolated cPAH TEQ Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-19c

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-18c Interpolated HHRA cPAH Concentrations Surface Soil.mxd 7/5/2024 11:48:14 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

TCDD TEQ halfRL Concentration in Soil [ng/kg]
- <5.2 (NB)
- 5.2 to 7.8 (1.5xNB)
- >7.8 to 13 (MTCA B C)
- >13 to 93 (MTCA B NC)
- >93

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated TCDD TEQ Concentrations in Surface Soil (0 to 2 feet)

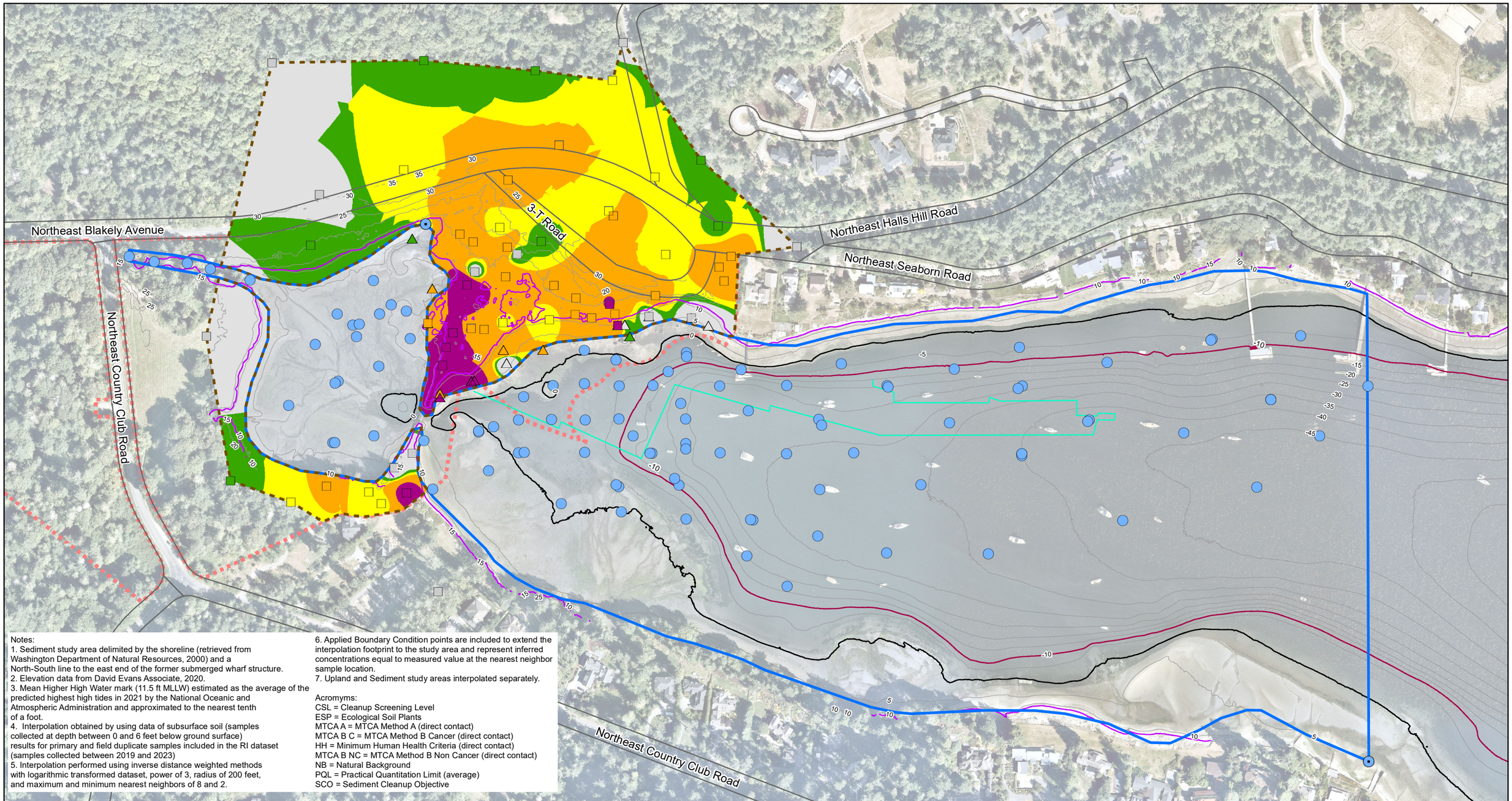
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-20a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-19a Interpolated TCDD Concentrations Surface Soil.mxd 7/5/2024 11:50:56 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface soil (samples collected at depth between 0 and 6 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

TCDD TEQ halfRL Concentration in Soil [ng/kg]
- <5.2 (NB)
- 5.2 to 7.8 (1.5xNB)
- >7.8 to 13 (MTCA B C)
- >13 to 93 (MTCA B NC)
- >93

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

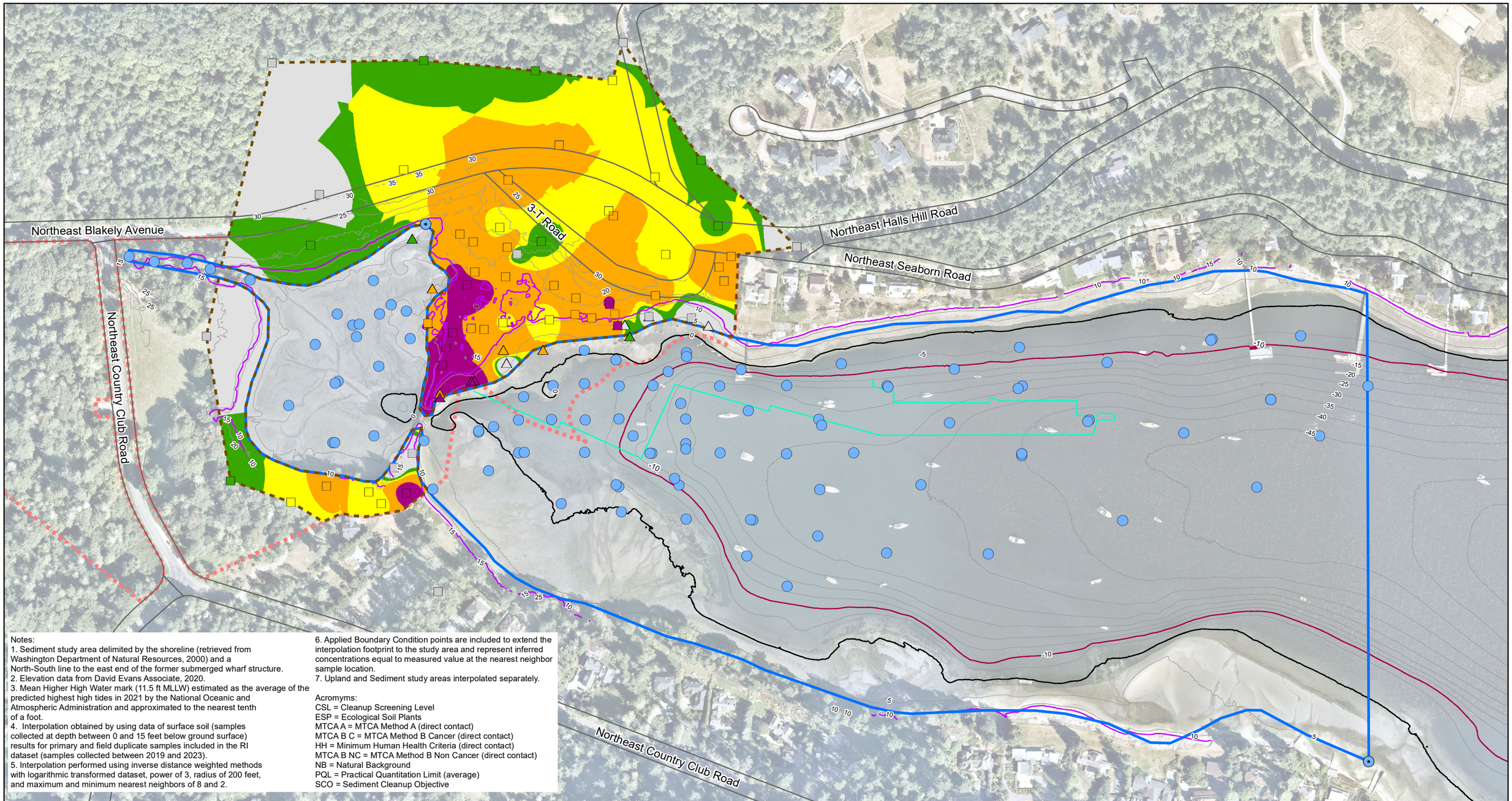
Interpolated TCDD TEQ Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

Figure 6-20b

MVI/Sea | July 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-19b Interpolated ECO TCDD Concentrations Surface Soil.mxd 7/5/2024 11:52:56 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 15 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

TCDD TEQ halfRL Concentration in Soil [ng/kg]
- <5.2 (NB)
- 5.2 to 7.8 (1.5xNB)
- >7.8 to 13 (MTCA B C)
- >13 to 93 (MTCA B NC)
- >93

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated TCDD TEQ Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

Figure 6-20c

MVI/Sea | July 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-19c Interpolated HHRA TCDD Concentrations Surface Soil.mxd 7/5/2024 11:55:08 AM

Northeast Blakely Avenue

Northeast Country Club Road

3-T Road

Northeast Halls Hill Road

Northeast Seaborn Road

Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

<VALUE>
- <30 (ESB)
- 30 to 70 (ESP)
- >70 to 7,000 (100xESP)
- >7,000 to 24,000 (MTCA B NC)
- >24,000

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Phenol Concentrations in Surface Soil (0 to 2 feet)

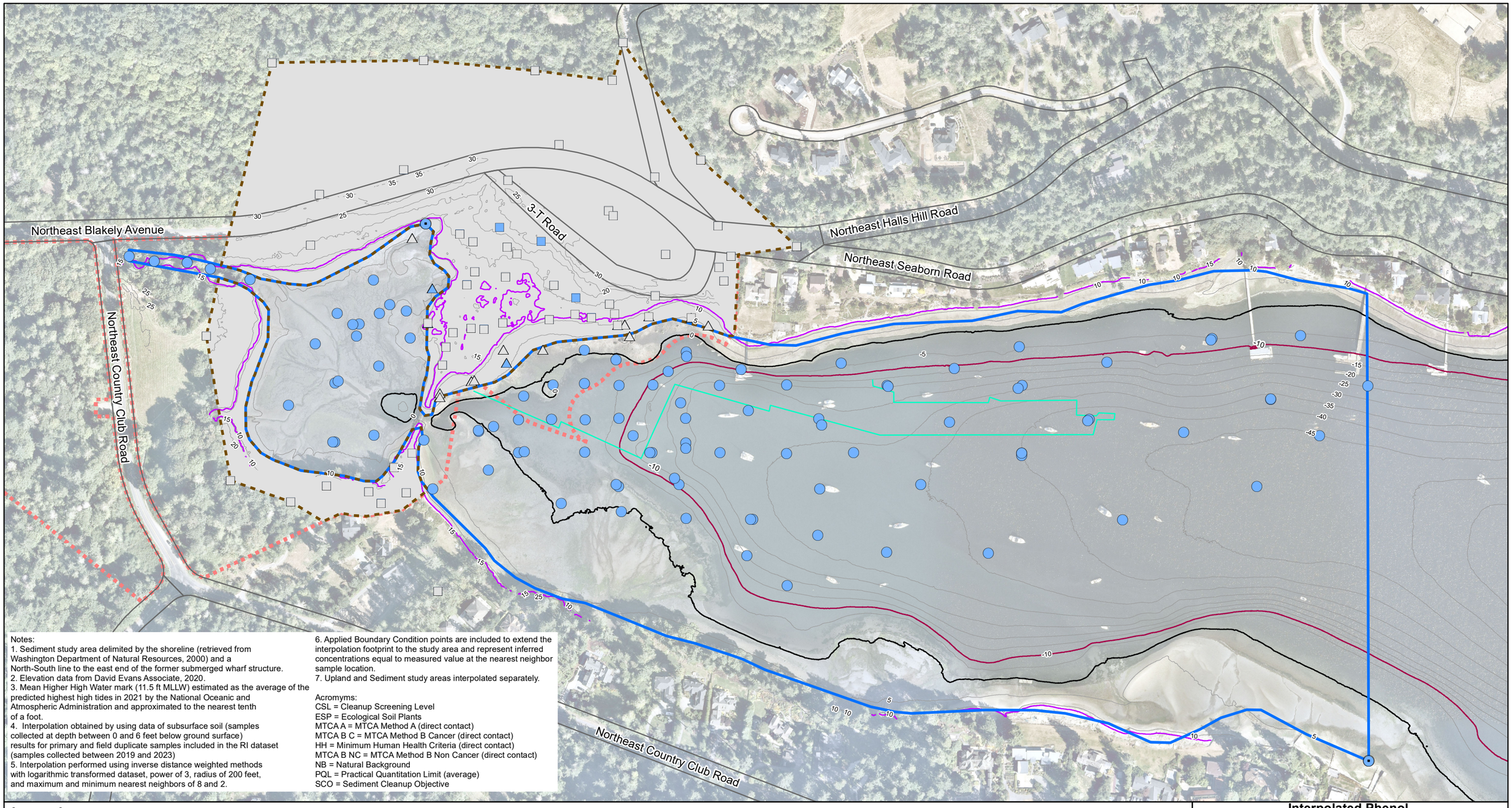
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-21a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-20a Interpolated Phenol Concentrations Surface Soil.mxd 7/22/2024 9:18:27 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface soil (samples collected at depth between 0 and 6 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Phenol Concentration in Soil (mg/kg)
- <30 (ESB)
- 30 to 70 (ESP)
- >70 to 7,000 (100xESP)
- >7,000 to 24,000 (MTCA B NC)
- >24,000

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

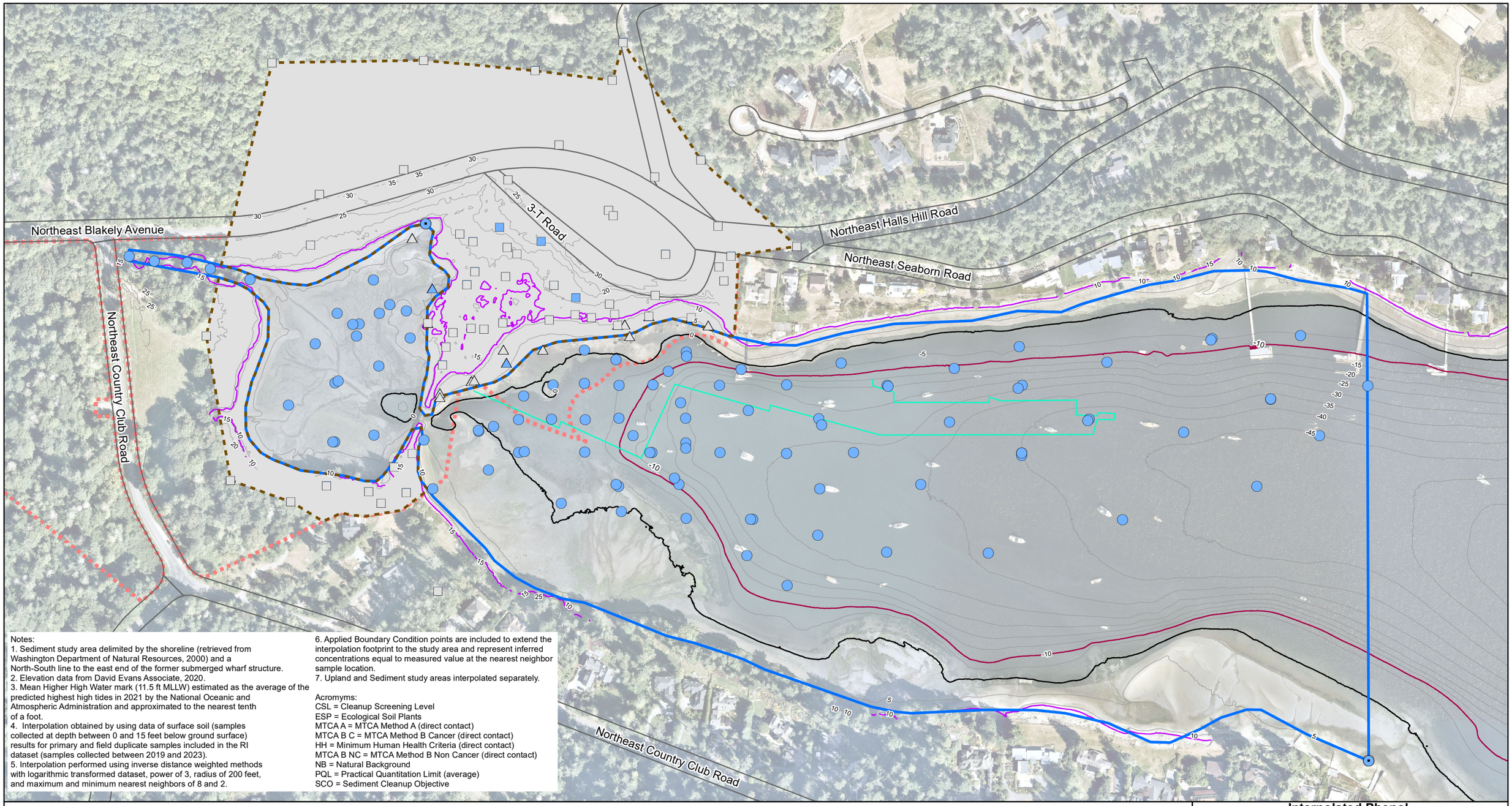
Interpolated Phenol Concentrations in Soil to Ecological Point of Compliance (0 to 6 feet)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

Figure 6-21b

MVI/Sea | July 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-20b Interpolated ECO Phenol Concentrations Surface Soil.mxd 7/22/2024 9:17:29 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 15 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Upland Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For soil, the locations did not have data available.

Phenol Concentration in Soil (mg/kg)
- <30 (ESB)
- 30 to 70 (ESP)
- >70 to 7,000 (100xESP)
- >7,000 to 24,000 (MTCA B NC)
- >24,000

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Phenol Concentrations in Soil to Human Health Point of Compliance (0 to 15 feet)

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-21c

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-20c Interpolated HHRA Phenol Concentrations Surface Soil.mxd 7/22/2024 9:29:17 AM

Northeast Blakely Avenue

Northeast Country Club Road

3-T Road

Northeast Halls Hill Road

Northeast Seaborn Road

Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source

- Sediment Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For sediment, the locations did not have data available.

Arsenic Concentration in Sediment (mg/kg)

- <11 (NB)
- >11 to 27.5 (2xNB)
- >27.5 to 57 (SCO)
- >57 to 93 (CSL)
- >93

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour

- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Arsenic Concentrations in Surface Sediment (0 to 10 cm below mudline)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-22a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-21a Interpolated Arsenic Concentrations Surface Sediment.mxd 7/6/2024 9:59:53 AM

Northeast Blakely Avenue
Northeast Country Club Road
3-T Road
Northeast Halls Hill Road
Northeast Seaborn Road
Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface sediment (samples deeper than 2 feet below mudline) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Applied Boundary Condition Sediment Sample Location

Arsenic Concentration in Sediment (mg/kg)
- <11 (NB)
- >11 to 27.5 (2xNB)
- >27.5 to 57 (SCO)
- >57 to 93 (CSL)
- >93

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour

- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Arsenic Concentrations in Sediment Cores (>10 cm below mudline)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-22b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-21b Interpolated Arsenic Concentrations Subsurface Sediment.mxd 7/6/2024 11:29:27 AM

Northeast Blakely Avenue
Northeast Country Club Road
3-T Road
Northeast Halls Hill Road
Northeast Seaborn Road
Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For sediment, the locations did not have data available.

Copper Concentration in Sediment (mg/kg)
- <45 (NB)
- >45 to 113 (2.5xNB)
- >113 to 225 (5xNB)
- >225 to 390 (SCO/CSL)
- > 390

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour

- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Copper Concentrations in Surface Sediment (0 to 10 cm below mudline)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-23a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-22a Interpolated Copper Concentrations Surface Sediment.mxd 7/6/2024 10:10:53 AM

Northeast Blakely Avenue

Northeast Country Club Road

3-T Road

Northeast Halls Hill Road

Northeast Seaborn Road

Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface sediment (samples deeper than 2 feet below mudline) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Applied Boundary Condition Sediment Sample Location

Copper Concentration in Sediment (mg/kg)
- <45 (NB)
- >45 to 113 (2.5xNB)
- >113 to 225 (5xNB)
- >225 to 390 (SCO/CSL)
- > 390

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour

- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Copper Concentrations in Sediment Cores (>10 cm below mudline)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

Figure 6-23b

MVI/Sea | July 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-22b Interpolated Copper Concentrations Subsurface Sediment.mxd 7/6/2024 11:34:50 AM

Northeast Blakely Avenue
Northeast Country Club Road
3-T Road
Northeast Halls Hill Road
Northeast Seaborn Road
Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For sediment, the locations did not have data available.

Lead Concentration in Sediment (mg/kg)
- <21 (NB)
- 21 to 210 (10xNB)
- >210 to 450 (SCO)
- > 450 to 530 (CSL)
- >530

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour

- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Lead Concentrations in Surface Sediment (0 to 10 cm below mudline)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-24a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-23a Interpolated Lead Concentrations Surface Sediment.mxd 7/6/2024 10:08:44 AM

Northeast Blakely Avenue
Northeast Country Club Road
3-T Road
Northeast Halls Hill Road
Northeast Seaborn Road
Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface sediment (samples deeper than 2 feet below mudline) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Applied Boundary Condition Sediment Sample Location

Lead Concentration in Sediment (mg/kg)
- <21 (NB)
- 21 to 210 (10xNB)
- >210 to 450 (SCO)
- > 450 to 530 (CSL)
- > 530

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour

- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Lead Concentrations in Sediment Cores (>10 cm below mudline)

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-24b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-23b Interpolated Lead Concentrations Subsurface Sediment.mxd 7/6/2024 11:39:39 AM

Northeast Blakely Avenue
Northeast Country Club Road
3-T Road
Northeast Halls Hill Road
Northeast Seaborn Road
Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For sediment, the locations did not have data available.

Mercury Concentration in Sediment (mg/kg)
- <0.2 (NB)
- >0.2 to 0.3 (1.5xNB)
- >0.3 to 0.41 (SCO)
- >0.41 to 0.59 (CSL)
- >0.59

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Mercury Concentrations in Surface Sediment (0 to 10 cm below mudline)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-25a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-24a Interpolated Mercury Concentrations Surface Sediment.mxd 7/6/2024 10:30:55 AM

Northeast Blakely Avenue
Northeast Country Club Road
3-T Road
Northeast Halls Hill Road
Northeast Seaborn Road
Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface sediment (samples deeper than 2 feet below mudline) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Applied Boundary Condition Sediment Sample Location

Mercury Concentration in Sediment (mg/kg)
- <0.2 (NB)
- >0.2 to 0.3 (1.5xNB)
- >0.3 to 0.41 (SCO)
- >0.41 to 0.59 (CSL)
- >0.59

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Mercury Concentrations in Sediment Cores (>10 cm below mudline)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-25b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-24b Interpolated Mercury Concentrations Subsurface Sediment.mxd 7/6/2024 11:44:23 AM

Northeast Blakely Avenue

Northeast Country Club Road

3-T Road

Northeast Halls Hill Road

Northeast Seaborn Road

Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For sediment, the locations did not have data available.

Zinc Concentration in Sediment (mg/kg)
- <93 (NB)
- >93 to 186 (2xNB)
- 186 to 410 (SCO)
- > 410 to 960 (CSL)
- > 960

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour

- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Zinc Concentrations in Surface Sediment (0 to 10 cm below mudline)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-26a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-25a Interpolated Zinc Concentrations Surface Sediment.mxd 7/6/2024 10:38:51 AM

Northeast Blakely Avenue
Northeast Country Club Road
3-T Road
Northeast Halls Hill Road
Northeast Seaborn Road
Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface sediment (samples deeper than 2 feet below mudline) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Applied Boundary Condition Sediment Sample Location

Zinc Concentration in Sediment (mg/kg)
- <93 (NB)
- >93 to 186 (2xNB)
- 186 to 410 (SCO)
- > 410 to 960 (CSL)
- > 960

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour

- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Zinc Concentrations in Sediment Cores (>10 cm below mudline)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-26b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-25b Interpolated Zinc Concentrations Subsurface Sediment.mxd 7/6/2024 11:50:26 AM

Northeast Blakely Avenue

Northeast Country Club Road

3-T Road

Northeast Halls Hill Road

Northeast Seaborn Road

Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source

- Sediment Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For sediment, the locations did not have data available.

cPAH TEQ Concentration in Sediment (mg/kg)

- <0.021 (NB)
- 0.021 to 0.15 (NF)
- >0.15 to 1.5 (10xNF)
- >1.5 to 15 (100xNF)
- >15

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour

- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

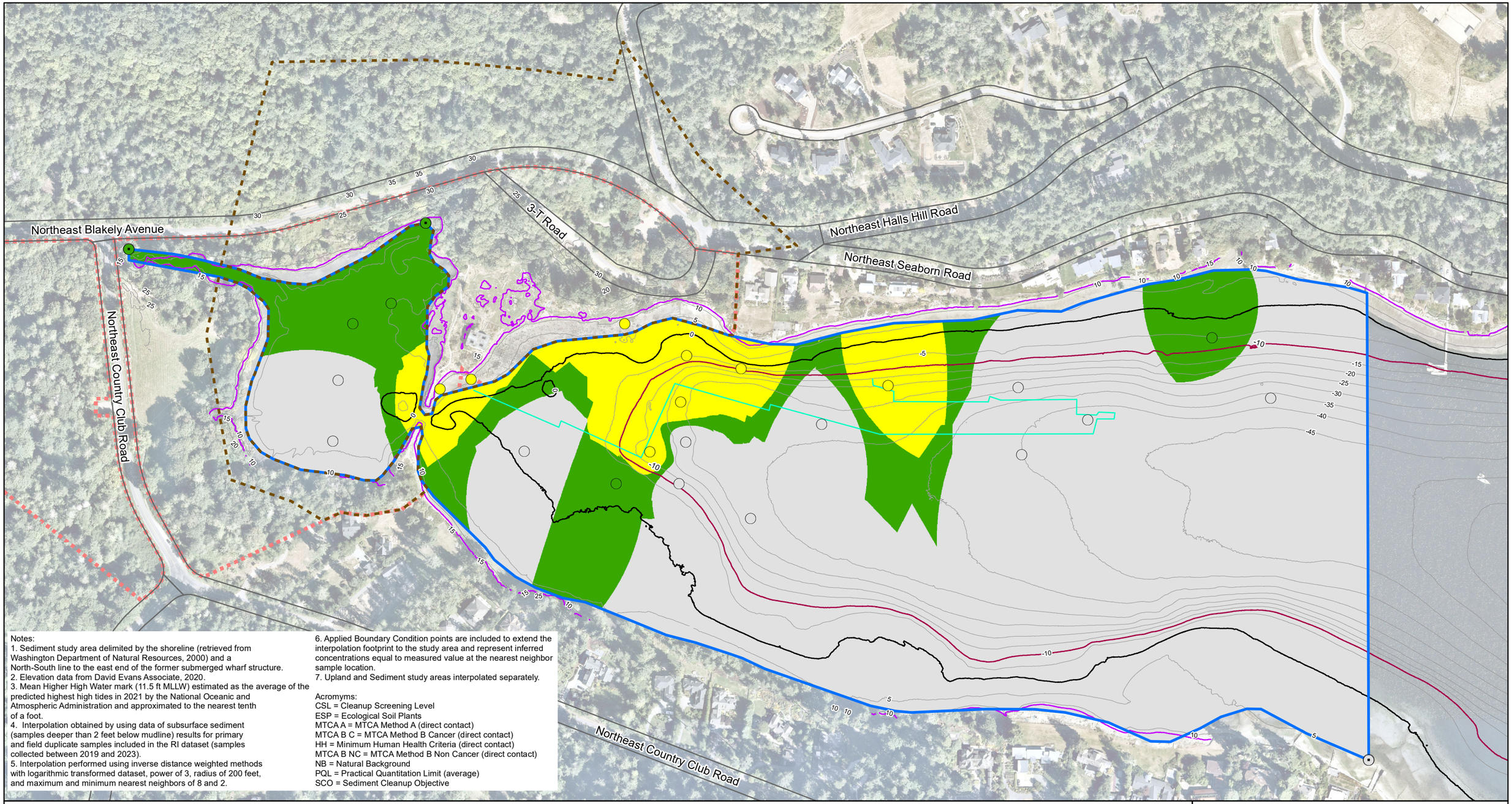
Interpolated cPAH TEQ Concentrations in Surface Sediment (0 to 10 cm below mudline)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

Figure 6-27a

MVI/Sea | July 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-26a Interpolated cPAH TEQ Concentrations Surface Sediment.mxd 7/22/2024 8:40:22 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface sediment (samples deeper than 2 feet below mudline) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Applied Boundary Condition Sediment Sample Location

cPAH TEQ Concentration in Sediment (mg/kg)
- <0.021 (NB)
- 0.021 to 0.15 (NF)
- >0.15 to 1.5 (10xNF)
- >1.5 to 15 (100xNF)
- > 15

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated cPAH TEQ Concentrations in Sediment Cores (>10 cm below mudline)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-27b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-26b Interpolated cPAH TEQ Concentrations Subsurface Sediment.mxd 7/22/2024 8:43:38 AM

Northeast Blakely Avenue
Northeast Country Club Road
3-T Road
Northeast Halls Hill Road
Northeast Seaborn Road
Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Both Sediment and Upland
- Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For sediment, the locations did not have data available.

TCDD TEQ Concentration in Sediment (ng/kg)
- <4 (NB)
- >4 to 8 (2xNB)
- >8 to 12.1 (HH)
- >12.1 to 24 (2xHH)
- > 24

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

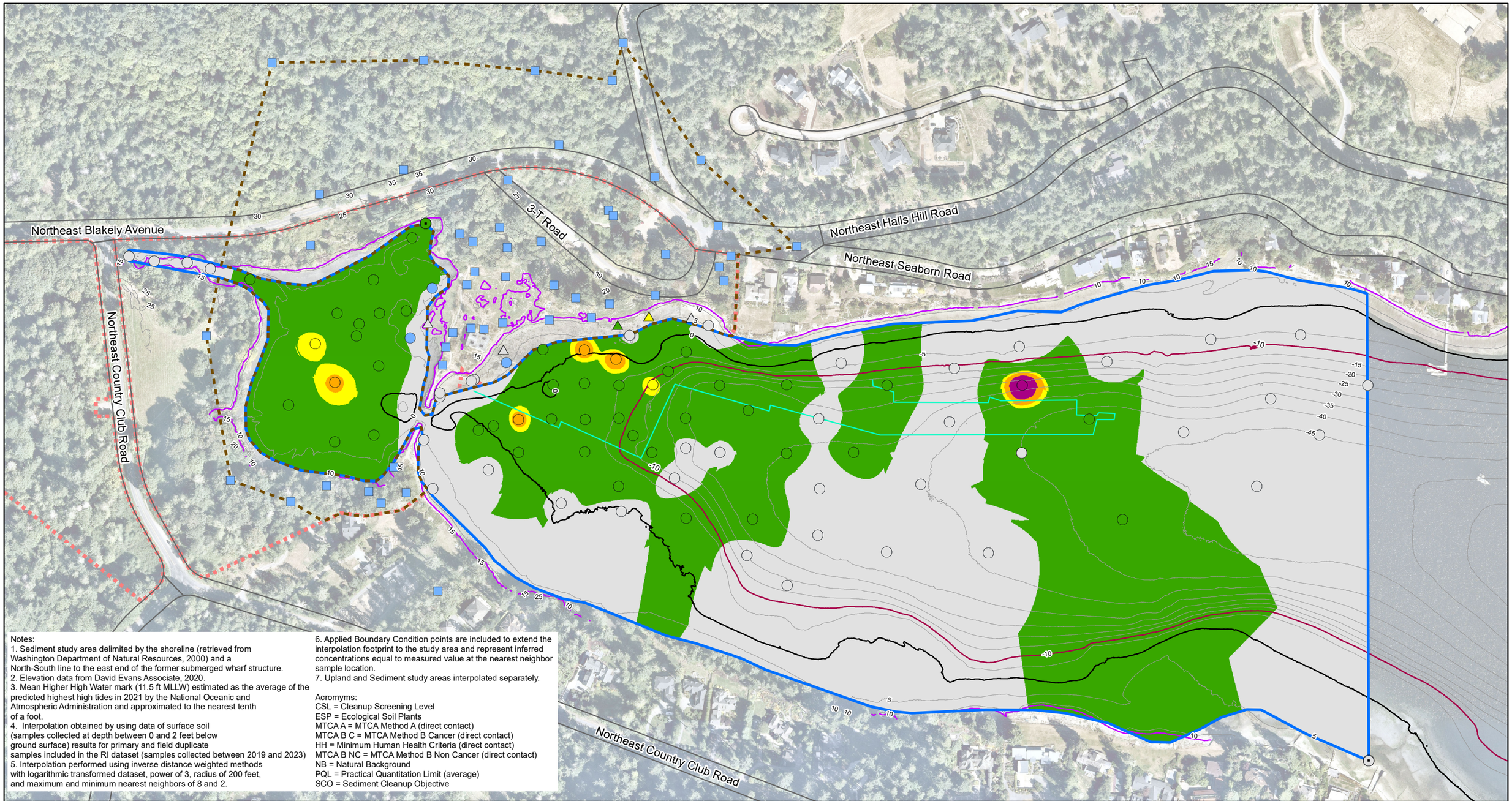
Interpolated TCDD TEQ Concentrations in Surface Sediment (0 to 10 cm below mudline)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

Figure 6-28

MVI/Sea | July 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-27a Interpolated TCDD TEQ Concentrations Surface Sediment.mxd 7/6/2024 10:56:52 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- ○ Sediment Sample Location
- △ Both Sediment and Upland
- ⊙ Applied Boundary Condition Sediment Sample Location

Locations not used for interpolation are shaded light blue. For sediment, the locations did not have data available.

Phenol Concentration in Sediment (mg/kg)
- <0.042 (SCO)
- 0.042 to 0.84 (2xSCO)
- >0.84 to 1.2 (CSL)
- >1.2 to 1.8 (1.5xCSL)
- >1.8

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Phenol Concentrations in Surface Sediment (0 to 10 cm below mudline)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-29a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-28a Interpolated Phenol Concentrations Surface Sediment.mxd 7/22/2024 9:00:25 AM

Northeast Blakely Avenue
Northeast Country Club Road
3-T Road
Northeast Halls Hill Road
Northeast Seaborn Road
Northeast Country Club Road

Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of subsurface sediment (samples deeper than 2 feet below mudline) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

Sample Source
- Sediment Sample Location
- Applied Boundary Condition Sediment Sample Location

Phenol Concentration in Sediment (mg/kg)
- <0.042 (SCO)
- 0.042 to 0.84 (2xSCO)
- >0.84 to 1.2 (CSL)
- >1.2 to 1.8 (1.5xCSL)
- > 1.8

- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

Interpolated Phenol Concentrations in Sediment Cores (>10 cm below mudline)
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-29b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\IDW Interpolations\IDW06092024\Revisions070224\Figure 6-28b Interpolated Phenol Concentrations Subsurface Sediment.mxd 7/22/2024 9:06:24 AM

Notes:
* Sample collected at station SG-05 failed the SCO and CSL bioassay performance criteria for the polychaete growth endpoint but passed both SCO and CSL criteria for the larval and amphipod endpoints.
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Extent of subsurface wood debris showed maximum at any location.
4. SPI sampling activities took place October 2020. Data extracted from Blakely Harbor Park Site Sediment Profile Imaging and Plan View Survey Report. Prepared by Integral Consulting Inc., 2021. Sediment profile images acquired showed an average penetration depth of 9.8 cm (sample size n=198).
5. Wood Debris percent coverage evaluated visually using sediment profile images, divers observations, and a semiquantitative assessment based on a quadrant method (for discrete samples).

Legend

Wood Debris % (All)
- > 75%
- 50 - 75%
- 10 - 50%
- < 10%

- Bioassay Fail Location
- Bioassay Pass Location
- Approximate Extend of Wood Debris
- Visible Wood Surface (2008)
- Shoreline
- Contour (-5 foot MLLW)
- Contours (Feet MLLW)
- Historical Wharf Structure
- 2021 Diver Transect Location
- Historical Diver Transect Location
- Road
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Sample Type
- Surface Sediment or Hand Auger Location
- SPI Sample Location (2020)
- Diver Transect Observation (2021)
- Diver Transect Observation (2008)

0 62.5 125 250 Feet

N

Visual Extent of Wood Debris at Surface (0-1 ft) and Bioassay Results

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

Figure 6-30a

MVI/Sea | July 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Revisions05172023\Figure 6-29a Extent of Wood Debris with BioassayV2.mxd 7/9/2024 9:16:30 AM

Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Wood debris percentage was assessed by using field methods as reported in the RI/FS Work Plan (Geosyntec, 2022).
4. Extent of subsurface wood debris showed prioritize results in borings advanced to 10 feet depth or above. Borings at HA sample locations were advanced to 2 feet depths with one HA boring advanced at 3 ft depth (HA-37), while borings at SB sample locations were advanced up to 20 feet depth. Maximum at any depth showed.

Legend

Wood Debris % (All)
- > 75%
- 50 - 75%
- 10 - 50%
- < 10%

- Extent of Subsurface Wood Debris > 50%
- Shoreline
- Contour (5 foot MLLW)
- Historical Wharf Structure
- Road
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Sample Type
- Sediment Core Sample Location
- Subsurface Soil Sample Location

N

0 62.5 125 250 Feet

Visual Extent of Wood Debris at Depth

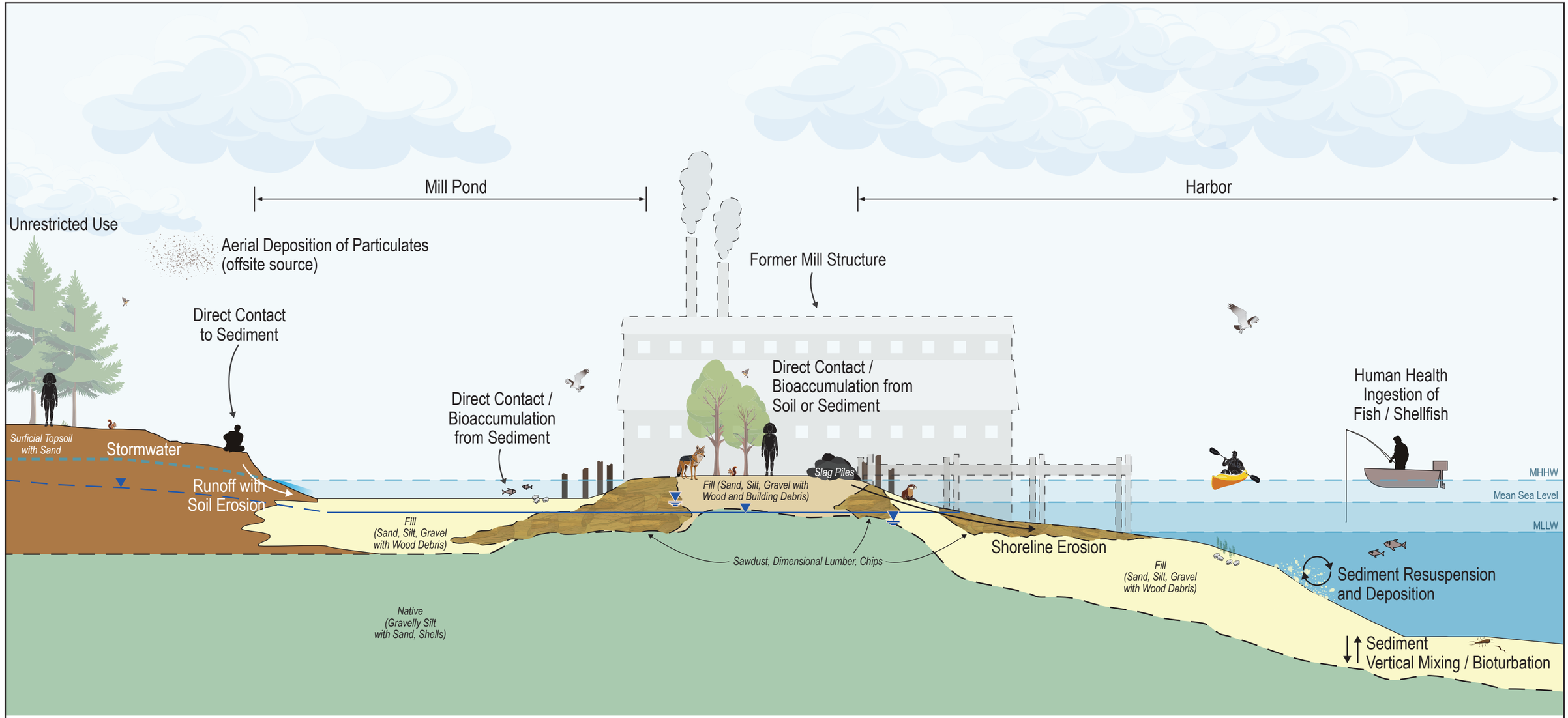
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 6-30b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Revisions05172023\Figure 6-29b Extent of Wood Debris with BioassayV3.mxd 7/9/2024 9:20:37 AM



LEGEND

- Fill (Sand, Silt, Gravel with Wood Debris)
- Fill (Sand, Silt, Gravel with Wood and Building Debris)
- Surficial Topsoil with Sand
- Fill (Sand, Silt, Gravel with Wood and Building Debris)
- Surficial Topsoil with Sand
- Groundwater

Notes:

1. Locations of historical buildings are approximate.
2. Scale is approximate
3. Geological units, fate and transport pathways, and exposure pathways are inferred based on current knowledge of the site from results of RI field surveys and sampling activities.
4. Unnamed, small creek input to Mill Pond is not shown.
5. Harbor is intended to represent both the Inner and Outer Harbor.

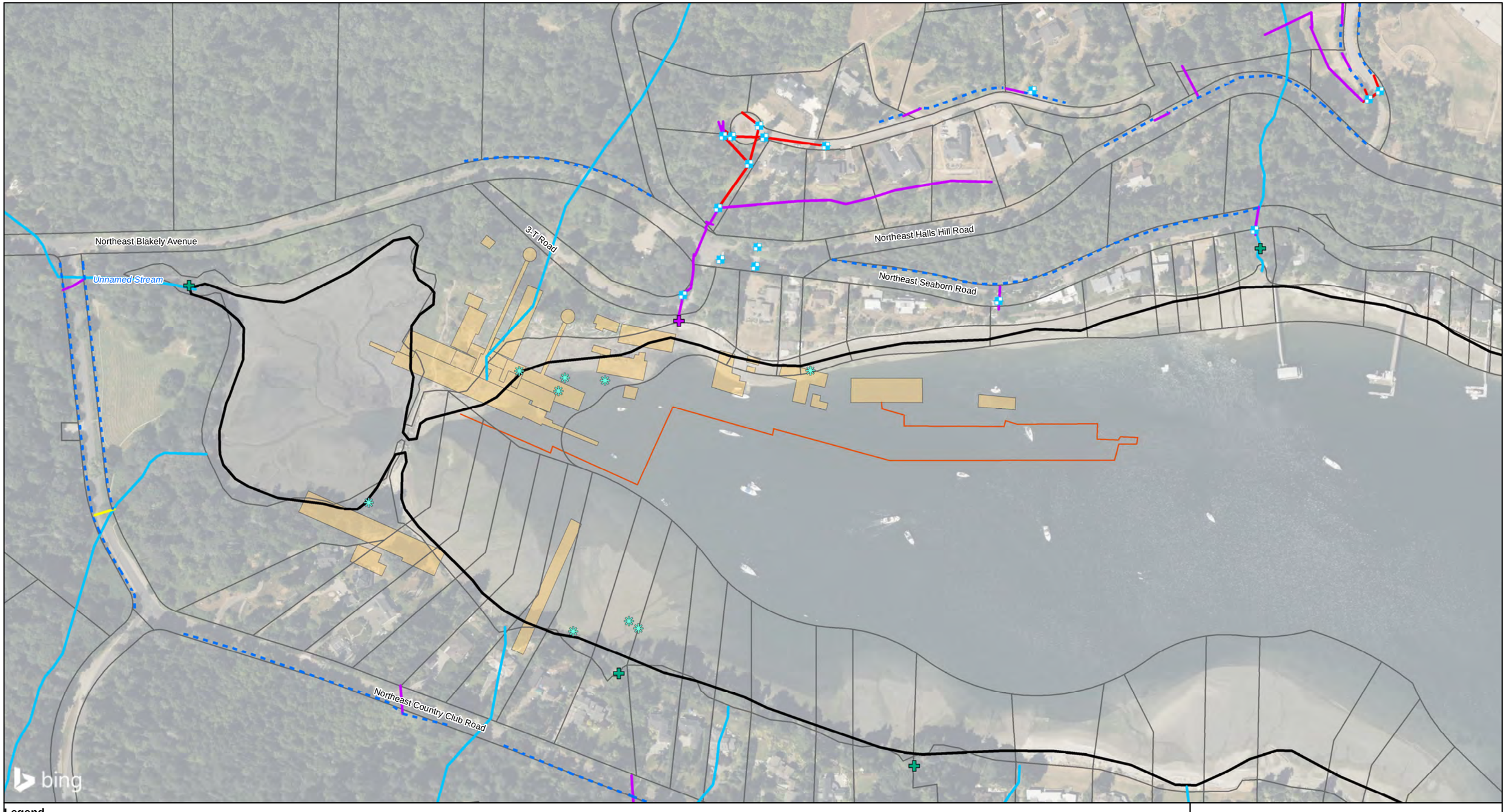
Conceptual Site Model
Remedial Investigation Report
Blakely Harbor Park Site

Geosyntec consultants

BDO / SEA | JULY 2024

Figure **7-1**

Filename.ai



Legend

Outfall Type
- Unknown (Blank)
- Natural
- Catch Basin
- Seep Location (Observed 8/19 thru 8/21, 2021)

Stormwater Conveyance Type
- Unclassified
- Culvert
- Pipe
- Open Stormwater Conveyance
- Approximate Stream Location
- Shoreline
- Historical Wharf Structure
- Parcel Boundary
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.
4. Stormwater System data provided by the City of Bainbridge Island, 01/18/2023.
5. Parcel dataset courtesy of Kitsap County.

N

0 75 150 300 Feet

Stormwater Conveyance System

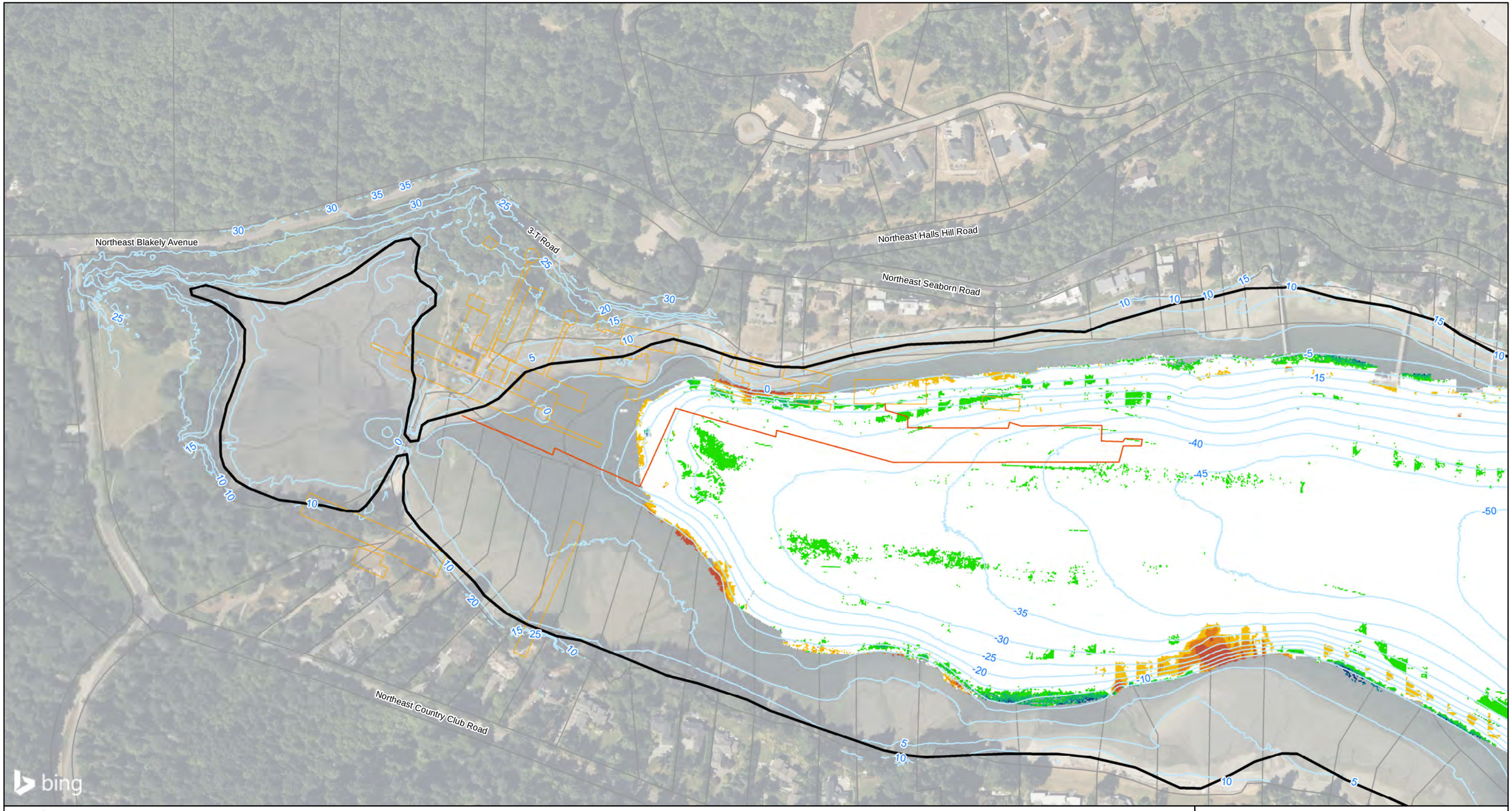
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 7-2

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Figure 7-2 Stormwater Conveyance System.mxd 7/11/2024 11:37:56 AM



Legend

Bathymetric Change in Feet (2009 thru 2020)

- < -3
- -3 to -2
- -2 to -1
- -1 to -0.5
- -0.5 to 0.5
- 0.5 to 1
- 1 to 2
- > 2
- Contour (2020, 5 foot MLLW)
- Shoreline
- Historical Wharf Structure
- Parcel Boundary
- Structures From 1917 Map and Figure 2 in GeoEngineers, 2019

Notes:
1. Locations of historical buildings are approximate.
2. Shoreline boundary provided by Washington State Department of Natural Resources.
3. Elevation data from David Evans and Associates, 2020.
4. 2009 Bathymetric data from 2009 NOAA H12025 dataset.
5. Parcel data courtesy of Kitsap County.

N

0 75 150 300 Feet

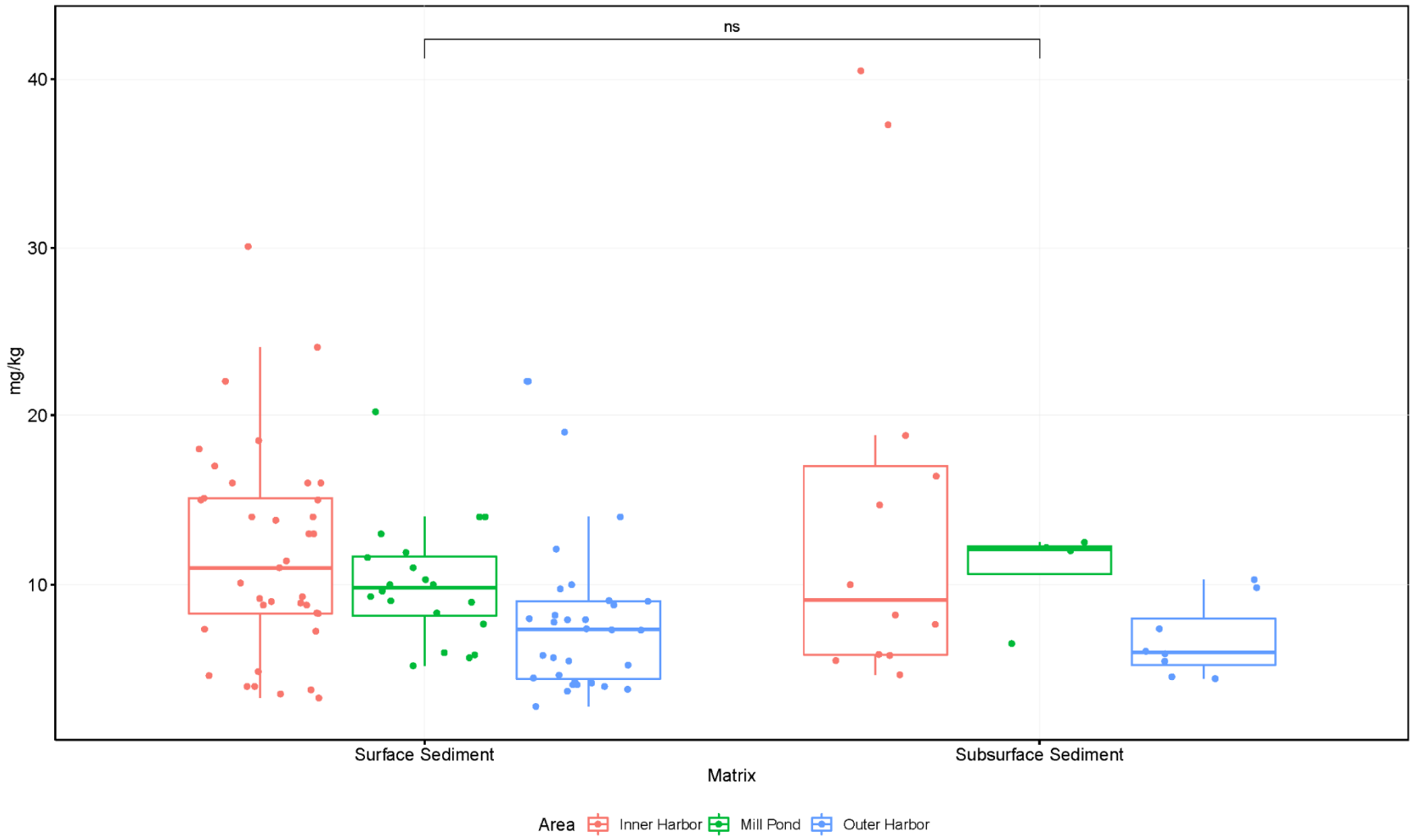
Bathymetric Change 2009 through 2020

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea	July 2024	**Figure 7-3**

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Figure 7-3 Bathymetric Change.mxd 7/29/2024 7:19:18 AM



The Box and Whiskers plot shows the distribution of the dataset along the median (central horizontal line). Boxes represent the interquartile range, including values between ± 25% of the median. Whiskers extending from the top and the bottom represents the bottom and top 25% of the data values excluding outliers.
Results of a nonparametric hypothesis test (Wilcoxon) are reported to the top of the two box plots: ns indicates that differences between the two dataset are not statistically significant, asterisks indicate that differences between the two dataset are statistically significant with 90% confidence (*), 95% confidence (**), and 99% confidence (***).

Dataset includes maximum at each surface (sediment grabs collected between 0-10 centimeters below mudline [bml], n=89) and subsurface (sediment cores advanced up to 10 feet bml, n=25) sediment locations at the Blakely Harbor Park Site. Maximum reported for field duplicates, half of reporting limits shown for non-detected results.

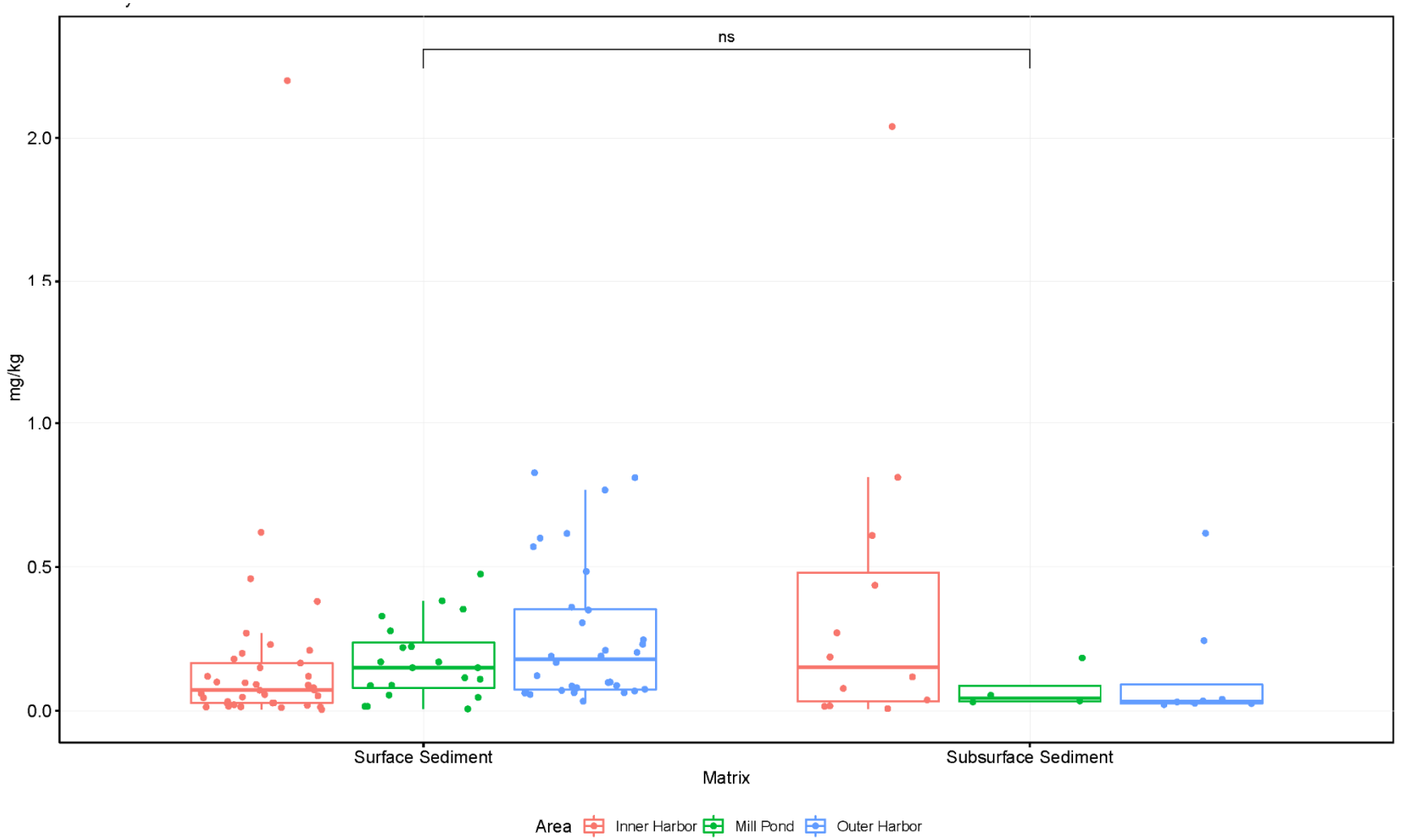
Arsenic Distribution in Study Area Sediment
Remedial Investigation Report
Blakely Harbor Park Site
Bainbridge Island (WA)

Geosyntec consultants

Figure 7-4a

SEA/GP	July 2024

I:\ Projects\DWT\PNG0900_Blakely Harbor\600 Deliverables\RI Report\Figures



The Box and Whiskers plot shows the distribution of the dataset along the median (central horizontal line). Boxes represent the interquartile range, including values between ± 25% of the median. Whiskers extending from the top and the bottom represents the bottom and top 25% of the data values excluding outliers.
Results of a nonparametric hypothesis test (Wilcoxon) are reported to the top of the two box plots: ns indicates that differences between the two dataset are not statistically significant, asterisks indicate that differences between the two dataset are statistically significant with 90% confidence (*), 95% confidence (**), and 99% confidence (***).

Dataset includes maximum at each surface (sediment grabs collected between 0-10 centimeters below mudline [bml], n=89) and subsurface (sediment cores advanced up to 10 feet bml, n=25) sediment locations at the Blakely Harbor Park Site. Maximum reported for field duplicates, half of reporting limits shown for non-detected results.

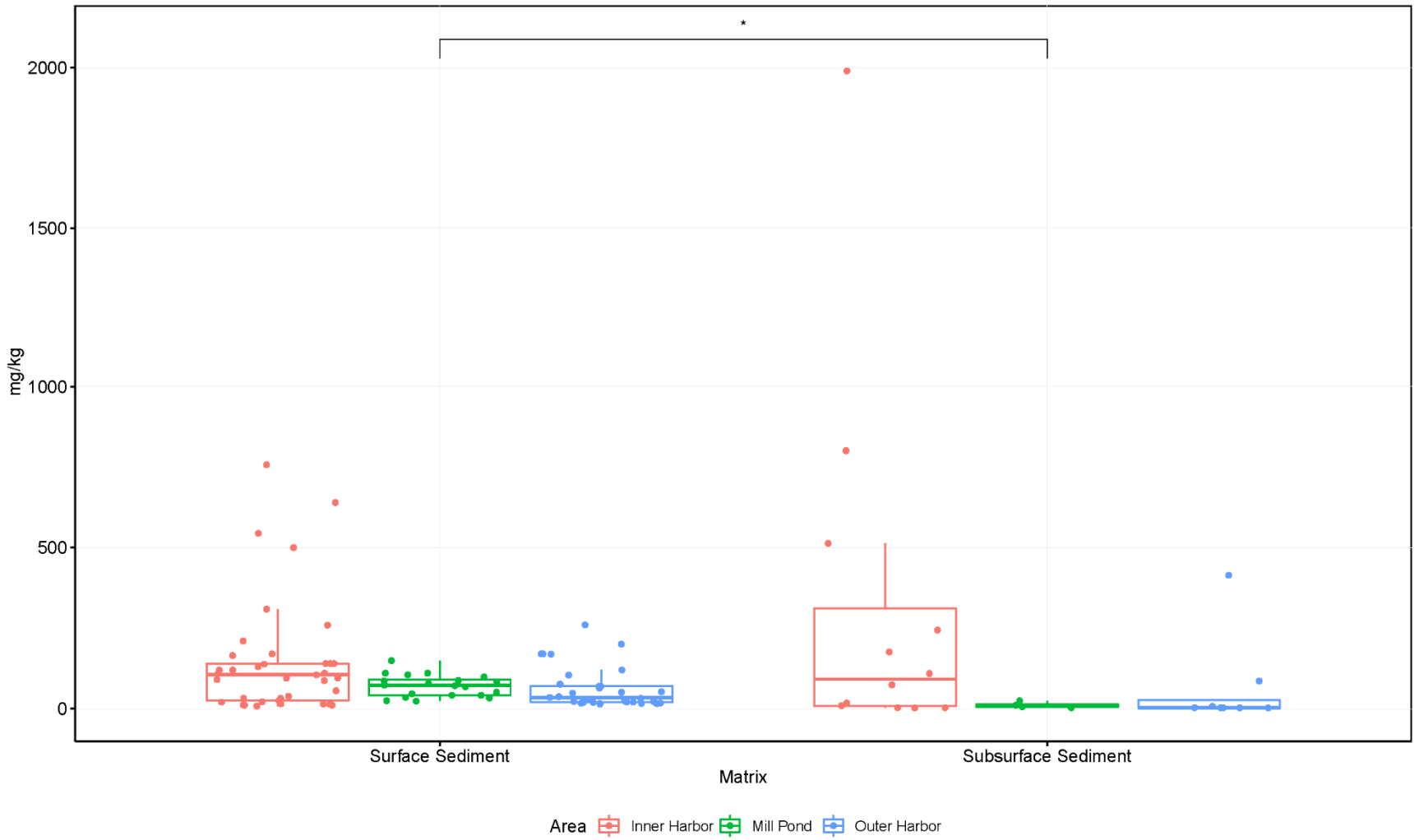
Mercury Distribution in Study Area Sediment
Remedial Investigation Report
Blakely Harbor Park Site
Bainbridge Island (WA)

Geosyntec consultants

Figure 7-4b

SEA/GP	July 2024

I:\ Projects\DWT\PNG0900_Blakely Harbor\600 Deliverables\RI Report\Figures



The Box and Whiskers plot shows the distribution of the dataset along the median (central horizontal line). Boxes represent the interquartile range, including values between ± 25% of the median. Whiskers extending from the top and the bottom represents the bottom and top 25% of the data values excluding outliers.
Results of a nonparametric hypothesis test (Wilcoxon) are reported to the top of the two box plots: ns indicates that differences between the two dataset are not statistically significant, asterisks indicate that differences between the two dataset are statistically significant with 90% confidence (*), 95% confidence (**), and 99% confidence (***).

Dataset includes maximum at each surface (sediment grabs collected between 0-10 centimeters below mudline [bml], n=89) and subsurface (sediment cores advanced up to 10 feet bml, n=25) sediment locations at the Blakely Harbor Park Site. Maximum reported for field duplicates, half of reporting limits shown for non-detected results.

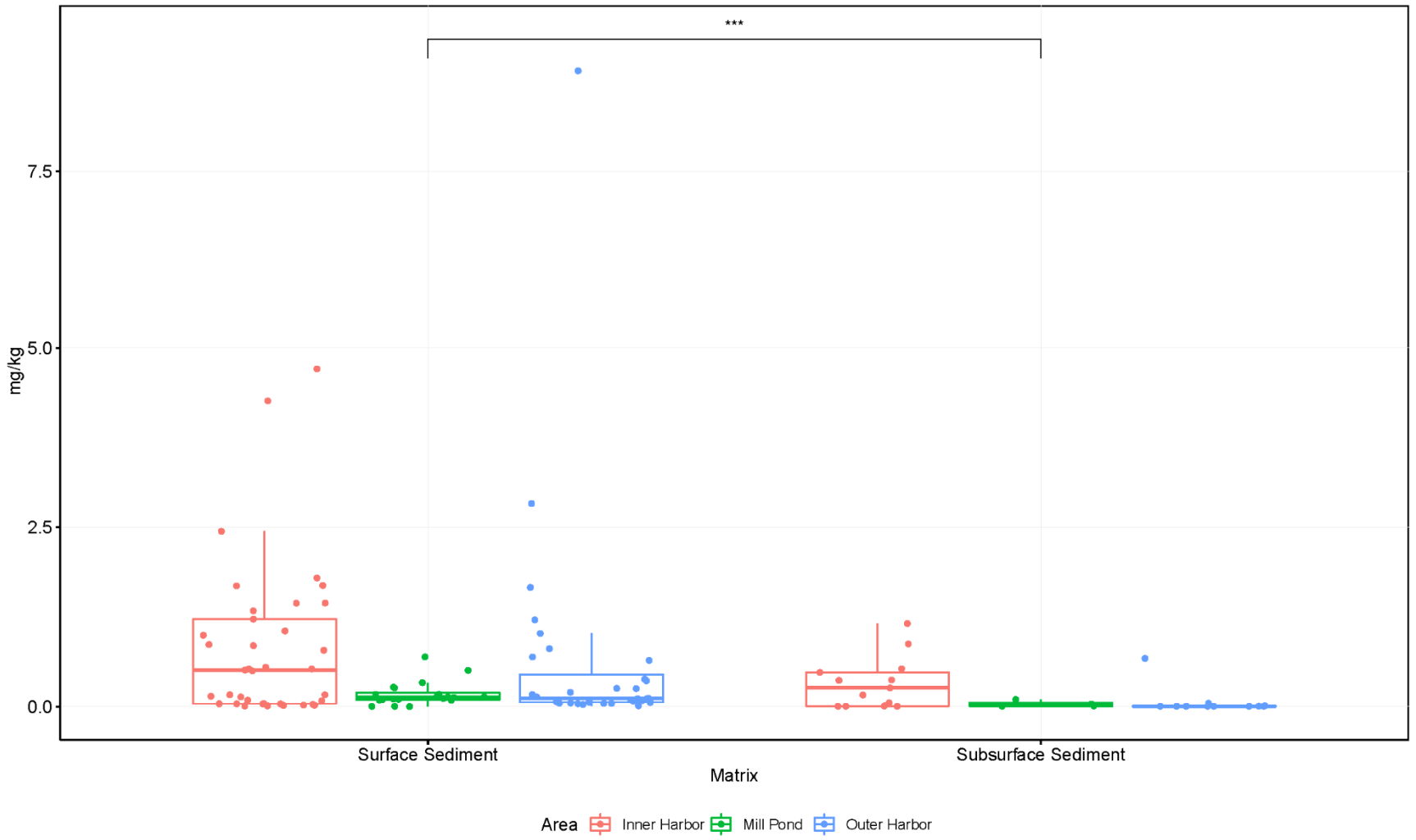
Lead Distribution in Study Area Sediment
Remedial Investigation Report
Blakely Harbor Park Site
Bainbridge Island (WA)

Geosyntec consultants

SEA/GP	July 2024

Figure 7-4c

I:\ Projects\DWT\PNG0900_Blakely Harbor\600 Deliverables\RI Report\Figures



The Box and Whiskers plot shows the distribution of the dataset along the median (central horizontal line). Boxes represent the interquartile range, including values between ± 25% of the median. Whiskers extending from the top and the bottom represents the bottom and top 25% of the data values excluding outliers.
Results of a nonparametric hypothesis test (Wilcoxon) are reported to the top of the two box plots: ns indicates that differences between the two dataset are not statistically significant, asterisks indicate that differences between the two dataset are statistically significant with 90% confidence (*), 95% confidence (**), and 99% confidence (***).

Dataset includes maximum at each surface (sediment grabs collected between 0-10 centimeters below mudline [bml], n=89) and subsurface (sediment cores advanced up to 10 feet bml, n=25) sediment locations at the Blakely Harbor Park Site. Maximum reported for field duplicates, half of reporting limits shown for non-detected results.

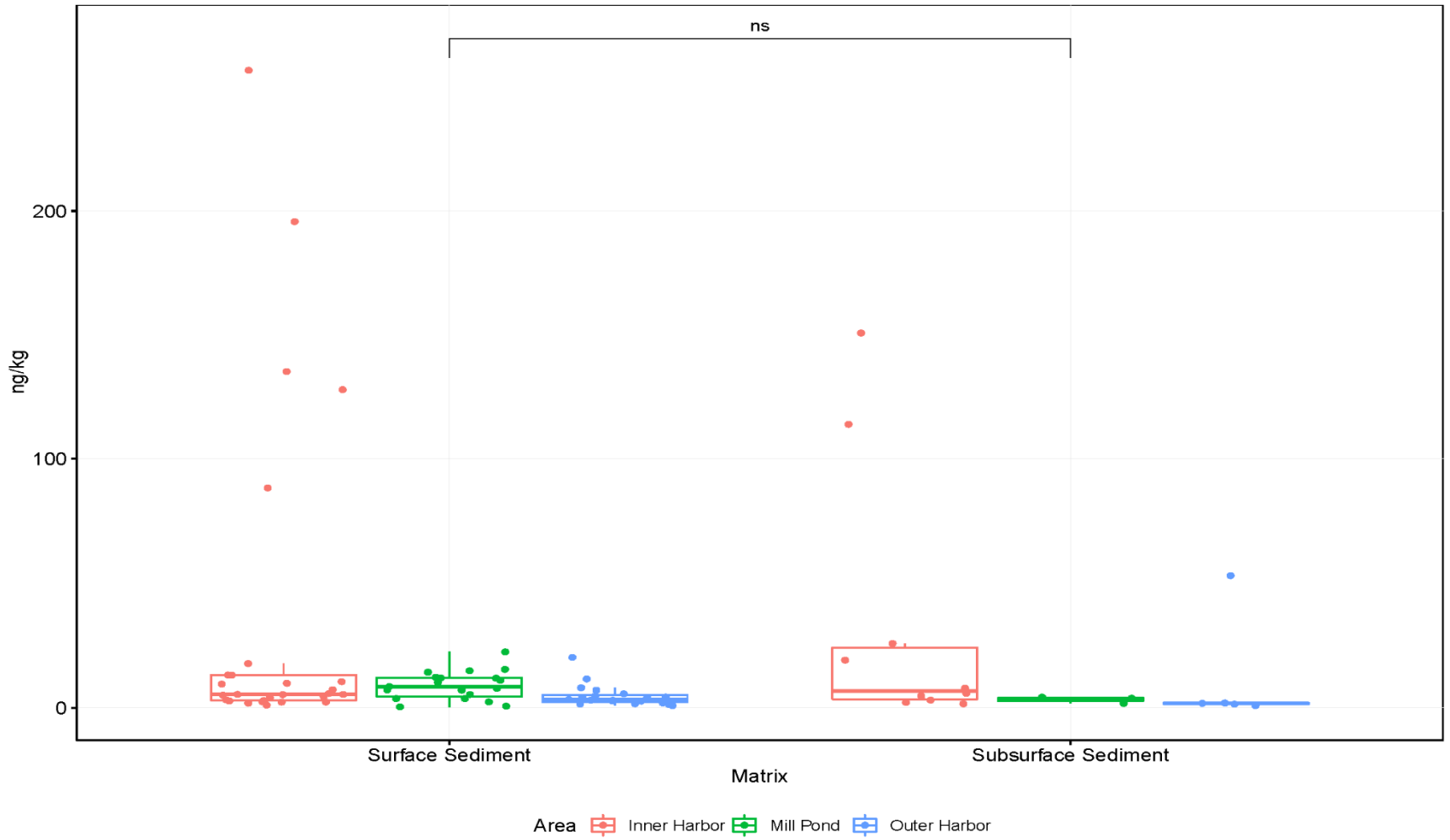
cPAH TEQ Distribution in Study Area Sediment
Remedial Investigation Report
Blakely Harbor Park Site
Bainbridge Island (WA)

Geosyntec consultants

Figure 7-4d

SEA/GP	July 2024

I:\Projects\DWT\PNG0900_Blakely Harbor\600 Deliverables\RI Report\Figures



The Box and Whiskers plot shows the distribution of the dataset along the median (central horizontal line). Boxes represent the interquartile range, including values between ± 25% of the median. Whiskers extending from the top and the bottom represents the bottom and top 25% of the data values excluding outliers.
Results of a nonparametric hypothesis test (Wilcoxon) are reported to the top of the two box plots: ns indicates that differences between the two dataset are not statistically significant, asterisks indicate that differences between the two dataset are statistically significant with 90% confidence (*), 95% confidence (**), and 99% confidence (***).

Dataset includes maximum at each surface (sediment grabs collected between 0-10 centimeters below mudline [bml], n=89) and subsurface (sediment cores advanced up to 10 feet bml, n=25) sediment locations at the Blakely Harbor Park Site. Maximum reported for field duplicates, half of reporting limits shown for non-detected results. TCDD TEQ was the highest at core sample BH-SC-34-1.5to3.3 (1376.9 ng/kg); this sample was not plotted for maximizing readability due to scaling. Output of the statistical analysis was unchanged when including BH-SC=34=1.5to3.3.

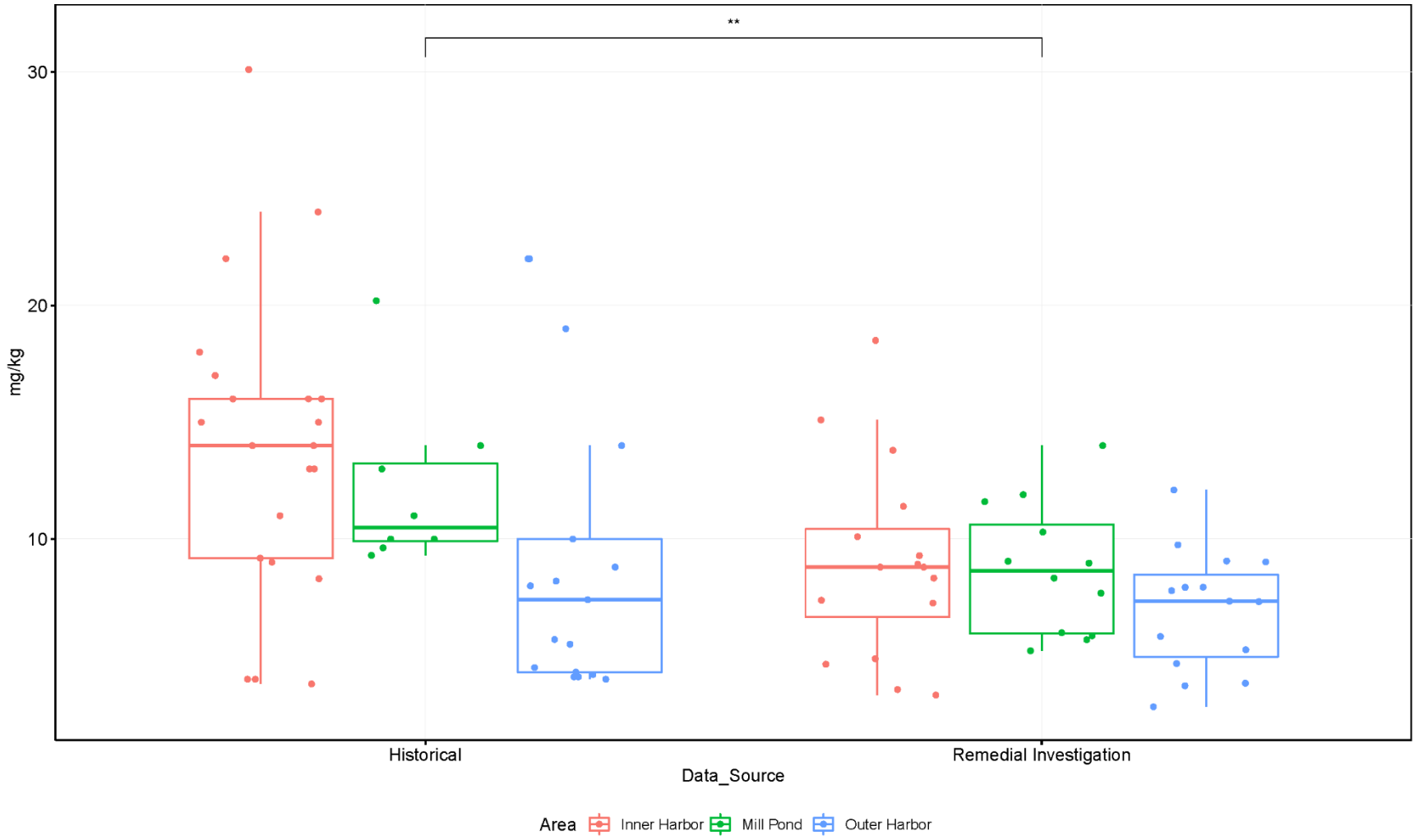
TCDD TEQ Distribution in Study Area Sediment
Remedial Investigation Report
Blakely Harbor Park Site
Bainbridge Island (WA)

Geosyntec consultants

SEA/GP	July 2024

Figure 7-4e

I:\Projects\DWT\PNG0900_Blakely Harbor\600 Deliverables\RI Report\Figures



The Box and Whiskers plot shows the distribution of the dataset along the median (central horizontal line). Boxes represent the interquartile range, including values between ± 25% of the median. Whiskers extending from the top and the bottom represents the bottom and top 25% of the data values excluding outliers.
Results of a nonparametric hypothesis test (Wilcoxon) are reported to the top of the two box plots: ns indicates that differences between the two dataset are not statistically significant, asterisks indicate that differences between the two dataset are statistically significant with 90% confidence (*), 95% confidence (**), and 99% confidence (***).

Dataset includes sediment grabs collected between 0-10 centimeters below mudline during historical (2019, n=46) and RI (2021/2023, n=43) field investigations at the Blakely Harbor Park Site. Maximum reported for field duplicates, half of reporting limits shown for non-detected results.

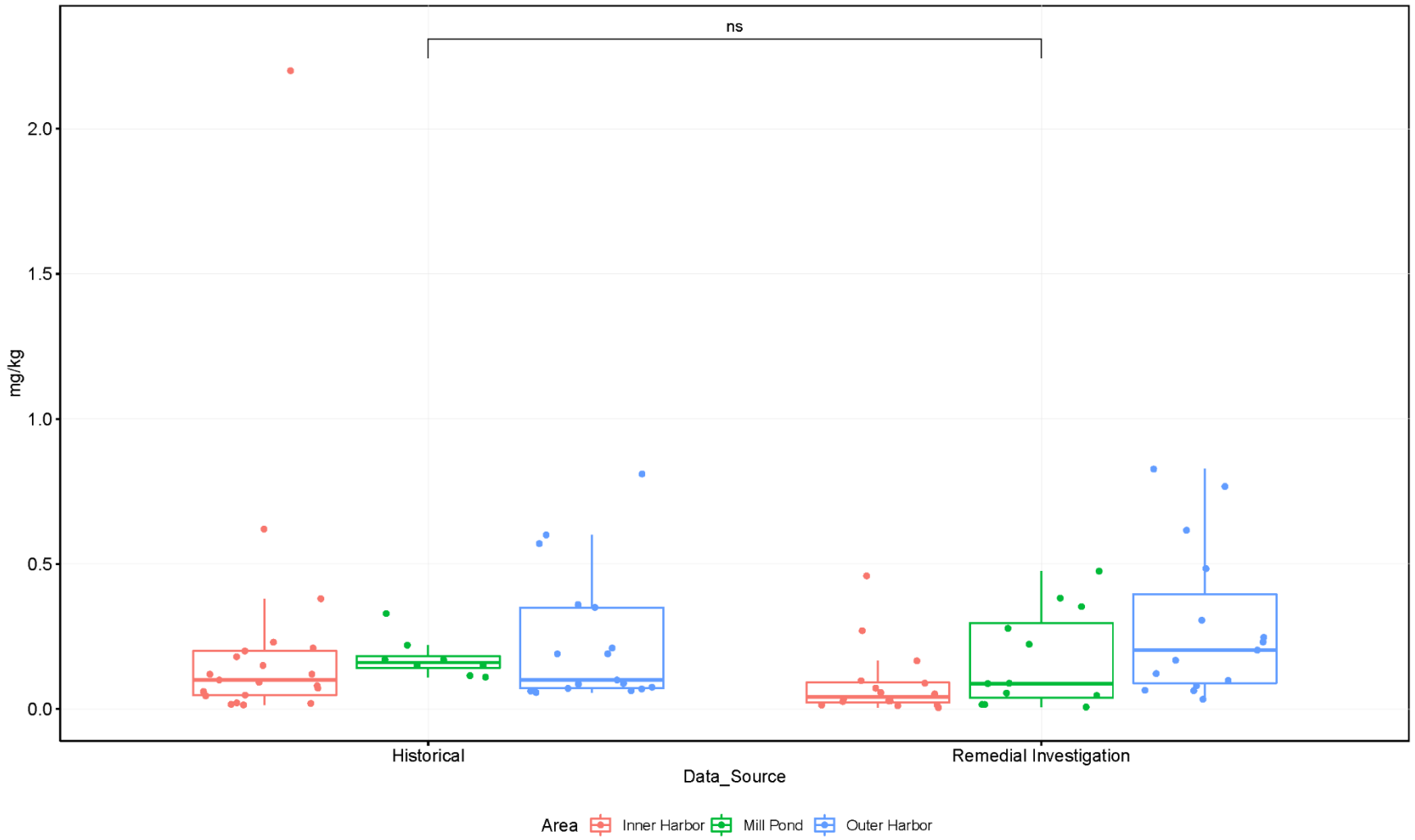
Arsenic Distribution in Historical and RI Surface Sediment
Remedial Investigation Report
Blakely Harbor Park Site
Bainbridge Island (WA)

Geosyntec consultants

SEA/GP	July 2024

Figure 7-5a

I:\Projects\DWT\PNG0900_Blakely Harbor\600 Deliverables\RI Report\Figures



The Box and Whiskers plot shows the distribution of the dataset along the median (central horizontal line). Boxes represent the interquartile range, including values between ± 25% of the median. Whiskers extending from the top and the bottom represents the bottom and top 25% of the data values excluding outliers.
Results of a nonparametric hypothesis test (Wilcoxon) are reported to the top of the two box plots: ns indicates that differences between the two dataset are not statistically significant, asterisks indicate that differences between the two dataset are statistically significant with 90% confidence (*), 95% confidence (**), and 99% confidence (***).

Dataset includes sediment grabs collected between 0-10 centimeters below mudline during historical (2019, n=46) and RI (2021/2023, n=43) field investigations at the Blakely Harbor Park Site. Maximum reported for field duplicates, half of reporting limits shown for non-detected results

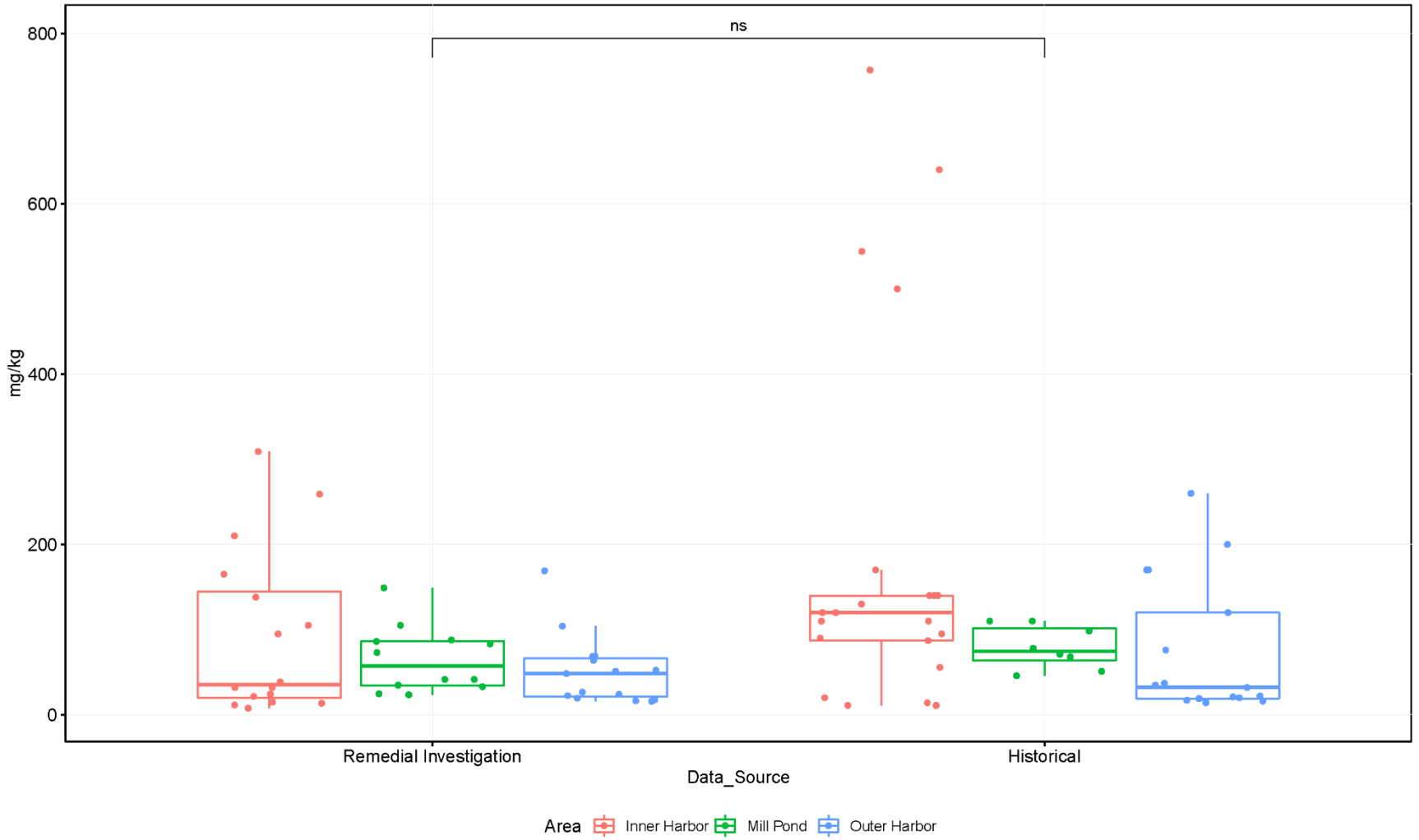
Mercury Distribution in Historical and RI Surface Sediment
Remedial Investigation Report
Blakely Harbor Park Site
Bainbridge Island (WA)

Geosyntec consultants

Figure 7-5b

SEA/GP	July 2024

I:\Projects\DWT\PNG0900_Blakely Harbor\600 Deliverables\RI Report\Figures



The Box and Whiskers plot shows the distribution of the dataset along the median (central horizontal line). Boxes represent the interquartile range, including values between ± 25% of the median. Whiskers extending from the top and the bottom represents the bottom and top 25% of the data values excluding outliers.
Results of a nonparametric hypothesis test (Wilcoxon) are reported to the top of the two box plots: ns indicates that differences between the two dataset are not statistically significant, asterisks indicate that differences between the two dataset are statistically significant with 90% confidence (*), 95% confidence (**), and 99% confidence (***).

Dataset includes sediment grabs collected between 0-10 centimeters below mudline during historical (2019, n=46) and RI (2021/2023, n=43) field investigations at the Blakely Harbor Park Site. Maximum reported for field duplicates, half of reporting limits shown for non-detected results

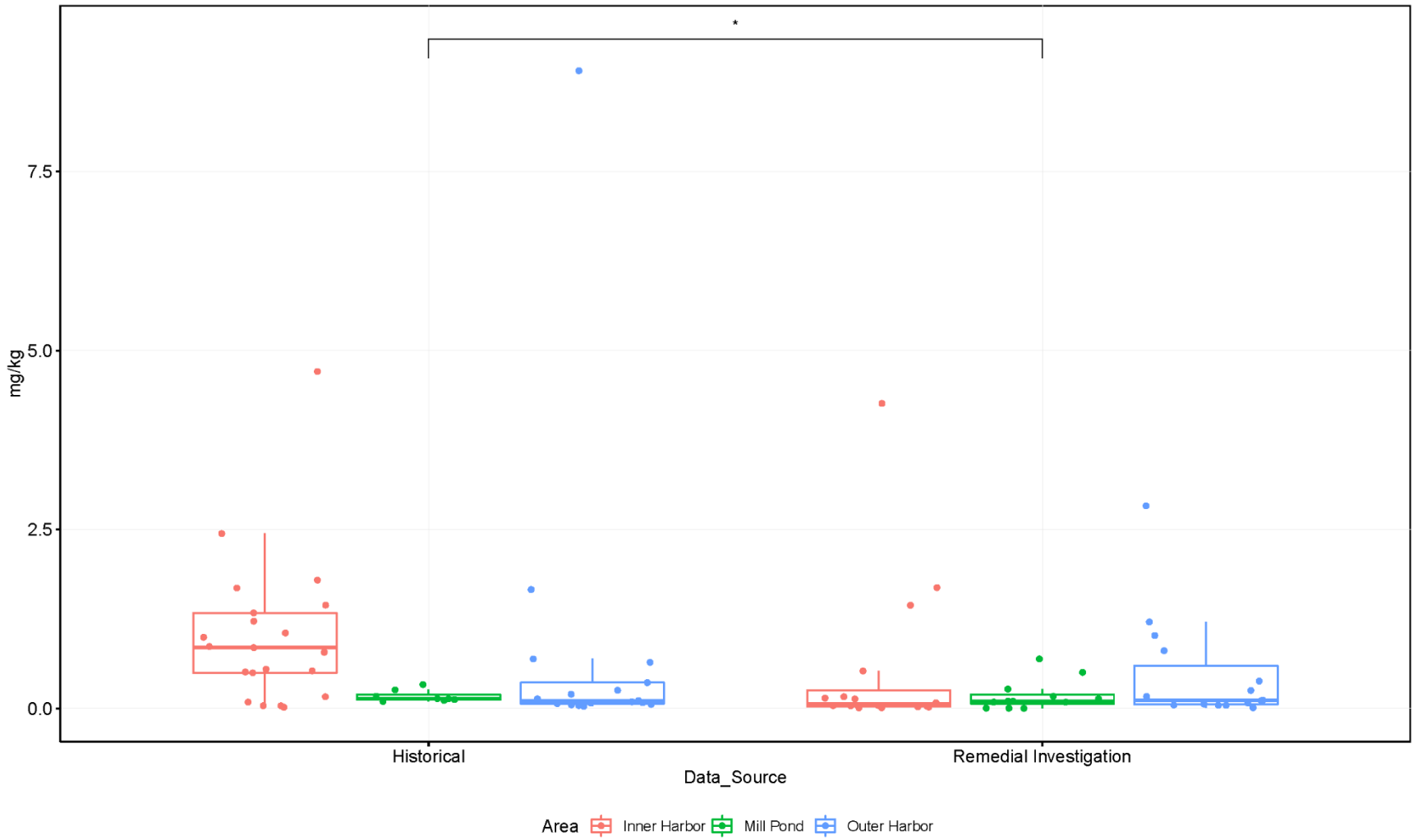
Lead Distribution in Historical and RI Surface Sediment
Remedial Investigation Report
Blakely Harbor Park Site
Bainbridge Island (WA)

Geosyntec consultants

SEA/GP	July 2024

Figure 7-5c

I:\ Projects\DWT\PNG0900_Blakely Harbor\600 Deliverables\RI Report\Figures



The Box and Whiskers plot shows the distribution of the dataset along the median (central horizontal line). Boxes represent the interquartile range, including values between ± 25% of the median. Whiskers extending from the top and the bottom represents the bottom and top 25% of the data values excluding outliers.
Results of a nonparametric hypothesis test (Wilcoxon) are reported to the top of the two box plots: ns indicates that differences between the two dataset are not statistically significant, asterisks indicate that differences between the two dataset are statistically significant with 90% confidence (*), 95% confidence (**), and 99% confidence (***).

Dataset includes sediment grabs collected between 0-10 centimeters below mudline during historical (2019, n=46) and RI (2021/2023, n=43) field investigations at the Blakely Harbor Park Site. Maximum reported for field duplicates, half of reporting limits shown for non-detected results

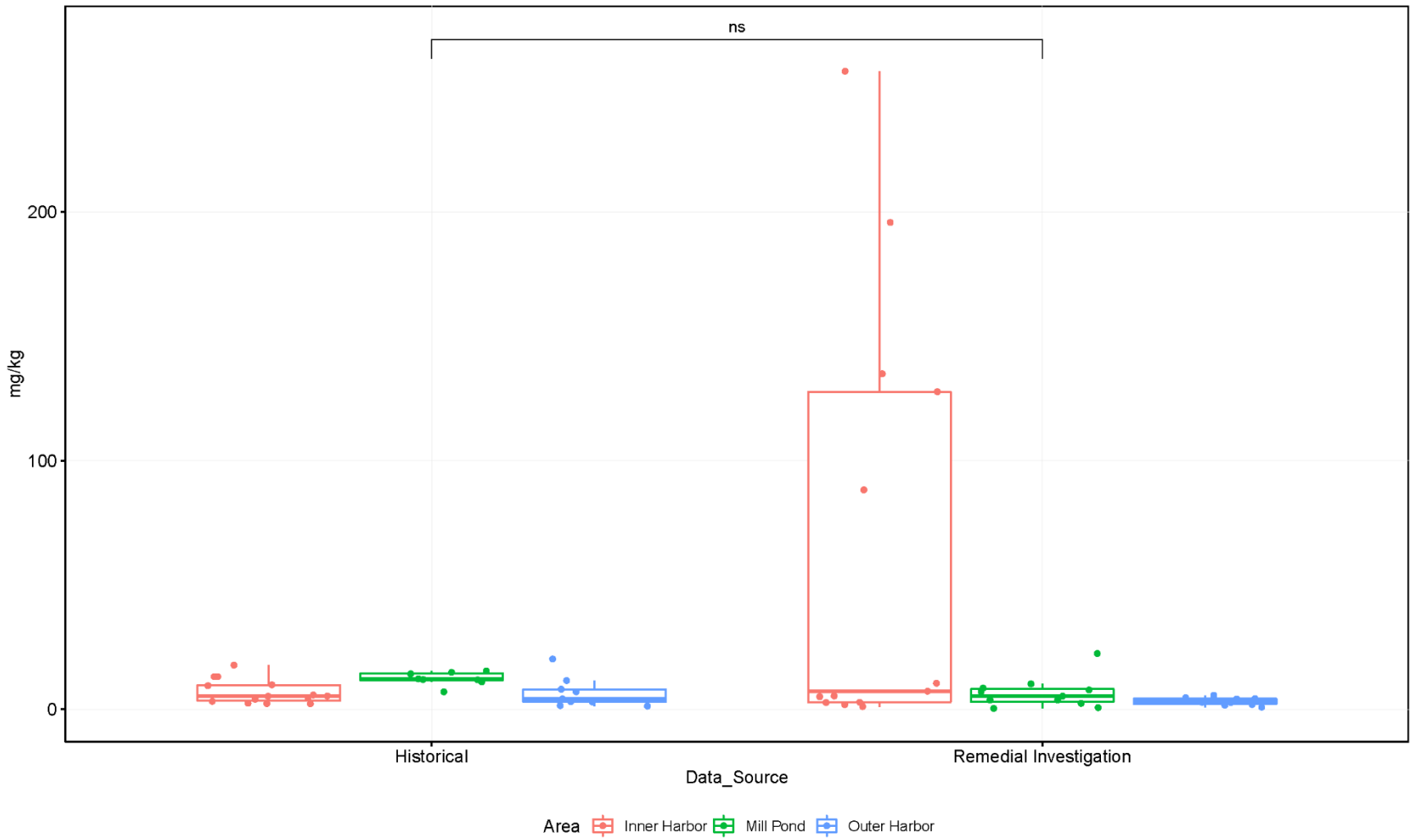
cPAH TEQ Distribution in Historical and RI Surface Sediment
Remedial Investigation Report
Blakely Harbor Park Site
Bainbridge Island (WA)

Geosyntec consultants

Figure 7-5d

SEA/GP	July 2024

I:\ Projects\DWT\PNG0900_Blakely Harbor\600 Deliverables\RI Report\Figures



The Box and Whiskers plot shows the distribution of the dataset along the median (central horizontal line). Boxes represent the interquartile range, including values between ± 25% of the median. Whiskers extending from the top and the bottom represents the bottom and top 25% of the data values excluding outliers.
Results of a nonparametric hypothesis test (Wilcoxon) are reported to the top of the two box plots: ns indicates that differences between the two dataset are not statistically significant, asterisks indicate that differences between the two dataset are statistically significant with 90% confidence (*), 95% confidence (**), and 99% confidence (***).

Dataset includes sediment grabs collected between 0-10 centimeters below mudline during historical (2019, n=46) and RI (2021/2023, n=43) field investigations at the Blakely Harbor Park Site. Maximum reported for field duplicates, half of reporting limits shown for non-detected results

TCDD TEQ Distribution in Historical and RI Surface Sediment
Remedial Investigation Report
Blakely Harbor Park Site
Bainbridge Island (WA)

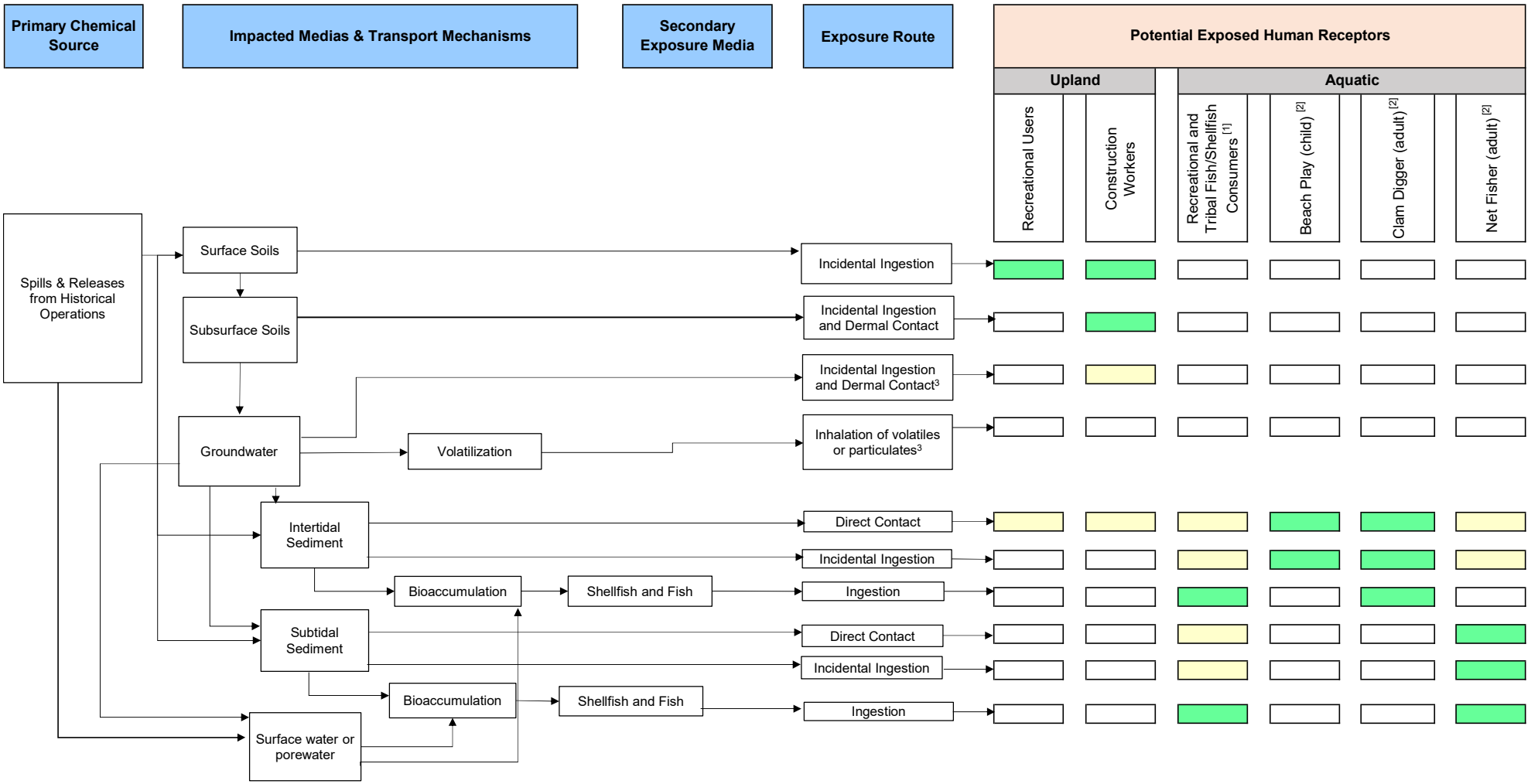
Geosyntec consultants

Figure 7-5e

SEA/GP	July 2024

I:\ Projects\DWT\PNG0900_Blakely Harbor\600 Deliverables\RI Report\Figures

Figure 7-6a. Conceptual Site Model and Potential Human Receptors



Legend:

Complete exposure pathway that will be evaluated via comparison to pathway specific risk-based Cleanup Standards.

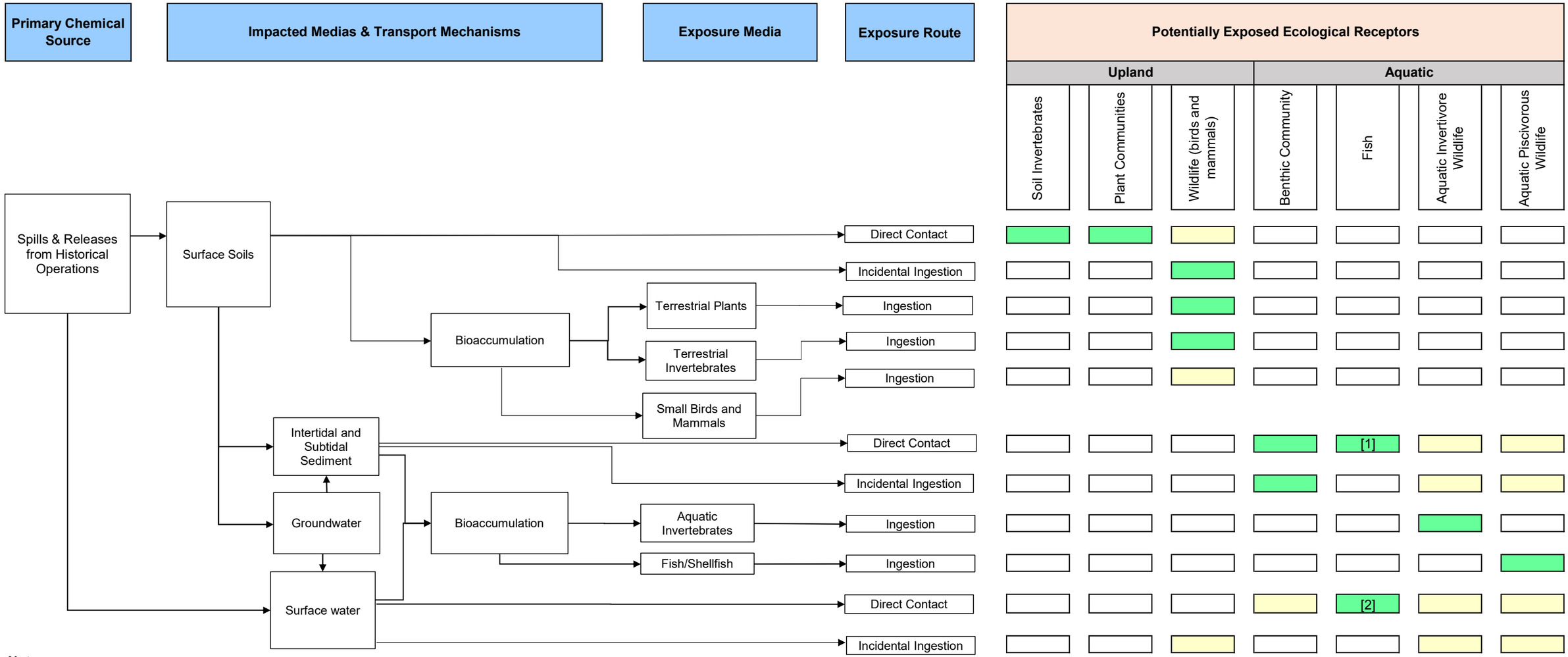
Potentially complete, but insignificant pathway (i.e. higher exposure frequency pathways are being evaluated for this media and will be protective of this receptor).

Incomplete exposure pathway; no evaluation or management action is necessary.

Footnotes:

1. Recreational and Tribal fish and shellfish consumers may be exposed via bioaccumulation of contaminants into fish and shellfish followed by consumption. These receptors have different consumption rates and exposure frequencies but are shown together here as the exposure pathway is the same.
2. Exposure to sediments via direct contact and incidental ingestion are evaluated as three representative activities as outlined in Ecology (2019) - child's beach play, clam digging, and net fishing.
3. No COCs were identified in groundwater so this pathway has been determined insignificant or incomplete.

Figure 7-6b. Conceptual Site Model and Potential Ecological Receptors



Notes:

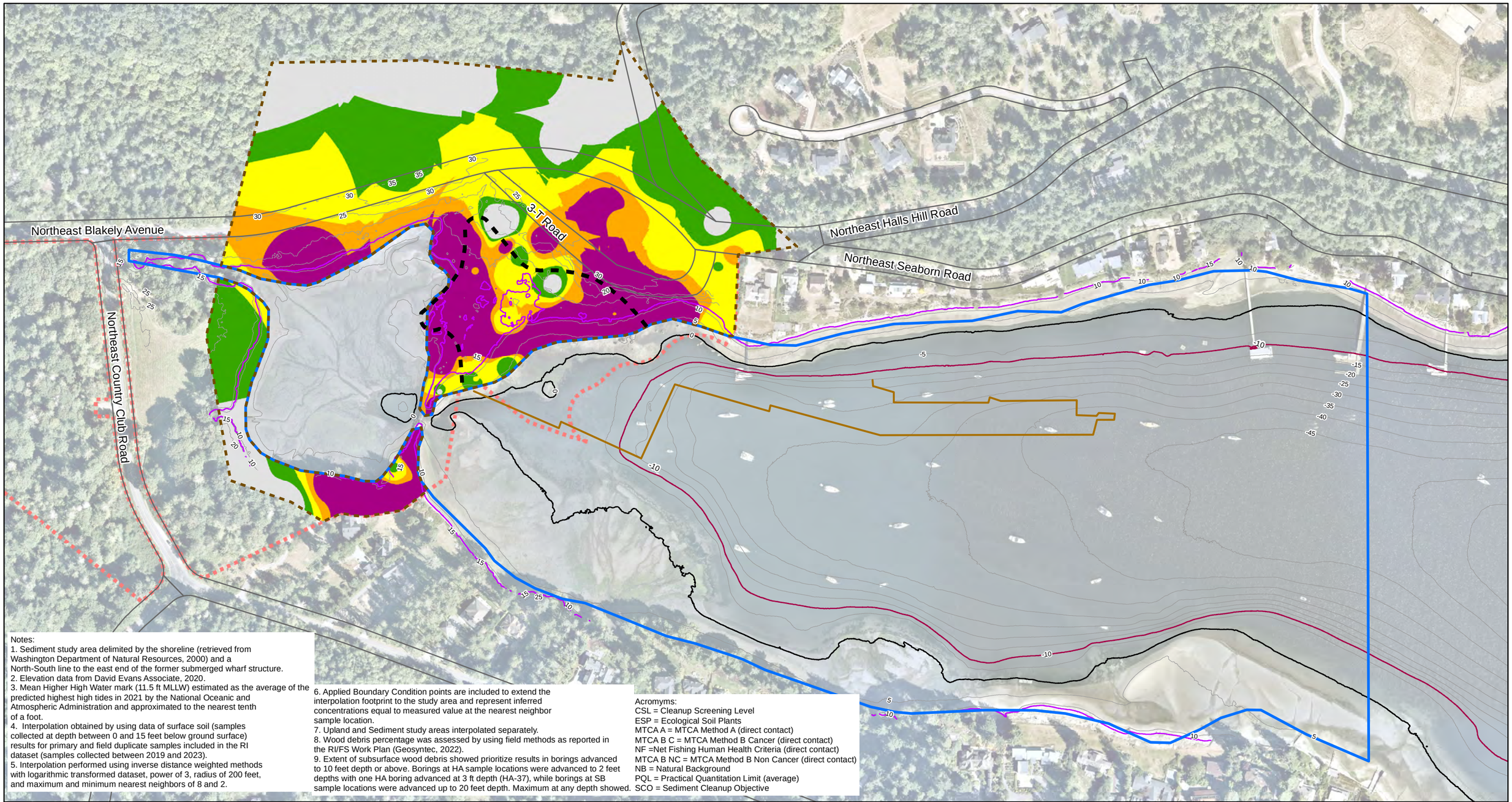
Complete exposure pathway that will be evaluated.

Potentially complete, but insignificant pathway.

Incomplete exposure pathway; no evaluation or management action is necessary.

[1] - The direct contact pathway for fish is complete; however, a quantitative evaluation will not be performed. Instead, a qualitative discussion is provided in the RI Report based on the results of the SCO screening performed for benthic invertebrates due to the comparison being protective of the direct contact for fish pathway

[2] - The direct contact pathway for fish is complete, but was not evaluated in the risk screening. A qualitative discussion is provided in the RI Report.



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 15 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.
8. Wood debris percentage was assessed by using field methods as reported in the RI/FS Work Plan (Geosyntec, 2022).
9. Extent of subsurface wood debris showed prioritize results in borings advanced to 10 feet depth or above. Borings at HA sample locations were advanced to 2 feet depths with one HA boring advanced at 3 ft depth (HA-37), while borings at SB sample locations were advanced up to 20 feet depth. Maximum at any depth showed.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
NF =Net Fishing Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

cPAHs TEQ ND halfRL Concentration in Soil (mg/kg)
- <0.016 (PQL)
- 0.016 to 0.038 (2xPQL)
- >0.038 to 0.1 (MTCA A)
- >0.1 to 0.19 (MTCA B C)
- >0.19

- Extent of Subsurface Wood Debris > 50%
- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour

- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

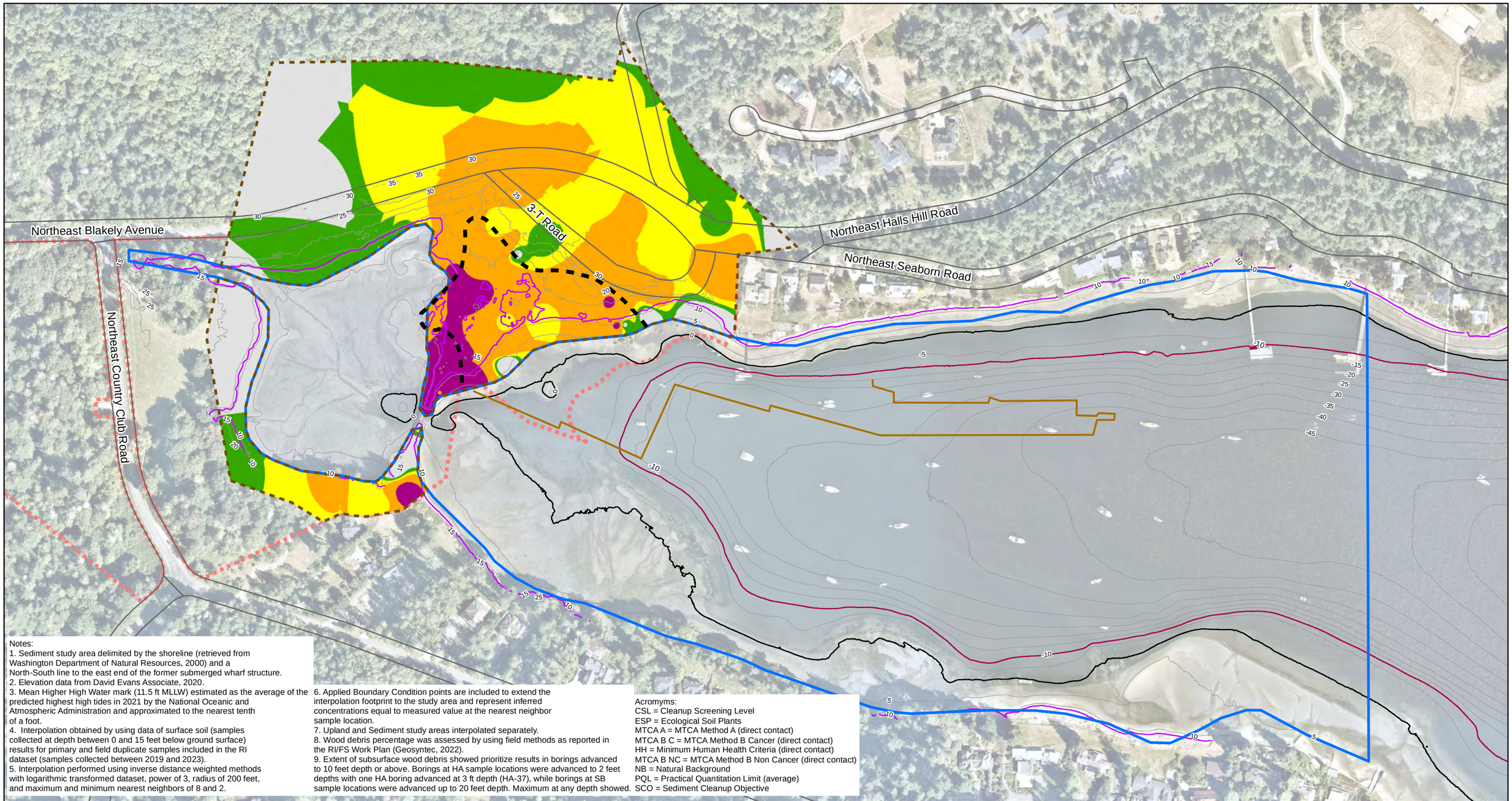
Overlay of cPAH TEQ Interpolated Concentrations in Soil Wood Debris Extent
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 7-7a

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Figure 7-7a Interpolated HHRA cPAH Concentrations Surface Soil and WW.mxd 7/29/2024 10:33:31 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 15 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023).
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.
8. Wood debris percentage was assessed by using field methods as reported in the RI/FS Work Plan (Geosyntec, 2022).
9. Extent of subsurface wood debris showed prioritize results in borings advanced to 10 feet depth or above. Borings at HA sample locations were advanced to 2 feet depths with one HA boring advanced at 3 ft depth (HA-37), while borings at SB sample locations were advanced up to 20 feet depth. Maximum at any depth showed.

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

TCDD TEQ halfRL Concentration in Soil [ng/kg]
- <5.2 (NB)
- 5.2 to 7.8 (1.5xNB)
- >7.8 to 13 (MTCA B C)
- >13 to 93 (MTCA B NC)
- >93

- Extent of Subsurface Wood Debris > 50%
- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

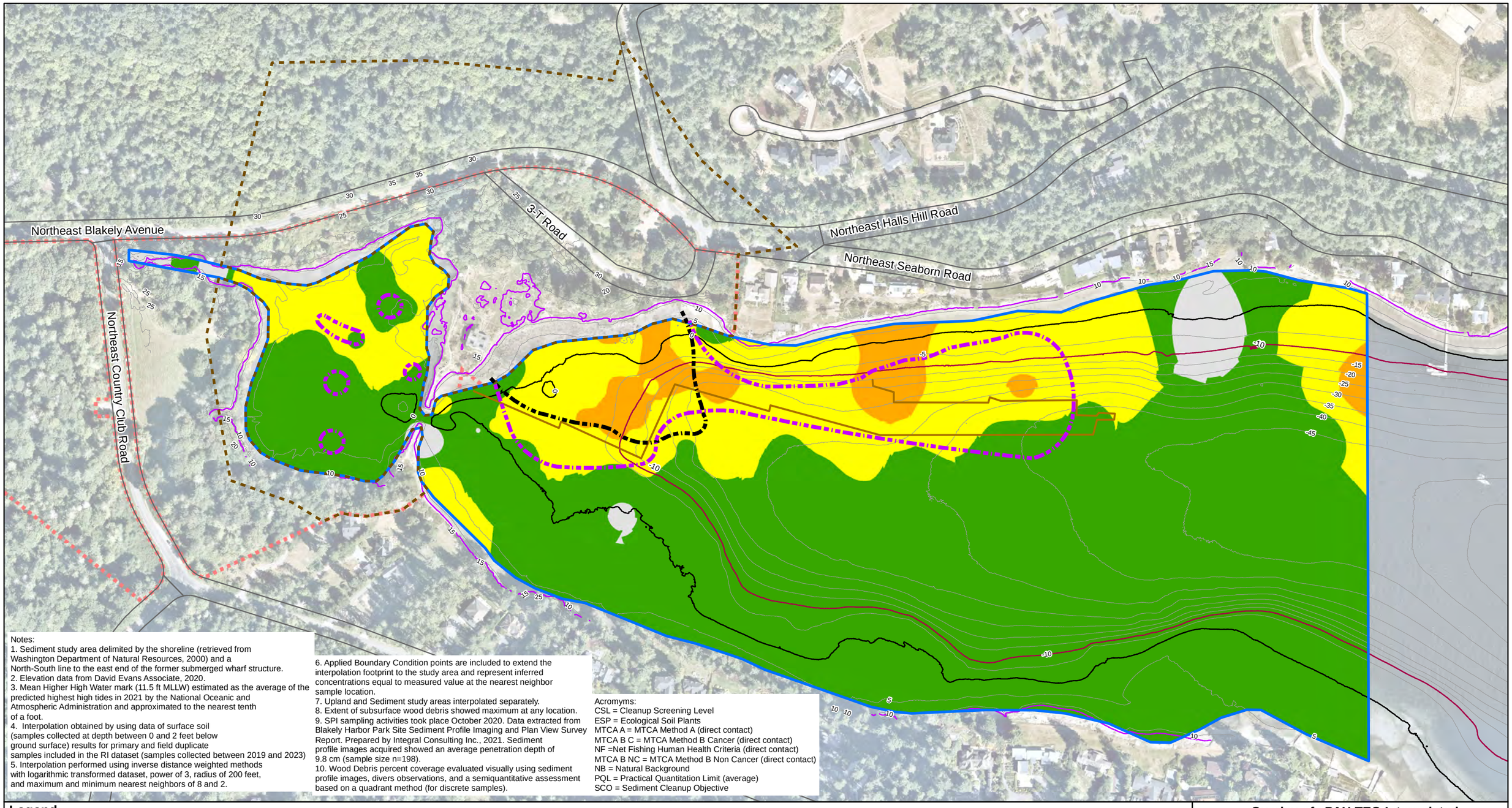
Overlay of TCDD TEQ Interpolated Concentrations in Soil Wood Debris Extent
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 7-7b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Figure 7-7b Interpolated HHRA TCDD Concentrations Surface Soil and WW.mxd 7/29/2024 10:35:22 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.
8. Extent of subsurface wood debris showed maximum at any location.
9. SPI sampling activities took place October 2020. Data extracted from Blakely Harbor Park Site Sediment Profile Imaging and Plan View Survey Report. Prepared by Integral Consulting Inc., 2021. Sediment profile images acquired showed an average penetration depth of 9.8 cm (sample size n=198).
10. Wood Debris percent coverage evaluated visually using sediment profile images, divers observations, and a semiquantitative assessment based on a quadrant method (for discrete samples).

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
NF =Net Fishing Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

cPAHs TEQ ND halfRL Concentration in Soil (mg/kg)
- <0.021 (NB)
- 0.021 to 0.15 (NF)
- >0.15 to 1.5 (10xNF)
- >1.5 to 15 (100xNF)
- >15

- Approximate Extend of Wood Debris
- Visible Wood Surface (2008)
- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour

- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

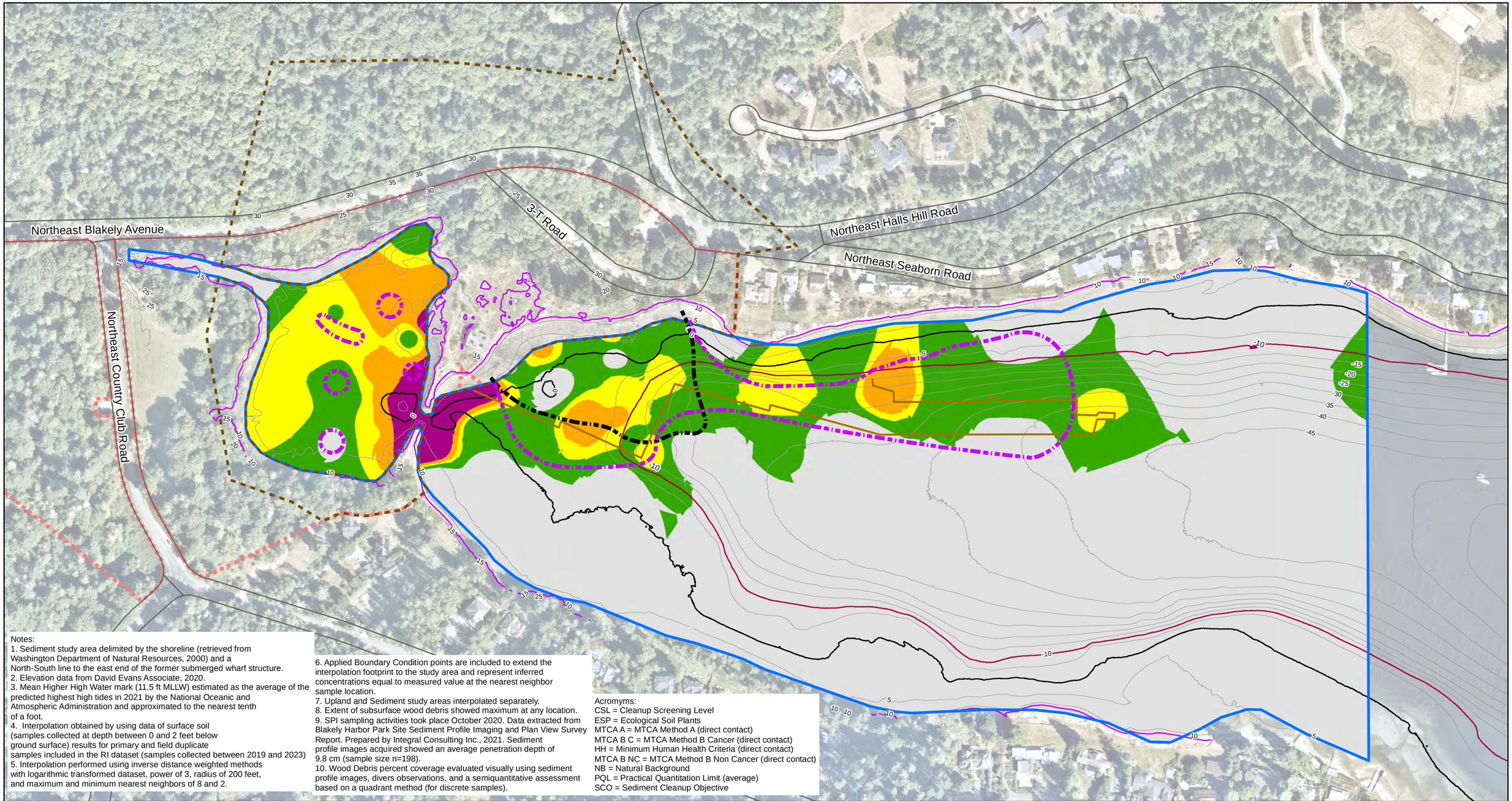
Overlay of cPAH TEQ Interpolated Concentrations in Sediment Wood Debris Extent
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

Figure 7-8a

MVI/Sea | July 2024

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Figure 7-8a Interpolated cPAH Concentrations Surface SedimentWW.mxd 7/29/2024 10:41:39 AM



Notes:
1. Sediment study area delimited by the shoreline (retrieved from Washington Department of Natural Resources, 2000) and a North-South line to the east end of the former submerged wharf structure.
2. Elevation data from David Evans Associate, 2020.
3. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
4. Interpolation obtained by using data of surface soil (samples collected at depth between 0 and 2 feet below ground surface) results for primary and field duplicate samples included in the RI dataset (samples collected between 2019 and 2023)
5. Interpolation performed using inverse distance weighted methods with logarithmic transformed dataset, power of 3, radius of 200 feet, and maximum and minimum nearest neighbors of 8 and 2.
6. Applied Boundary Condition points are included to extend the interpolation footprint to the study area and represent inferred concentrations equal to measured value at the nearest neighbor sample location.
7. Upland and Sediment study areas interpolated separately.
8. Extent of subsurface wood debris showed maximum at any location.
9. SPI sampling activities took place October 2020. Data extracted from Blakely Harbor Park Site Sediment Profile Imaging and Plan View Survey Report. Prepared by Integral Consulting Inc., 2021. Sediment profile images acquired showed an average penetration depth of 9.8 cm (sample size n=198).
10. Wood Debris percent coverage evaluated visually using sediment profile images, divers observations, and a semiquantitative assessment based on a quadrant method (for discrete samples).

Acromyms:
CSL = Cleanup Screening Level
ESP = Ecological Soil Plants
MTCA A = MTCA Method A (direct contact)
MTCA B C = MTCA Method B Cancer (direct contact)
HH = Minimum Human Health Criteria (direct contact)
MTCA B NC = MTCA Method B Non Cancer (direct contact)
NB = Natural Background
PQL = Practical Quantitation Limit (average)
SCO = Sediment Cleanup Objective

Legend

TCDD TEQ Concentration in Sediment (ng/kg)
- <4 (NB)
- >4 to 8 (2xNB)
- >8 to 12.1 (HH)
- >12.1 to 24 (2xHH)
- > 24

- Approximate Extend of Wood Debris
- Visible Wood Surface (2008)
- Historical Wharf Structure
- -10 ft MLLW Contour
- MHHW Contour
- 0 ft MLLW Contour
- 5 ft MLLW Contour
- Sediment Study Area
- Upland Study Area
- Bainbridge Island Parks (BI Parks) Parcel Boundary

N

0 300 Feet

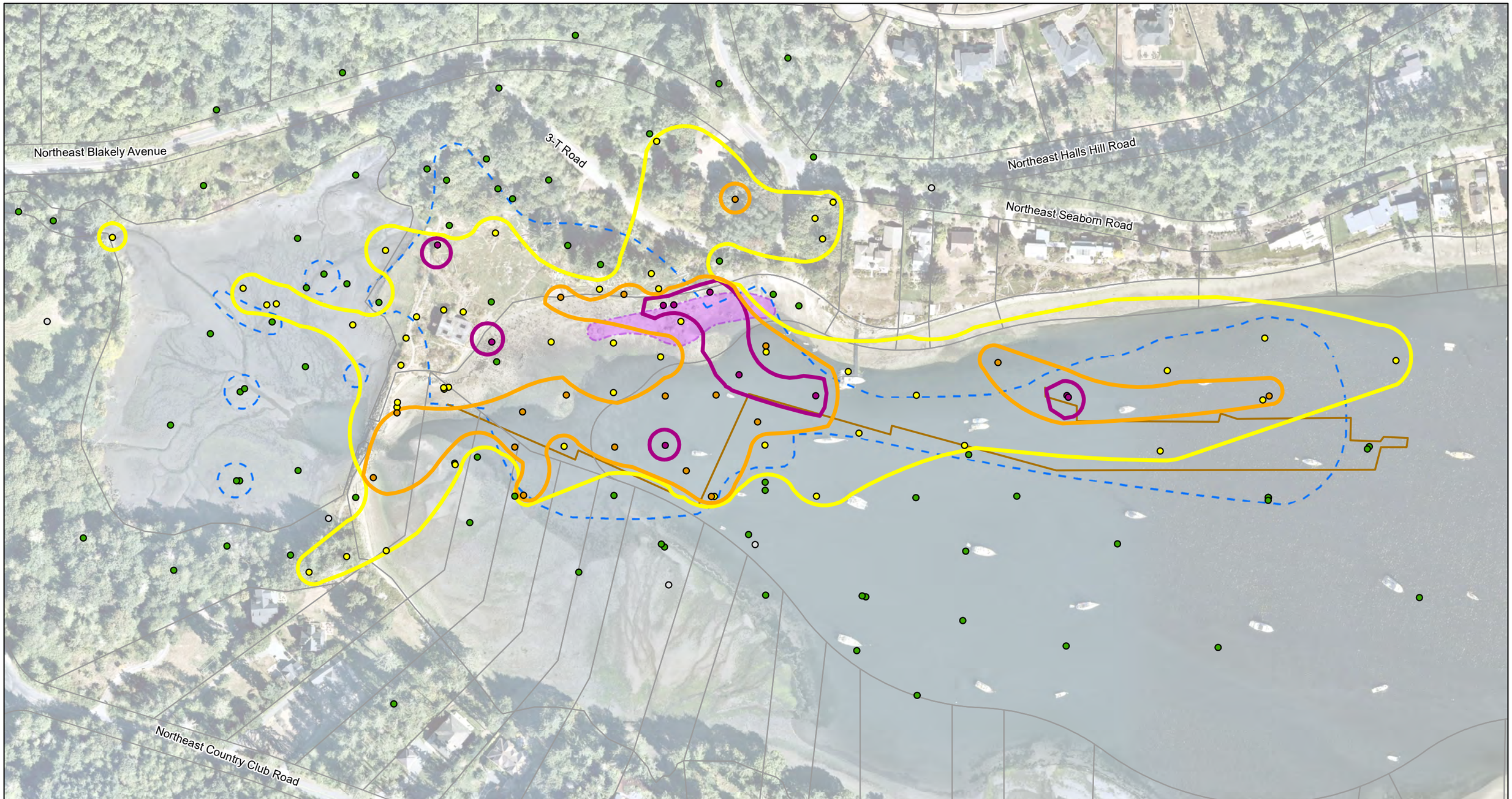
Overlay of TCDD TEQ Interpolated Concentrations in Sediment Wood Debris Extent
Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | July 2024

Figure 7-8b

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Figure 7-8b Interpolated TCDD TEQ Concentrations Surface Sediment and WW.mxd 7/29/2024 10:44:38 AM



Legend

Exceedance Factor

- ≤1
- >1 to 10
- >10 to 50
- >50 to 100
- >100

Exceedance Footprint

- Greater than 100x Exceedance Factor
- Greater than 50x Exceedance Factor
- Greater than 10x Exceedance Factor
- Parcel Boundary
- Approximate Extent of Large Slag Piles Surveyed During the 2021 Field Investigation
- Approximate Extent of Wood Debris >50%
- Historical Wharf Structure

Notes:
1. Elevation data from David Evans Associate, 2020.
2. Mean Higher High Water mark (11.5 ft MLLW) estimated as the average of the predicted highest high tides in 2021 by the National Oceanic and Atmospheric Administration and approximated to the nearest tenth of a foot.
3. Exceedance factors are the ratios of COC concentrations compared to their respective refined screening levels. The maximum exceedance factor for a sample location is presented.

MLLW = Mean Lower Low Water
MHHW = Mean Higher High Water

N

0 300 Feet

Overlay of Wood Debris and Slag with Exceedance Footprints

Remedial Investigation Report
Blakely Harbor Park Site
(Bainbridge Island, WA)

Geosyntec consultants

MVI/Sea | August 2024

Figure 7-9

P:\Projects\Blakely Harbor\PNG0900 (Pt Blakely)\900 GIS and CAD\MXDs\RI Report\Figure 9-1 Spatial Areas COCs Above Site Screening Levels.mxd 8/14/2024 12:21:39 PM