FINAL AS-BUILT REPORT
WHATCOM WATERWAY CLEANUP IN PHASE 1 SITE AREAS

Prepared for

Port of Bellingham

Prepared by

Anchor QEA, LLC

September 2018

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TABLE OF CONTENTS

EXECUTIVE SUMMARY ES-1

1 INTRODUCTION 1

1.1 Site Location and Vicinity 1

1.2 Overview of Site Cleanup Requirements 2

1.3 Purpose of Report 4

1.4 Report Organization 4

2 BACKGROUND AND OVERVIEW 5

2.1 Site Background 5

2.2 Required Cleanup Actions 8

2.3 Sediment Cleanup Levels 11

2.4 Design Basis 12

2.5 Changes Due to Conditions Encountered During Construction 12

3 COMPLETED CONSTRUCTION ACTIVITIES 15

3.1 Site Preparation and Environmental Controls 16

3.1.1 Soil and Debris Management 16

3.1.2 Water and Stormwater Management 18

3.1.3 Sediment and Entrained Water Management 19

3.1.4 Soil and Debris Transload Facility 20

3.1.5 Best Management Practices and Other Environmental Controls 20

3.2 Inner Waterway Construction 21

3.2.1 Debris and Structure Removal and Disposal 21

3.2.2 Source Control Measures 22

3.2.3 Dredging, Excavation, and Material Management 24

3.2.4 Engineered Capping 25

3.2.5 Structure Replacement 26

3.3 Outer Waterway Construction 27

3.3.1 Dredging and Material Management 27

3.3.2 RMC Placement 28

3.3.3 Engineered Capping 28

3.4 Log Pond Construction....29
3.4.1 Debris and Structure Removal and Disposal....29
3.4.2 Engineered Capping....30
4 ENVIRONMENTAL MONITORING....32
4.1 Protection Monitoring....32
4.1.1 Water Quality....32
Criteria 33
Methodology....33
Monitored Activities and Results....34
4.1.2 Air Quality....35
4.2 Sediment Monitoring....36
4.2.1 Inner Waterway Pre-Cap Samples....36
Methods....36
Results and Discussion....37
4.2.2 Unit 1C Post-Dredge Samples....37
Methods....37
Results and Discussion....38
4.2.3 Unit 1C Samples Following Residuals Management....39
Methods....39
Results and Discussion....40
4.3 Tissue Monitoring....40
4.3.1 Crab Tissue....41
Adult Crab....41
Juvenile Crab....42
4.3.2 Caged Clam Tissue....43
Methods....43
Results and Discussion....44
5 REFERENCES....46

List of Tables

Table 1 Crab Tissue Monitoring Data
Table 2 Mercury Concentrations in Adult Crab Tissue
Table 3 Mercury Concentrations in Juvenile Crab Tissue
Table 4 Co-Located Clam Tissue, Porewater, and Sediment Mercury Concentrations

List of Figures

Figure ES-1 Cleanup Elements in Phase 1
Figure ES-2 Project Results – Central Waterfront Shoreline
Figure ES-3 Project Results – South Shoreline
Figure ES-4 Project Results – Log Pond Area
Figure 1 Site Vicinity Map and Pre-Construction Conditions
Figure 2 Cleanup Elements in Phase 1
Figure 3 Staging and Stockpiling Areas
Figure 4 Project Results – Central Waterfront Shoreline
Figure 5 Project Results – Meridian Pacific Property
Figure 6 Project Results – South Shoreline
Figure 7 Project Results – South Shoreline Cutback
Figure 8 Inner Waterway Elevations Following Dredging
Figure 9 Inner Waterway Elevations Following Cap Placement
Figure 10 Outer Waterway Elevations Following Dredging
Figure 11 Outer Waterway Elevations Following Residuals Management and Cap Placement
Figure 12 Project Results – Log Pond Area
Figure 13 Log Pond Elevations Following Cap Placement
Figure 14 Sediment and Tissue Environmental Monitoring Stations Compliance
Figure 15 Mercury Concentrations in Adult Dungeness Crab Tissue
Figure 16 Mercury Concentrations in Juvenile Dungeness Crab Tissue
Figure 17 Mercury Concentrations in Clam Tissue and Porewater

List of Appendices

Appendix A	Permits and Approvals
Appendix B	Summary of Environmental Controls
Appendix C	Record Drawings
Appendix D	Geotechnical Monitoring Data and Observations
Appendix E	Water Quality Monitoring Data
Appendix F	Air Quality Monitoring Data
Appendix G	Environmental Monitoring Testing Data
Appendix H	Supplemental Coring Program for BST
Appendix I	Physical Testing Data
Appendix J	Disposal Documentation
Appendix K	Stormwater Measures Summary
Appendix L	Demobilization Documentation
Appendix M	Construction Photographs

LIST OF ACRONYMS AND ABBREVIATIONS

µg	microgram
ARI	Analytical Resources Inc.
ASB	aerated stabilization basin
BMP	best management practice
BST	Bellingham Shipping Terminal
CAP	Cleanup Action Plan
cm	centimeter
CMCRP	Compliance Monitoring and Contingency Response Plan
cy	cubic yard
D/F	dioxin/furan
DNR	Washington Department of Natural Resources
Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
FSEIS	Final Supplemental Environmental Impact Statement
GIS	geographic information system
GP West	Georgia-Pacific West, Inc.
kg	kilogram
L	liter
Lafarge	Lafarge Seattle Cement Plant
mg	milligram
mL	milliliter
MLLW	mean lower low water
MNR	monitored natural recovery
MTCA	Model Toxics Control Act
ng	nanogram
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity units
PAH	polycyclic aromatic hydrocarbon
PDCR	Preliminary Design Concept Report
PID	photo ionization detector
PLP	potentially liable party

Port	Port of Bellingham
PRDI	Pre-Remedial Design Investigation
Project	Whatcom Waterway Cleanup in Phase 1 Site Areas Project
PSEP	Puget Sound Estuary Program
QA	quality assurance
RCW	Revised Code of Washington
Report	Whatcom Waterway Cleanup in Phase 1 Site Areas As-Built Report
RI/FS	Remedial Investigation and Feasibility Study
RMC	residuals management cover
SEPA	State Environmental Policy Act
sf	square foot
Site	Whatcom Waterway Site
SMS	Sediment Management Standards
SQAPP	Sampling and Quality Assurance Project Plan for Compliance Monitoring
SQS	sediment quality standard
SSA	staging and stockpiling area
TEQ	2,3,7,8-toxicity equivalents
TOC	total organic carbon
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WM	Waste Management
WQMP	Water Quality Monitoring Plan

GLOSSARY

Whatcom Waterway Site (Site)	The overall Model Toxics Control Act (MTCA) cleanup site addressed by the Whatcom Waterway Consent Decree. This area includes both Whatcom Waterway and adjacent aquatic lands impacted by historic mercury discharges from the former Georgia-Pacific chlor-alkali plant wastewater discharges. The Site includes both Phase 1 and Phase 2 cleanup areas and additional areas being addressed by monitored natural recovery.
Whatcom Waterway	The physical waterway extending from Roeder Avenue to deep water. Whatcom Waterway includes both the Inner Waterway and Outer Waterway areas.
Inner Waterway	The inner portion of Whatcom Waterway, extending from Roeder Avenue to the beginning of the federal navigation channel at Waterway Station 29+00. The Inner Waterway includes Site Units 2 and 3 of the Whatcom Waterway Site.
Outer Waterway	The outer portion of Whatcom Waterway, extending from Station 29+00 into deep water. The Outer Waterway includes Site Units 1A, 1B, and 1C of the Whatcom Waterway Site. The federal navigation channel is located within the Outer Waterway.
Federal Navigation Channel	The federal navigation project as currently authorized in existing Water Resources Development Act legislation. The authorized project includes a 30-foot deep navigation channel extending from Station 29+00 of Whatcom Waterway into deep water. The Federal Navigation Channel is maintained by coordinated actions of the U.S. Army Corps of Engineers and the Port of Bellingham as the local sponsor.
Central Waterfront Site	The MTCA site located on certain properties between Whatcom Waterway and I&J Waterway. The Central Waterfront Site is undergoing a Remedial Investigation and Feasibility Study (RI/FS) investigation under a MTCA Agreed Order.

GP West Site	The MTCA site located on upland property on the south side of Whatcom Waterway. The Georgia-Pacific West, Inc. (GP West) Site is divided into two remedial action units (RAUs), the Pulp and Tissue Mill RAU and the Chlor-Alkali RAU. The RAUs are in different stages of the cleanup process under MTCA.
Log Pond	Site Unit 4 of the Whatcom Waterway Site. The Log Pond is located between Whatcom Waterway and the GP West Site. The Log Pond was capped in 2001 as part of an interim cleanup action. Additional capping was completed as part of the Whatcom Waterway Phase 1 cleanup work.
Chlor-Alkali Remedial Action Unit	The Chlor-Alkali Remedial Action Unit comprises the western portion of the GP West Site adjacent to the Log Pond and Cornwall Avenue.
Pulp and Tissue Mill Remedial Action Unit	The Pulp and Tissue Mill Remedial Action Unit comprises the eastern portion of the GP West Site adjacent to Whatcom Waterway and Roeder Avenue.
Whatcom Waterway Cleanup in Phase 1 Site Areas (Project)	The construction and monitoring activities completed to implement the final cleanup of Phase 1 Areas of the Whatcom Waterway Site.
Phase 1 Site Areas	Whatcom Waterway Site Units 2A, 3B, 4, and portions of Units 1C and 2C. Cleanup of these units has been completed.
Phase 2 Site Areas	Whatcom Waterway Site Units 1A, 1B, 2B, and 8, and portions of Units 1C, 2C, 5B, 6B, and 6C. These areas will be cleaned up as part of a future phase of construction, consistent with the requirements of the First Amendment to the Whatcom Waterway Consent Decree.
Monitored Natural Recovery Areas (MNR Areas)	Whatcom Waterway Site Units 3A, 5A, 5C, 6A, 7, and 9, and portions of Units 5B, 6B, and 6C. Clean sediment is naturally accumulating in these areas and they are subject to long-term compliance monitoring requirements.

Central Waterfront Shoreline	The length of shoreline located along the Central Waterfront Site from the aerated stabilization basin (wastewater treatment lagoon) to the former Meridian-Pacific property.
South Shoreline	The length of shoreline located along the GP West Site from the former GP West dock to the west end of the Central Avenue pier.

EXECUTIVE SUMMARY

This As-Built Report (Report) summarizes completed cleanup construction and associated monitoring activities for the Whatcom Waterway Cleanup in Phase 1 Site Areas Project (Project). The work was performed in accordance with the requirements of Consent Decree No. 07-2-02257-7 (Ecology 2007a) and the First Amendment to the Consent Decree (Ecology 2011) between the Washington State Department of Ecology (Ecology) and the Port of Bellingham (Port) and other cooperating potentially liable parties (PLPs).

Consistent with the First Amendment to the Consent Decree, the design and implementation of the cleanup of the Whatcom Waterway Site (Site) is being implemented in two phases, with two separate and independent construction projects, each addressing distinct areas of the Site. This Report describes construction activities and associated monitoring completed for the Phase 1 Site Areas.

The Project included cleanup construction within three areas of the Site, known as the Inner Waterway, the Log Pond, and the Bellingham Shipping Terminal (BST). The work performed in these areas is shown on Figure ES-1, and included the following activities:

- **Inner Waterway areas (Units 2A and 3B and portions of Units 3A, 2C, and 5C):** Dredging and capping was performed within portions of the Inner Waterway. This work included remediation of the portion of Whatcom Waterway that overlaps with the Central Waterfront Site along the northern shoreline of Whatcom Waterway (Figure ES-2). Cleanup in the Inner Waterway also included some structure demolition and removal, replacement or removal of bulkheads in steep shoreline areas along the northern shoreline, removal of the clarifier and associated bulkhead along the southern shoreline (Figure ES-3), and repair and replacement of some existing structures as necessary to accomplish the remediation.
- **Log Pond area (Unit 4):** A cap was placed within the Log Pond during 2000/2001 as part of an interim cleanup action, and contingency actions were required to repair the cap boundaries during the Project. Work within the Log Pond included shoreline capping as necessary to repair the shoreline edges of the cap (Figure ES-4). Cleanup within the Log Pond also included stabilization of the shoreline located adjacent to the BST and

some demolition of selected structures (e.g., timber piles) as necessary to complete the contingency actions.

- **Bellingham Shipping Terminal area (Portions of Units 1C, 2C, 5A, and 5B):** The BST is located within the Outer Waterway. Remediation activities included dredging and upland disposal of contaminated sediments from portions of Units 1C, 5A, and 5B and placement of an engineered cap in the transition area between Unit 1C and Unit 2C.

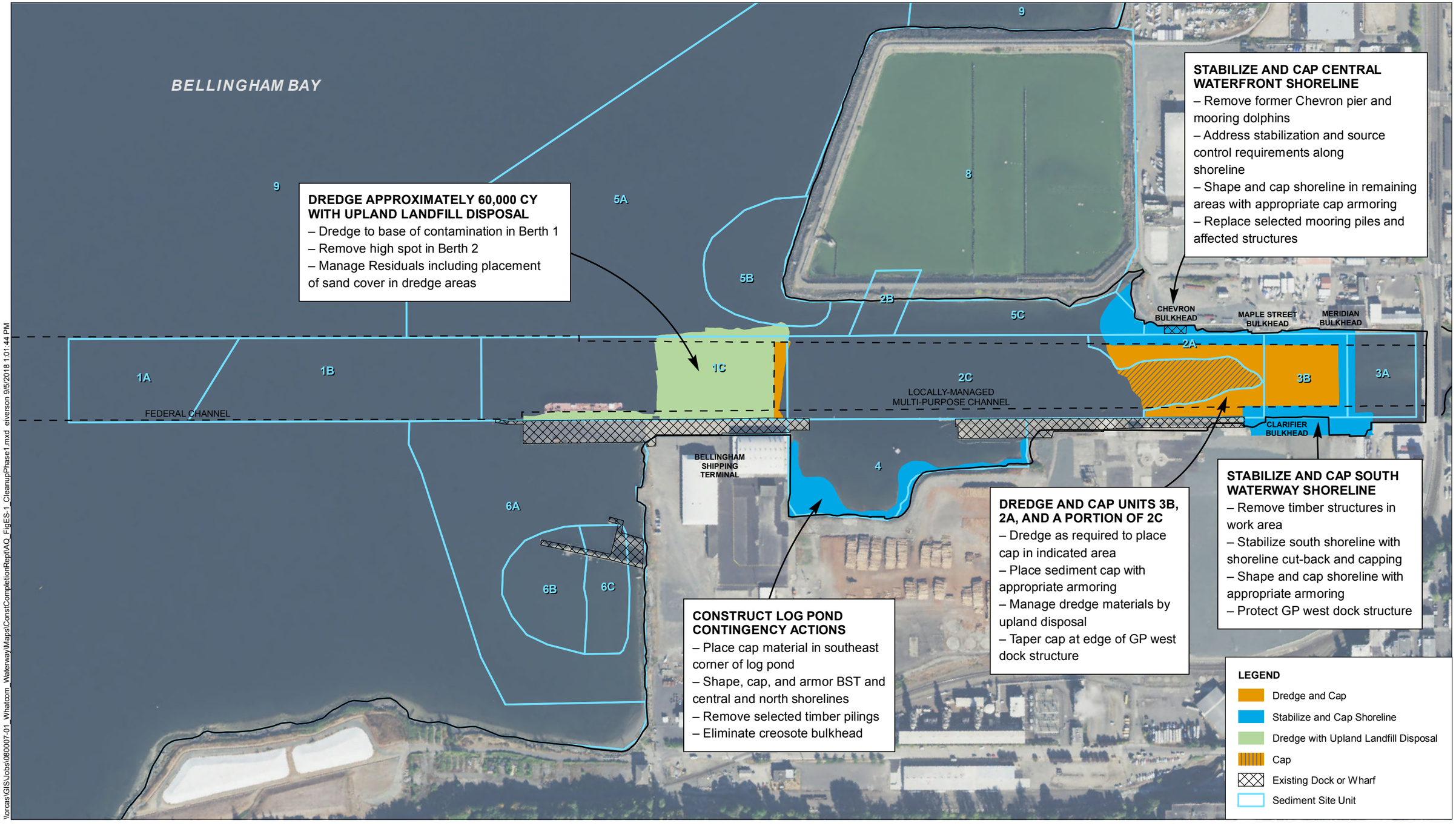
Overall, the Project included the following:

- Removal of former industrial structures including the former clarifier
- Removal or elimination of approximately 1,100 feet of treated timber bulkheads
- Removal of over 5,900 square feet (sf) of overwater docks, floats, and catwalks, and removal of dozens of treated timber pilings and dolphins
- Construction of 765 feet of containment wall along the Central Waterfront Site to address source control concerns associated with contaminated soils and groundwater
- Removal of approximately 5,035 tons of concrete debris from shoreline areas
- Removal and landfill disposal of 111,450 cy of contaminated sediments
- Excavation and landfill disposal of 9,900 tons (approximately 6,600 cy) of contaminated soils
- Reuse of over 2,150 tons (approximately 1,430 cy) of clean soil
- Placement of approximately 800,000 sf of engineered caps to safely contain remaining contaminated sediments
- Net improvements to intertidal and shallow-water habitat supporting salmonids and other aquatic species along more than half a mile of shoreline
- Replacement of marine infrastructure (dolphins, pilings, floats) that needed to be removed to accomplish the cleanup

Monitoring activities were performed during the Project, including protection monitoring and performance monitoring.

- Protection monitoring documented protection of human health and the environment from construction-related impacts. Monitoring principally included water and air quality, and showed that Contractor BMPs implemented during the work were protective of water quality and there were no air quality impacts during the Project.

- Performance monitoring included sediment and tissue testing, and documented that construction activities met Ecology requirements as defined in the EDR. Sediment was tested following dredging and placement of the residuals cover. This testing demonstrated that dredging and residuals management activities were effective at meeting Project requirements. Tissue testing was also performed to evaluate whether sediment disturbance during construction resulted in increases in mercury levels in the food chain. Results of that testing did not show any significant impacts to the food chain.



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NOTES:
1. Site units are shown based on those in Figure 2-3 Cleanup Action Plan, Whatcom Waterway Site, September 2007. Unit 9 boundary updated based on PRDI findings.
2. Unit 2B was established in the Cleanup Action Plan based on the anticipated marina access channel location. This location will be adjusted during final design.
3. Horizontal datum: Washington State Plane North, NAD 83 U.S. Survey Feet.
4. Aerial imagery from National Agriculture Imagery Program (NAIP), September 2, 2017.

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Figure ES-1
Cleanup Elements in Phase 1
As-built Report
Whatcom Waterway Cleanup in Phase 1 Site Areas

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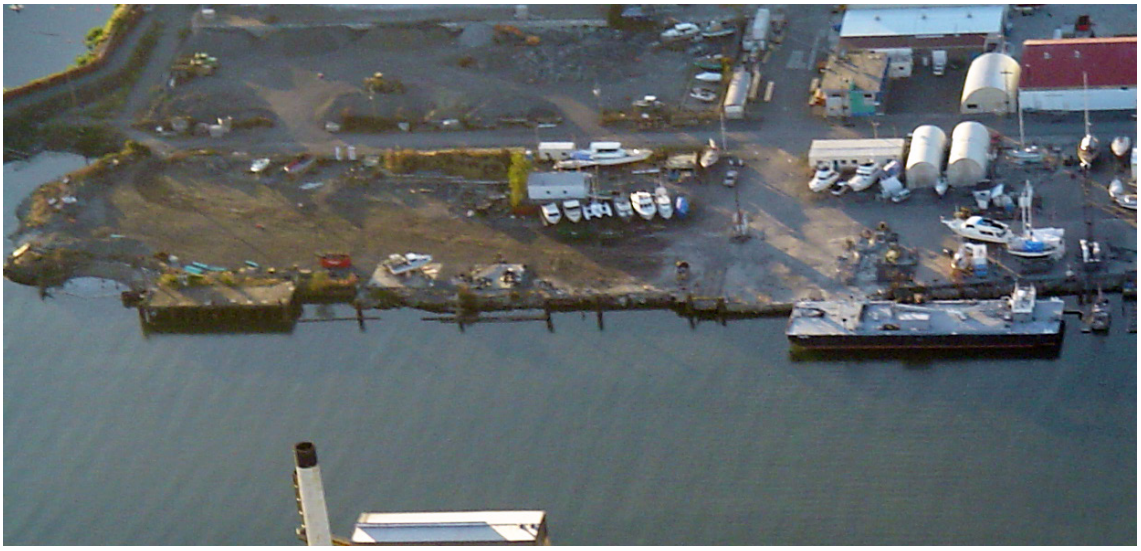
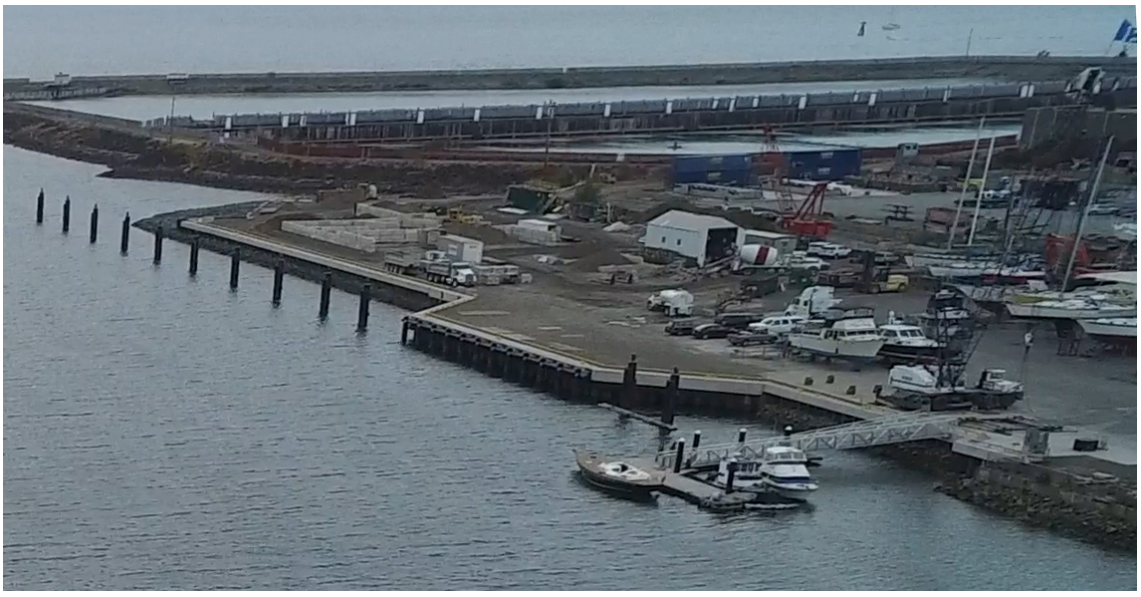


Before Construction: The Central Waterfront shoreline was characterized by unstable shoreline conditions, including extensive infill with concrete and rubble debris, failing concrete and creosote-treated timber bulkheads, and areas of eroding soils. The Chevron pier and dozens of other creosote-treated timber pilings and dolphins were present in shoreline areas. Soil and groundwater source control concerns posed risks for recontamination of sediments.



After Construction: Creosote-treated pilings, dolphins, and the former Chevron pier have been removed. Concrete and rubble debris has been removed, and the shoreline has been cut back to provide a stable sloping shoreline with improved aquatic habitat conditions. Soil and groundwater source control concerns have been addressed with the installation of over 700 feet of containment wall, most buried below grade. Pilings and dolphins required for continued operation of marine trades activities have been replaced with structures that serve the same function but are constructed of environmentally friendly materials.

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Figure ES-2
Project Results – Central Waterfront Shoreline
As-Built Report
Whatcom Waterway Cleanup in Phase 1 Site Areas

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Before Construction: The South Shoreline consisted of a vertical bulkhead and fill area occupied by the abandoned clarifier structure. Numerous creosote-treated timber dolphins and unused structures were present.

After Construction: Unused in-water structures were removed. The clarifier and associated creosote-treated timber bulkhead were removed. A shoreline cutback was performed to create a gently sloping, stable shoreline. The shoreline and subtidal areas were capped to safely contain residual impacted sediments.

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Figure ES-3
Project Results – South Shoreline
As-Built Report
Whatcom Waterway Cleanup in Phase 1 Site Areas

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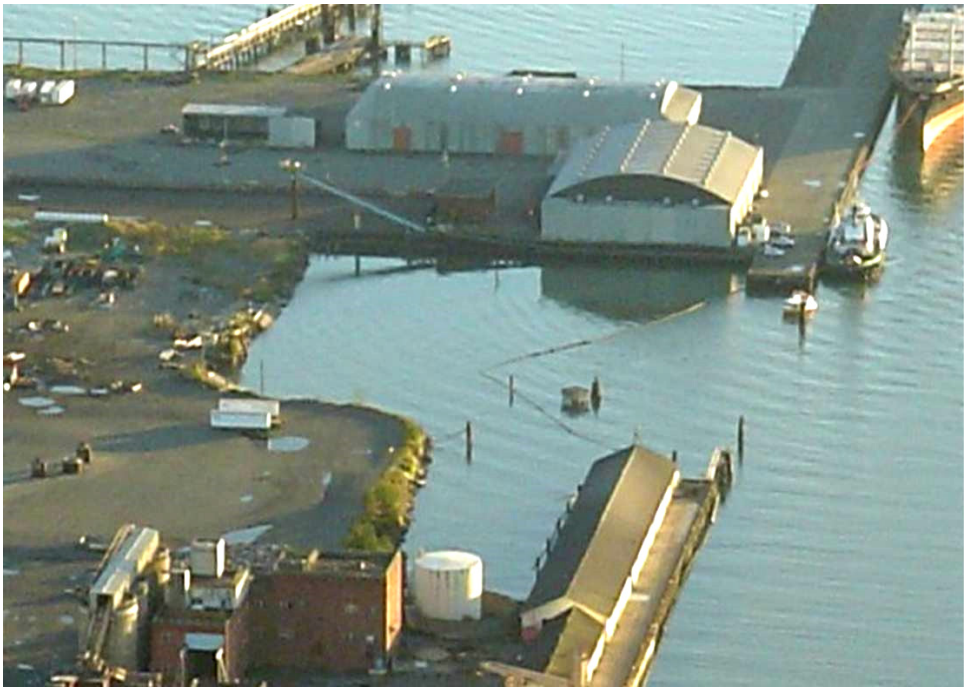
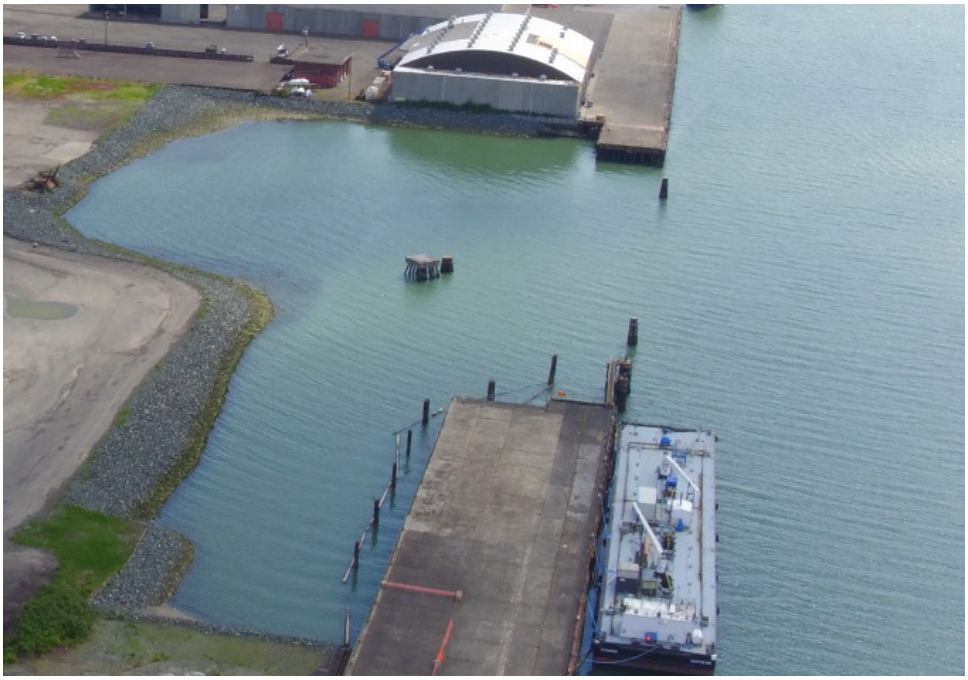


Before Construction: The Log Pond shoreline was unstable and eroding. Extensive concrete debris, numerous unused creosote-treated pilings, and timber structures were present. A creosote-treated bulkhead was present along the BST shoreline.



After Construction: Debris and unused treated wood structures were removed. The Log Pond shoreline was capped and stabilized against potential future erosion. The creosote-treated bulkhead present along the BST shoreline was eliminated.

1 INTRODUCTION

This As-Built Report (Report) summarizes completed construction activities and associated monitoring for the Whatcom Waterway Cleanup in Phase 1 Site Areas Project (Project). The work was performed in accordance with the requirements of Consent Decree No. 07-2-02257-7 (Ecology 2007a) and the First Amendment to the Consent Decree (Ecology 2011) between the Washington State Department of Ecology (Ecology) and the Port of Bellingham (Port) and other cooperating potentially liable parties (PLPs).

The Whatcom Waterway Site (Site) location and vicinity are shown in Figure 1. The Project was implemented in accordance with requirements of the Ecology-approved Engineering Design Report (EDR; Anchor QEA 2015) and applicable permits (Appendix A). An overview of the work performed during the Project is shown in Figure 2.

1.1 Site Location and Vicinity

Figure 1 presents the Site vicinity and location features prior to construction of the Project, including the overall Site boundary and the location of Site units within the Site. Figure 1 also shows the location of several other cleanup sites designated by Ecology and located in adjacent portions of Bellingham Bay. These adjacent sites include the Central Waterfront, I&J Waterway, Georgia-Pacific West, Inc. (GP West), Cornwall Avenue Landfill, South State Street Manufactured Gas Plant, and R.G. Haley. The cleanup action for the Site is being coordinated with these separate site cleanups.

The Site includes sediments that have been impacted by contaminants historically released from industrial waterfront activities, including mercury discharges from the former GP chlor-alkali plant. The chlor-alkali plant was located on the southern shoreline of the Site and operated between 1965 and 1999, when it was permanently closed. The chlor-alkali plant discharged mercury-containing wastewater into Whatcom Waterway, primarily during the late 1960s and 1970s.

The Site boundary shown in Figure 1 was determined based on the extent of surface and subsurface mercury contamination in sediments exceeding regulatory cleanup levels as determined during the Remedial Investigation and Feasibility Study (RI/FS) process and

during subsequent Pre-Remedial Design Investigations (PRDI) conducted during 2008 (Anchor QEA 2010).

Other Site-associated contaminants include wood waste and degradation products from historical log rafting activities and phenolic compounds from pulp mill wastewater discharges. Some contaminants (hydrocarbons and boatyard metals) associated with the Central Waterfront Site were co-located with subsurface contamination in shoreline areas along the northern portion of the Site. These contaminants were remediated as part of the Site cleanup action described in this Report. Section 2 of this Report provides additional detail regarding the nature and extent of contaminants located within the Site.

1.2 Overview of Site Cleanup Requirements

The Preliminary Design Concept Report (PDCR; Anchor QEA 2012) provides an overall summary of Site cleanup requirements as defined in the Consent Decree (Ecology 2007a) and the First Amendment to the Consent Decree (Ecology 2011). These actions include cleanup construction activities performed in Phase 1 Site Areas, separate work to be performed in Phase 2 Site Areas, and monitoring activities to be performed in other areas of the Site to be managed by monitored natural recovery (MNR).

The cleanup action for the Site was selected by Ecology after completion of an RI/FS, which began in 1996 and has included two supplements. It was finalized in 2006 with a Supplemental RI/FS Report (RETEC 2006) describing the nature and extent of contamination, presenting the conceptual site model, and assessing potential alternatives for cleanup of each portion of the Site. Technologies evaluated in the RI/FS included removal with upland disposal, treatment, reuse, containment (including capping, nearshore confined disposal, and confined aquatic disposal), enhanced natural recovery, MNR, and institutional controls. Potential environmental impacts associated with the cleanup alternatives were evaluated under the State Environmental Policy Act (SEPA). Ecology's SEPA impacts analysis was documented in a Final Supplemental Environmental Impact Statement (FSEIS) issued by Ecology (Ecology 2007b).

As described in the RI/FS, the cleanup action for the Site also includes implementation of contingency actions within the portion of the Site known as the Log Pond (Figure 1). In late 2000 and early 2001, GP, with Ecology oversight, implemented an interim action to clean up contaminated sediment in the Log Pond area. This interim action beneficially reused 43,000 cubic yards (cy) of clean dredged materials from the Swinomish navigation channel and Squalicum Waterway. The materials were used to cap contaminated sediment in the Log Pond area and to improve habitat substrate and elevations for use by aquatic organisms. Monitoring results confirmed that the majority of the cap met performance objectives; however, some erosion had occurred at the shoreline edges where the cap was the thinnest, exposing mercury-contaminated sediment. As part of the Project, contingency actions were implemented within the Log Pond to contain exposed contaminants and to correct and prevent cap erosion.

In 2007, Ecology developed a Cleanup Action Plan (CAP) for the Site. The CAP describes Ecology's selected cleanup action for the Site, consistent with Model Toxics Control Act (MTCA) and Sediment Management Standards (SMS) requirements. In 2007, after public notice and opportunity to comment, a Consent Decree (Ecology 2007a), including the CAP, was signed by the cooperating PLPs and Ecology and entered into the records of Whatcom County Superior Court.

In 2011, after public notice and opportunity to comment, the First Amendment to the Consent Decree (including amendments to the CAP and schedule) was signed by the cooperating PLPs and Ecology and entered into the records of Whatcom County Superior Court (Ecology 2011). The adjustments made to the original cleanup action affected certain areas of the Site as described in Section 2 of this Report.

Consistent with the requirements of the First Amendment to the Consent Decree, the design and implementation of the cleanup is being implemented in two cleanup phases, with two separate and independent construction projects, each addressing distinct areas of the Site. This Report documents the cleanup work conducted within the Phase 1 Site Areas (Figure 2). Information on the currently approved plan to address the Phase 2 Site Areas can be found in the PDCR (Anchor QEA 2012). The PDCR also describes the management of the areas of the Site for which the selected cleanup action was MNR. No cleanup construction activities are required for these MNR areas.

1.3 Purpose of Report

This Report describes the following work completed during the Project:

- Completed Construction Activities in Phase 1 Site Areas: This Report documents completed dredging and capping activities conducted in the Inner Waterway, the Log Pond, and the Bellingham Shipping Terminal. This Report also documents the removal and replacement of certain marine structures as required to implement the work.
- Completion of Coordinated Source Control Activities: The Project included construction of shoreline source control measures along the Whatcom Waterway shoreline adjacent to the Central Waterfront Site. These activities were required to address source control concerns related to contaminated soils and groundwater within the Central Waterfront Site.
- Completed protection and performance monitoring activities: Extensive monitoring was conducted to ensure protection of human health and the environment during construction activities. Monitoring was also performed to verify that cleanup objectives were met.

1.4 Report Organization

The information contained in this Report has been organized in the following manner:

- **Section 2 – Background and Overview:** Section 2 provides background regarding the cleanup decision and the requirements of the design.
- **Section 3 – Construction Activities:** Section 3 describes the completed construction activities, including site preparation and environmental controls, the remediation activities in the various areas of the Site, and implementation of coordinated source control measures and structure removal and replacements.
- **Section 4 – Environmental Monitoring:** Section 4 summarizes protection and performance monitoring activities that were conducted as part of the Project.
- **Section 5 – References:** Section 5 lists applicable references cited in this Report.

Numerous appendices are attached, containing supplemental information.

2 BACKGROUND AND OVERVIEW

This section provides additional information regarding the history of the Site and context for the Project. Also described in this section are the sources for information used in developing the engineering design, and the design criteria applied to the construction elements of the Project.

2.1 Site Background

As described in Section 1.1, the Site includes sediments that have been impacted by contaminants historically released from industrial waterfront activities, including mercury discharges from the former GP chlor-alkali plant, wood waste and degradation products from historic log rafting activities, and phenolic compounds from pulp mill wastewater discharges. There are multiple cleanup sites located adjacent to Whatcom Waterway as shown in Figure 1, and sediment contamination from those other sites is co-located with subsurface contamination in portions of the Site. Cleanup of the Site is being coordinated with these separate actions, which are also overseen by Ecology.

The chlor-alkali plant discharged mercury-containing wastewater into Whatcom Waterway primarily during the late 1960s and 1970s. Initial environmental investigations of the Site during the 1980s and 1990s identified mercury in sediment at concentrations that exceed applicable standards, as well other contaminants from industrial releases.

The RI/FS process for the Site began in 1996 and included two supplements to reflect updated land use within portions of the Site. The most recent 2006 Supplemental RI/FS Report (RETEC 2006) described the nature and extent of contamination, presented the conceptual site model, and assessed potential alternatives for cleanup of each portion of the Site. In the RI/FS, the different portions of the Site were divided into sediment Site units as shown in Figure 1. These units were developed based on differences in the following parameters:

- Physical factors, including bathymetry, sediment particle size and texture, wood material distribution, wind and wave energies, and the characteristics of adjacent shorelines

- Land use and navigation, including upland zoning, shoreline infrastructure, navigation uses, natural resources, ongoing waterfront revitalization activities, and potential interrelationships between cleanup considerations and these factors
- Natural resources, including the types of existing aquatic habitats within the unit
- Contaminant distribution, including patterns of surface and subsurface contamination and relative contaminant concentrations

Site cleanup technologies evaluated include removal with upland disposal, treatment, reuse, containment (including capping, nearshore confined disposal, and confined aquatic disposal), enhanced natural recovery, MNR, and institutional controls. Potential environmental impacts associated with the cleanup action were evaluated under SEPA. Ecology's SEPA impacts analysis was documented in an FSEIS issued by Ecology (Ecology 2007b).

Ecology subsequently developed a CAP for the Site. The CAP describes Ecology's selected cleanup action for the Site, consistent with MTCA and SMS requirements. The CAP included the following information:

- Summary of the Site background and environmental conditions
- Cleanup requirements applicable to the Site, including cleanup standards and other federal, state, and local laws applicable to the cleanup action
- Summary description of the remedial alternatives evaluated in the RI/FS
- Rationale for selection of the proposed cleanup alternative
- A description of the cleanup action selected by Ecology, including a description of the types, levels, and amounts of hazardous substances that were to remain on Site as part of the cleanup and the measures to be used to prevent migration and contact with those substances
- A description of compliance monitoring, contingency action requirements, and institutional controls

In 2007, after public notice and opportunity to comment, a Consent Decree (including the CAP) was signed by the cooperating PLPs and Ecology, and entered into the records of Whatcom County Superior Court.

Under the terms of the Consent Decree, the Port and the other cooperating PLPs developed a PRDI Work Plan (Anchor QEA 2008) for Ecology review, which focused on filling pre-design data gaps to allow remedial design and permitting activities to move forward. Following Ecology approval of the Work Plan in June 2008, investigation activities commenced in July 2008 and were completed in May 2009. Extensive testing activities completed as part of the PRDI included the following:

- Updated surveys of Site physical conditions using bathymetric and side-scan sonar surveys and sediment probing within the aerated stabilization basin (ASB)
- Oceanographic data collection documenting current and wave behavior within Bellingham Bay
- Surface sediment testing, including both chemical and biological (i.e., bioassay) testing
- Specialized testing of sediments, including porewater and mercury speciation in surface sediments, and contaminant leachability measurements in planned dredging areas
- Testing of subsurface sediment quality using samples collected by vibracore, hollow-stem auger, and diver-deployed core methods
- Collection of geotechnical data for use in engineering design of the cleanup action
- Surveys of current habitat characteristics, including surveys of eelgrass occurrence within the proposed construction areas

Most PRDI findings were consistent with previous expectations or represented an improvement in Site environmental conditions. Information developed during the PRDI documented that surface sediment quality continued to recover naturally within most areas of the Site. No contamination exceeding Site cleanup levels was detected in planned MNR areas and no exceedances of cleanup levels were noted in surface sediments within Units 6B or 6C, which had been identified for capping. The lateral extent of surface sediment contamination within Unit 5B was determined to be smaller than previously estimated. Within Unit 8 (ASB), the thickness of the contaminated sludge was verified, and this sludge was determined to overlay a thick sequence of clean native sandy sediments. Also, with the exception of the transition sands immediately beneath the ASB sludges, no contamination was identified in the sandy materials used to construct the interior of the ASB berm or in the sediments beneath the berm.

In one area, the PRDI findings provided new information that required a substantial change to the planned cleanup as defined in the original CAP (Ecology 2007a). Specifically, updated information indicated that levels of dioxins/furans (D/Fs) in buried sediments offshore of the shipping terminal (within Units 1A and 1B) would render these sediments unlikely to meet Dredged Material Management Program guidelines for unconfined open-water disposal, as planned in the original CAP. Concentrations of D/Fs in these materials (expressed using the 2,3,7,8-toxicity equivalents [TEQ] method) ranged from 26 to 39.8 nanograms (ng) TEQ/kilogram (kg), with an average concentration of 33 ng TEQ/kg.

The primary effect of the D/F testing data was that a different disposal option was needed for the Units 1A/1B materials slated for unconfined open-water disposal in the original CAP. As described below, Ecology developed the First Amendment to the Consent Decree (Ecology 2011), including changes to the cleanup action to provide a different management method for these sediments. This also presented an opportunity to manage a portion of the sediments from Units 1C and 5B differently.

In 2011, after public notice and opportunity to comment, the First Amendment to the Consent Decree (including amendments to the CAP and schedule) was signed by the cooperating PLPs and Ecology and entered into the records of Whatcom County Superior Court. The adjustments made to the original cleanup action affected specific areas of the Site.

2.2 Required Cleanup Actions

Consistent with the First Amendment to the Consent Decree, the design and implementation of the cleanup of the Site is being implemented in two cleanup phases, with two separate and independent construction projects, each addressing distinct areas of the Site. This Report describes construction activities and associated monitoring completed for the Phase 1 Site Areas. Monitoring activities were conducted in accordance with the Compliance Monitoring and Contingency Response Plan (CMCRP) and Water Quality Monitoring Plan (WQMP) contained in the EDR (Anchor QEA 2015), and the Sampling and Quality Assurance Project Plan for Compliance Monitoring (SQAPP; Anchor QEA 2016) associated with the CMCRP.

The Project employed three primary remedial action technologies, including remedial dredging, engineered capping, and installation of containment wall structures to address shoreline source control requirements. Remedial dredging included the controlled removal of contaminated sediments from the aquatic environment using mechanical dredging methods. Engineered capping is the controlled placement of clean material to isolate contaminated sediment from the aquatic environment. An engineered cap protects the environment by providing the following functions:

- Physical isolation of the contaminated material from the benthic environment
- Physical containment of the underlying contaminated material, preventing resuspension and transport
- Reduction of the flux of dissolved contaminants into the engineered cap and overlying water column

Several cap types were used during the Project to address specific conditions in different areas of the Site:

- Three-layer engineered caps consisting of sand, gravel filter, and rock armor layers were used to isolate contaminated sediments and provide erosion protection from wind waves and propeller wash (propwash forces). This engineered cap design was primarily employed along shorelines and in nearshore areas.
- Two-layer caps consisting of sand and gravel armor were used to isolate contamination and provide erosion protection from primarily propwash forces. This engineered cap design is primarily used in open-water areas where water depths result in lower propwash velocities and wind wave forces.
- Two-layer caps consisting of gravel filter and rock armor were used for erosion protection along the Log Pond shoreline areas that are experiencing ongoing erosion but where no chemical recontamination has occurred.

Containment wall structures were installed along the shoreline of the Central Waterfront Site as required to address the following upland source control considerations:

- Preventing uncontrolled slope movement during nearshore dredging and engineered capping operations
- Containing contaminated soils in nearshore areas

- Minimizing potential cap recontamination from migration of contaminated groundwater from the adjacent upland cleanup areas

The Project included cleanup actions in the Inner Waterway area, the Log Pond, and the Bellingham Shipping Terminal (BST) area. The work performed in these areas is shown on Figure 2, and summarized below:

- **Inner Waterway areas (Units 2A and 3B and portions of Units 3A, 2C, and 5C):** Dredging and capping was performed within portions of the Inner Waterway. This work included remediation of the portion of Whatcom Waterway that overlaps with the Central Waterfront Site (along the northern shoreline of Whatcom Waterway). Cleanup in the Inner Waterway also included some structure demolition and removal, replacement or removal of bulkheads in steep shoreline areas along the northern shoreline, removal of the clarifier and associated bulkhead along the southern shoreline, and repair and replacement of some existing structures as necessary to accomplish the remediation.
- **Log Pond area (Unit 4):** A cap was placed within the Log Pond during 2000/2001 as part of an Interim Remedial Action and contingency actions were required to repair the cap boundaries during the Project. Work within the Log Pond included shoreline capping as necessary to repair these shoreline edges of the cap. Cleanup within the Log Pond also included stabilization of the shoreline located adjacent to the BST and some demolition of selected structures (e.g., timber piles) as necessary to complete the contingency actions.
- **Bellingham Shipping Terminal area (Portions of Units 1C, 2C, 5A, and 5B):** The BST is located within the Outer Waterway. Remediation activities included dredging and upland disposal of contaminated sediments from portions of Units 1C, 5A, and 5B and placement of an engineered cap in the transition area between Unit 1C and Unit 2C.

Monitoring activities were performed during the Project, including protection monitoring and performance monitoring. Protection monitoring included water quality monitoring and air quality monitoring. Performance monitoring including collection of sediment, tissue, and porewater monitoring data to document that cleanup objectives were met for the Phase 1 Site Areas.

2.3 Sediment Cleanup Levels

Sediment cleanup levels and points of compliance were defined in the CAP and Consent Decree (Ecology 2007a) for the Site. These criteria remained unchanged in the First Amendment to the Consent Decree (Ecology 2011). Site cleanup levels and points of compliance include the following:

- **Sediment quality standard (SQS) for Site-associated contaminants:** The CAP defined sediment cleanup levels for Site-associated contaminants, including mercury and phenolic compounds. For these compounds, the cleanup levels for benthic protection were established at the SQS. Compliance with the benthic SQS is to be determined using a combination of chemical testing and contingent bioassay testing. Samples that exceed the chemical SQS but pass bioassay testing are considered to comply with the benthic SQS, consistent with Washington's SMS regulations.
- **Bioaccumulation screening level for mercury:** An additional requirement for mercury was established in the CAP and Consent Decree, to ensure that the cleanup protects against potential bioaccumulation of mercury and methylmercury compounds. This screening level is 1.2 milligrams (mg) total mercury per kg dry weight. This value was developed using area-weighted averaging but is to be applied throughout surface sediments at the Site.
- **Sediment points of compliance:** Compliance with the sediment cleanup levels is measured based on the thickness of the sediment biologically active zone. In Bellingham Bay, this thickness is the upper 12 centimeters (cm) of the sediment bed. In addition, while cleanup levels do not directly apply to sediment below 12 cm, the SMS require that the potential risks of the current or future exposure of deeper sediments be considered and minimized through the implementation of the cleanup action.

D/Fs are known to be present in surface and subsurface sediments throughout most of Bellingham Bay and other urban bays within Puget Sound. The full range of sources for these compounds in Bellingham Bay has not yet been determined but may include contributions from many sources throughout the bay, including former combustion sources, former GP pulp and paper mill operations, former wood-treating facilities, historic and ongoing stormwater and wastewater discharges, and atmospheric deposition.

Since execution of the First Amendment to the Consent Decree, Ecology conducted work to determine if regional background concentrations of certain bioaccumulative chemicals existed in Bellingham Bay (Ecology 2015). That work identified a regional background D/F concentration of 15 ng TEQ/kg.

2.4 Design Basis

The design basis for the remedial dredging, engineered capping, and installation of containment wall structures at the Site is presented in the EDR (Anchor QEA 2015). Dredge prisms were designed based on the nature and extent of contamination in each area and on the target sediment removal elevations. In areas identified for placement of caps, these target removal elevations considered the proposed final capping design. Secondary considerations in dredge prism designs included geotechnical properties of the sediment, locations, and characteristics of adjacent structures, and the typical precision and accuracy of dredging equipment that was anticipated to be utilized to implement the work. The thicknesses of the engineered caps were based on parameters that include evaluation of contaminant mobility, bioturbation, erosion protection, future maintenance, construction tolerances, and geotechnical considerations. The shoreline stabilization and source control measures taken along the Central Waterfront Shoreline considered the presence of petroleum and associated contaminants in area soils and groundwater.

2.5 Changes Due to Conditions Encountered During Construction

Construction activities were implemented in accordance with the cleanup design detailed in the EDR (Anchor QEA 2015) and required permits and approvals for the Project. Minor adjustments were performed where required to complete project objectives and respond to conditions encountered during construction. These adjustments included the following:

- Minor Adjustments to Containment Wall Alignment: Sheetpile containment walls were constructed to contain contaminated soils and groundwater along the shoreline of the Central Waterfront Site. Minor adjustments to the wall alignments were required to address subsurface obstructions that were encountered during installation of the containment wall.

- **Limited Revisions to Dredge Prisms:**
  - Increases in Inner Waterway Dredging: The limits of dredging activities within the Inner Waterway were increased slightly to address areas of recent sediment deposition as documented during pre-construction surveys. Final dredging limits were well within permit tolerances.
  - Reductions in Outer Waterway Dredging: During completion of dredging within the Outer Waterway, clean native material was encountered at shallower elevations than had been anticipated in the EDR. After completion of a supplemental coring study to document these conditions, Ecology approved adjustment of the dredge elevations for the northwest quadrant of Unit 1C dredging prism. This change slightly reduced the dredging volumes in this area.
- **Limited Adjustments to Cap Extents:**
  - Adjustments to Log Pond Shoreline Capping Profile: During capping of the Log Pond shoreline, minor adjustments were performed to the capping profile in order to ensure that the cap addressed all areas to the top of slope. Design optimization included limited shoreline cutbacks at the top of slope and minor adjustments of the final toe of slope.
  - Adjustments to Capping Area at the C Street Cutback: During capping in the C Street area of the Central Waterfront Site, additional concrete and other debris were encountered in top-of-slope areas. This material was removed, and the cap was extended further upland as necessary to provide protection to the new top of slope.
- **Replacement of Damaged Structures:**
  - Damaged Concrete Slab Replacement: A concrete slab located at the eastern end of the Central Waterfront Site was damaged by construction equipment during completion of shoreline debris removal and installation of shoreline containment walls. This damaged concrete slab was replaced.
  - Colony Wharf Float Replacement: During implementation of the Project, it was determined that a replacement float system would be required to support continued operations of the Landings and Colony Wharf. Permits for replacement

floats were obtained from the U.S. Army Corps of Engineers (USACE), and the replacement floats were installed during the Project.

Record Drawings for all completed construction activities are contained in Appendix C, including the above-described adjustments for field conditions.

3 COMPLETED CONSTRUCTION ACTIVITIES

This section provides a summary of construction activities completed during the Project. Prior to initiation of construction, site controls were established to manage safety and environmental risks of construction. Construction activities were then implemented in each of three Site areas: the Inner Waterway, the Outer Waterway and the Log Pond.

Overall, the Project included the following:

- Removal of former above-ground industrial structures including the former clarifier and select subsurface industrial structures
- Removal or elimination of approximately 1,100 feet of treated timber bulkheads
- Removal of over 5,900 square feet (sf) of overwater docks, floats, and catwalks, and removal of dozens of treated timber pilings and dolphins
- Construction of 765 feet of containment wall along the Central Waterfront Site to address source control concerns associated with contaminated soils and groundwater
- Removal of approximately 5,035 tons of concrete debris from shoreline areas
- Removal and landfill disposal of 111,450 cy of contaminated sediments
  - Removal and disposal of 103,700 cy of contaminated sediments from state-owned aquatic lands
  - Removal and disposal of 7,750 cy of contaminated sediments from areas other than state-owned aquatic lands
- Excavation and landfill disposal of 9,900 tons (approximately 6,600 cy) of contaminated soils
- Reuse of over 2,150 tons (approximately 1,430 cy) of clean soil
- Placement of approximately 800,000 sf of engineered caps and RMC material to safely contain remaining contaminated sediments and to manage dredging residuals
  - Placement of 610,000 sf of engineered caps and RMC material in state-owned aquatic lands
  - Placement of 190,000 sf of engineered caps in areas other than state-owned aquatic lands
- Net improvements to intertidal and shallow-water habitat supporting salmonids and other aquatic species along more than half a mile of shoreline

- Replacement of marine infrastructure (dolphins, pilings, floats) that needed to be removed to accomplish the cleanup

Construction drawings are attached as Appendix C, and photographs taken during construction activities are attached as Appendix M.

3.1 Site Preparation and Environmental Controls

Site preparation for construction included establishing a series of environmental controls to provide for proper management of materials generated during the Project. These included the development of material management areas, water management facilities, and the implementation of activity-specific best management practices (BMPs). These activities were completed in accordance with environmental permits and use authorizations for the Project (see Appendices A and B).

3.1.1 Soil and Debris Management

Five temporary staging and stockpiling areas (SSAs) were constructed as part of the Project, as shown in Figure 3. Four SSAs were established on the GP West Site and one was established on the Central Waterfront Site:

- The **GP West Site SSA** was the primary temporary stockpile area for impacted soil, treated timber, and debris generated during shoreline excavation work; other temporary stockpile areas were developed for concrete, metals, untreated wood, and other debris. Dissimilar materials were segregated into and managed in discreet stockpiles. Soil and treated timber stockpile areas were constructed on top of existing asphalt pavement, were contained by an asphalt sealed concrete block perimeter wall, and included temporary storm drainage modifications to contain contact stormwater and soil dewatering.
- The **South Shoreline SSA** was a secondary area for temporary stockpiling for concrete and metal debris generated during the work along the South Shoreline. The SSA was constructed on top of existing concrete foundations with individual cell designations to segregate different types of material.
- The **Cap Material Barge Loading SSA** was an extension of the GP West Site SSA, and was used for the temporary stockpiling of clean imported engineered cap materials in

support of the in-water engineered cap construction. The stockpiles were established on top of existing asphalt pavement areas, and the cap materials included sands, cobbles, and armor rock. A temporary conveyor system assembled on the former GP Dock was used to load the clean imported cap materials onto barges for the in-water cap construction work.

- The **Log Pond Area SSA** was also an extension of the GP West Site SSA and was used for the temporary stockpiling of clean imported engineered cap materials in support of the engineered cap construction work in the Log Pond Area. The stockpiles were established on top of existing asphalt pavement areas, and the cap materials included sands, cobbles, and armor rock.
- The **Central Waterfront Site SSA** was used mostly for staging equipment and materials such as coated steel sheetpiling, concrete formwork supplies, and limited staging of imported clean soils and gravels for work upland of the containment wall.

Upon completion of the work, all five of the SSAs were cleared out, cleaned, decontaminated, and decommissioned where necessary (e.g., the soil and treated timber stockpile area). Follow-up inspections were completed to verify areas were returned to their pre-construction condition (see Appendices L and M).

The Contract and the Contractor-developed work plans included procedures to track generated materials, allow for the reuse of generated soils, and dispose of generated soils and debris. Soil suitability depended upon field observations, soil sampling, chemical analysis, and material testing if necessary. Soil and debris management procedures included the following:

- **Material Tracking:**
  - Weight scaling was used throughout the Project to track soil and debris into the SSAs and prior to transport of the soil and debris for final disposition (e.g., recycling or landfill disposal).
  - Landfill permits were reviewed prior to disposal of sediment, soil, or debris; see Appendix A. Certificates of disposal were provided by the landfills for all disposed material (see Appendix J).

- Soil and Debris Disposal Procedures:
  - Soil was pre-characterized for Subtitle D landfill disposal; waste profiles for soil and debris were developed by the Contractor.
  - Soil determined to be unsuitable for reuse was loaded into truck and trailer combinations, scale-weighed prior to departure, and hauled to an approved disposal facility.
- Soil Re-use Procedures:
  - Soil that appeared to be geotechnically suitable for reuse was temporarily stockpiled, then sampled and analyzed to verify whether or not it was chemically suitable for upland reuse consistent with the requirements of the EDR.
- Concrete Re-use Procedures:
  - Concrete debris was size-reduced, metals and other non-concrete materials were separated, and the size-reduced concrete was added to existing concrete stockpiles for future use by the Port on other projects.

3.1.2 Water and Stormwater Management

Water and stormwater management practices are described in detail in Appendix K. Water management facilities included the following:

- Use of existing conveyance and treatment facilities for non-contact stormwater and for water from temporary pre-treatment systems
- Temporary water pre-treatment system for excavation dewatering, contact stormwater and soil dewatering from SSAs, and other water-generating work on the GP West Site
- Temporary water pre-treatment system for excavation dewatering and stormwater from the Central Waterfront Site
- Dredged sediment dewatering systems on barges during dredging operations

Project stormwater was managed by the Contractor under a Construction Stormwater General Permit (WAR302834). In addition, the Port obtained Ecology approval to manage contact stormwater, construction dewatering, and other construction-generated water using

existing conveyance and treatment facilities under their National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit (WA0001091).

To manage contact stormwater and dewatering waters from the GP West Site, South Shoreline, Cap Material Barge Loading, and Log Pond Area SSAs, a temporary water pre-treatment system was constructed on the GP West Site (see Section 3.1.1). The system consisted of a weir tank capable of oil/water separation, oil absorbent booms deployed in the weir tank, and a temporary, above-ground pipeline to convey water to the Port's existing NPDES-permitted treatment facility. Oil absorbent materials were added to stockpiles of impacted soils and debris that were disposed of in approved Subtitle D landfills.

A separate temporary water pre-treatment system was constructed on the Central Waterfront Site to manage contact stormwater from the Central Waterfront Site SSA and excavation dewatering waters from shoreline excavation work. The system consisted of a settling tank, an oil/water separator tank, and a surge tank; temporary above-ground piping conveyed pre-treated water to the Port's existing NPDES-permitted treatment facility. Oil removed from water managed by the pre-treatment system was disposed of by a third-party contractor, Marine Vacuum Services, Inc.[1]

With the exception of the dredged sediment dewatering systems, all waters managed during the Project were conveyed to the Port's existing NPDES-permitted treatment facility. No discharges to Bellingham Bay from the NPDES-permitted treatment facility occurred during the Project.

3.1.3 Sediment and Entrained Water Management

Water quality associated with dredging and in-water construction was managed in accordance with permits and approvals for the Project (see Appendix A). This included implementing marine water quality monitoring (see Section 4.1.1), implementing operational and structural BMPs to minimize dredging-related impacts, and using a permitted sediment transloading facility equipped to manage contaminated sediment and entrained waters.

[1] Among other services, Marine Vacuum Services conducts oil recycling services under the alternate fuels program (website: http://marinevacuum.com/Washington-Oil-Processing-Recycling-Companies-Services.php).

The Lafarge Seattle Cement Plant (Lafarge) was used to transload contaminated sediment from barges into sealed railcars for disposal at the Waste Management (WM) Columbia Ridge Landfill. Waters generated from sediment dewatering at the Lafarge facility were either stabilized for disposal along with the sediments using a drying agent, or were treated by Lafarge's water treatment system and then shipped to Marine Vacuum Services for further treatment and ultimate discharge to a Publicly Owned Treatment Works (POTW) under a King County METRO Waste Discharge Permit.[2] Sediment transloading operations at Lafarge were regularly monitored over the course of the Project. Certificates of disposal were provided by the landfills for all disposed materials (see Appendix J).

3.1.4 Soil and Debris Transload Facility

Contaminated soil and debris generated during the Project were disposed of at the WM Greater Wenatchee Landfill. These materials were either direct-shipped by truck, or were trucked to the WM Alaska Street Transfer Station and transported to the landfill by rail. The WM Alaska Street Transfer Station is a fully permitted solid waste facility with water management facilities.

3.1.5 Best Management Practices and Other Environmental Controls

BMPs were employed throughout the Project as follows:

- BMPs implemented in upland areas included pavement sweeping along equipment haul routes, stormwater inlet protection, tank containment[3], use of sealed and contained stockpile areas, dust suppression, equipment decontamination[4], water pre-treatment systems, readily available spill kits, and segregating impacted or potentially impacted soils from imported or reusable project-generated soils.
- BMPs implemented at the Lafarge facility included operation of transload spill containment measures, pavement sweeping, management of generated waters, and

[2] King County Waste Discharge Permit No. 7676-05.
[3] Tank containment consisted of sealed plastic berm placed under the water pre-treatment system tanks for spill or leakage protection.
[4] Equipment used in the Former GP West Site SSA to handle impacted soil and debris was decontaminated before leaving the SSA to avoid cross-contamination in other work areas.

operational controls to avoid cross-contamination of unrelated Lafarge operations from its dredged material management operation.

- BMPs used during shoreline construction and excavation activities included working above the tidal water level when possible, monitoring marine and weather conditions, monitoring marine water quality, deploying floating containment booms and oil absorbent booms, stabilizing disturbed shorelines prior to tidal inundation, managing stormwater upland of the shoreline, and staging equipment and materials upland of the shoreline.
- BMPs for overwater work (e.g., dredging, capping, structure removal, and pile driving) included monitoring barge loading, deploying silt curtains, deploying floating containment booms and oil absorbent booms, dredge dewatering management, overwater spill containment for work platforms and piling extraction, and staging spill kits on the marine vessels. Water quality monitoring was performed consistent with the agency-approved WQMP contained in the EDR (Anchor QEA 2015), and dredging and capping methods and production rates were adjusted as necessary during the work based on feedback from that monitoring (see Section 4.1.1 and Appendix E for additional water quality monitoring details).

3.2 Inner Waterway Construction

Work completed in the Inner Waterway included debris and structure removal, installation of containment walls to address upland source control issues, dredging and engineered capping, shoreline restoration, and structure replacement. Each of these work elements is described in greater detail below. Figures 4 through 9 summarize work performed in this area.

3.2.1 Debris and Structure Removal and Disposal

Extensive removal of debris and structures was completed from Inner Waterway areas. Debris removed within the Inner Waterway included concrete, treated timber, metal, and other anthropogenic materials:

- Overwater and shoreline structures were removed along the Central Waterfront Shoreline including about 360 linear feet of degraded concrete and treated timber bulkheads, dozens of obsolete treated timber and steel pipe piling, a hydraulic-

operated steel barge ramp, and about 8,850 sf of overwater treated timber and concrete docks and gangways.

- Overwater and shoreline structures were removed along the South Shoreline in preparation for construction of the engineered cap and to eliminate obsolete structures and degraded treated timber features. Structure removal along the South Shoreline included a 160-foot-diameter, 14-foot-tall concrete clarifier and a portion of the clarifier's supporting treated timber piling, a treated timber bulkhead supporting the clarifier, obsolete piping from the clarifier, a treated timber foam tank with associated piping[5], and other treated timber features. In total, about 475 linear feet of treated timber and steel bulkheads, about 75 linear feet of piping, a 360-sf overwater treated timber catwalk and piling, and miscellaneous treated timber piling and concrete foundations were removed from the South Shoreline.

All debris was hauled to either the GP West Site SSA or South Shoreline SSA for temporary stockpiling. Concrete debris was size-reduced to separate and extract reinforcing steel and other non-concrete material; the resulting concrete was added to existing concrete stockpiles along the southeast corner of the GP West Site for future use by the Port on other projects. Metals were hauled to a recycling facility. Treated timber and other debris were hauled to a Subtitle D landfill.

3.2.2 Source Control Measures

A continuous steel sheetpile wall was installed along the Central Waterfront Shoreline to contain impacted soils and groundwater landward of the wall.[6] The sheetpile alignment is visible in Figure 4. The sheetpile wall was constructed in multiple subsections (listed from east to west):

- East Central Waterfront Wall
- Maple Street Bulkhead
- West Maple Street Wall

[5] The primary clarifier and foam tank were part of the former GP West Pulp and Tissue Mill's process water treatment system that were decommissioned by GP West in 2008.

[6] The extent of impacted soils and groundwater upland—or landward—of the wall was characterized during the remedial investigation of the Central Waterfront Site.

- West Central Waterfront Wall
- Chevron Cutoff Wall

The individual sheetpile seams were installed with a sealant from the Maple Street Bulkhead midsection to the Chevron Cutoff Wall. All sheetpiles between the East Central Waterfront Wall and the West Central Waterfront Wall subsections were terminated in or below the clay unit (i.e., Bellingham Drift layer). The Chevron Cutoff Wall subsection was driven to 25 feet below ground surface consistent with design for the Project. Sheetpiles were driven to the design tip elevation, which varied based on the defined section. Sheetpiles terminated shallower than the design tip elevation were reviewed and approved in real-time by the structural and geotechnical engineer. A table summarizing the as-built sheetpile tip elevations is presented in Appendix C.

During wall installation, subsurface obstructions were encountered that required minor realignment of portions of the containment wall. These areas were located primarily on the eastern end of the East Central Waterfront Wall and at the Chevron Cutoff Wall. Wall obstructions and hard-driving conditions also resulted in damage to the joint sealant in portions of the Maple Street Bulkhead. This damage was successfully repaired by welding and application of sealant to the exterior of the wall.

To meet remedial objectives while maintaining berth depths for Port operations, the Maple Street Bulkhead was constructed with lateral support from a single-row of tiebacks installed for the full length of the wall. Tiebacks were installed at an elevation of 8.0 feet mean lower low water (MLLW) at the wall face and bonded for approximately 50 feet of tieback length in the clay unit. Full-time observation of tieback installation and testing was performed by a field engineer. Tieback testing was performed consistent with the recommendation of the Post-Tensioning Institute. The tieback testing results were reviewed and approved in real-time by a geotechnical engineer. Tieback installation and testing record forms, including results of performance and creep testing, are presented in Appendix D. A fender system was installed adjacent to the bulkhead to protect the tiebacks from vessel damage.

Following installation of the tiebacks and fender system, some water seepage was noted at several of the tieback penetrations of the wall face. These seeps will be repaired in the future as part of a separate project.

The former barge ramp located upland of the Maple Street Bulkhead subsection was removed. This included removal of the overwater ramp and dozens of foundation piles. The ramp cavity was backfilled after containment wall and tieback installation.

3.2.3 Dredging, Excavation, and Material Management

Dredging within the Inner Waterway was conducted following completion of shoreline debris and structure removal. In all, 50,650 cy of contaminated sediment was removed from the Inner Waterway over an area of 290,762 sf. Following completion of dredging, post-dredging surveys were conducted to verify that design elevations were met. These design elevations were established to accommodate placement of the engineered cap to contain remaining impacted sediment, while maintaining the functional operation depth for the Inner Waterway.

The footprint of dredging required to complete the Project was slightly larger than the boundary included in the EDR (Figure 8). This was due to recent sedimentation (i.e., since the 2008 design survey). This increased the limits of dredging by 56,485 sf. However, dredge volumes and areas were well within permit tolerances.

Third-party post-dredging bathymetric surveys were submitted to the construction manager upon completion of dredging in areas defined by the Contractor. The construction manager reviewed each post-dredging survey and either accepted completion of dredging in the defined area, or instructed the Contractor to complete additional removal until the design elevation was achieved. Figure 8 documents the extents of dredging and also includes the final post-dredging survey, which was created by merging together the post-dredging survey files for each acceptance area (see also Appendix C).

All dredging was completed using mechanical methods using a 6-cy cutting bucket and a 10-cy sealed edge bucket. Both were operated using one of two derricks. Dredged sediment was loaded into sealed barges for transport to the sediment offloading facility in Seattle.

In addition to the removal of sediment by dredging, soil was removed from shoreline cutback areas using upland excavation equipment. This included significant bank cutbacks along both the Central Waterfront Shoreline and the South Shoreline. Excavation activities were also conducted to install a temporary "relief trench" landward of the West Central Waterfront Wall to relieve pressure during dredging along the wall. Upon completion of dredging and construction of the engineered cap, the temporary excavation along the wall was backfilled with structural fill and soil suitable for re-use from the initial excavation. In total, about 9,900 tons of impacted or unsuitable soil was removed from the shorelines and disposed of in a Subtitle D landfill (WM Greater Wenatchee Landfill). About 2,150 tons of soil removed from the shorelines was reused.

3.2.4 Engineered Capping

Dredging in the Inner Waterway was followed by placement of an engineered cap to contain remaining impacted sediments. Engineered cap placement occurred along the Central Waterfront Shoreline, the South Shoreline, and throughout the open-water areas in the Inner Waterway using four different cap types. Each cap type was designed for a specific set of site conditions and uses. The caps included varying thicknesses of sand, filter, and armor rock layers to isolate contamination and provide erosion protection. Details of each cap type (including cap composition, placement thicknesses and tolerances, and placement slopes) are documented in the Record Drawings (Appendix C). Overall, engineered caps were placed over 449,231 sf of area in the Inner Waterway. The extents and final elevations of the engineered cap are illustrated on Figure 9.

Capping materials were obtained from a clean quarry source in the Nooksack River valley. The materials were sampled and analyzed prior to use to verify that they complied with physical design requirements (see Appendix I) and were free of chemical contamination (see Appendix G). Periodic inspections of the quarry operations were conducted over the course

of the Project. Separate from sediment quality standards, physical material testing was completed as part of the source material approval; see Appendix I.

To confirm that proper horizontal coverage and thickness of the engineered cap were achieved, the construction manager performed quality assurance (QA) inspections of the Contractor's work and reviewed survey documentation. After the Contractor determined that the design thickness of an individual layer of the cap was achieved in a defined footprint, the construction manager reviewed the post-capping surveys and either: 1) accepted that the design thickness was achieved for that layer and authorized the Contractor to proceed with placement of the subsequent layer; or 2) directed the Contractor to place more material in specific areas if design thicknesses were not met.

The post-dredging and post-capping surveys were also reviewed by a geotechnical engineer to identify areas of excessive settlement or potential cap instability. The final cap elevations were observed to be within the over-dredge and cap placement tolerance set forth in the Contract documents. There was no evidence of excessive cap settlement and/or cap instability of Inner Waterway areas.

3.2.5 Structure Replacement

Some of the structures that were removed to facilitate the remediation work required replacement to preserve existing navigation uses. These structures are shown in Figure 4 and Figure 6. Replacement structures served the same function as the removed structures, described as follows:

- Existing piling, dolphins, log booms, and floating piers located along the Central Waterfront Shoreline were removed to enable completion of shoreline stabilization, dredging, and capping. In this area, 12 dolphins, 5 replacement individual piles, and a float system were replaced.
- Along the South Shoreline, a number of structures and dolphins were removed to implement site cleanup (as detailed in Section 3.2.1). A single dolphin and associated catwalk were replaced.
- As discussed in Section 3.2.2, the existing barge ramp landward of the containment wall on the Central Waterfront Site was removed and filled in with clean soil backfill.

The ramp will be replaced in the future with a structure serving the same function. That replacement ramp will be constructed with a foundation that does not create a preferential migration pathway for contaminated groundwater.

- A crane pad located on the Central Waterfront Site that was damaged during completion of dredging, wall installation, and capping activities was replaced upon completion of the remediation work to provide a location for continued crane operations.

3.3 Outer Waterway Construction

Work completed in the Outer Waterway primarily included dredging and residuals management cover (RMC) placement in the Whatcom Waterway federal channel and adjacent berth areas. A small section of engineered cap was also placed at the transition between the Outer Waterway and the Inner Waterway. No capping was performed within the federal navigation channel.

3.3.1 Dredging and Material Management

Dredging occurred at the BST to remove contaminated sediments from the federal navigation channel areas and berth areas adjacent to the BST pier. Figure 10 documents the extent of dredging and also includes the final post-dredging survey, which was created by merging together the post-dredging survey files for each acceptance area (see also Appendix C).

- The required dredging elevations offshore of the BST Berth 1 were designed to achieve complete removal of the contaminated sediments in this area. Overall, 57,539 cy of contaminated sediment was removed from areas offshore of BST Berth 1. The footprint of dredging in the BST Berth 1 was 217,428 sf.
- To minimize the risks of sediment recontamination in Berth 1 due to propwash, a high spot within BST Berth 2 was also removed, totaling 3,257 cy of sediment over an area of 29,348 sf.

During dredging activities, the Contractor encountered a hard layer of native sediment (i.e., sediment that had not been previously dredged) in a portion of the dredge prism. A supplemental sediment coring program (Appendix H) was performed to verify the boundary elevation between clean and contaminated sediments. Based on the updated information,

Ecology approved modification of the dredge prism in this area, reducing the required volume of dredging by approximately 1,500 cy.

Third-party post-dredging bathymetric surveys were submitted to and reviewed by the construction manager. These surveys verified that required dredging elevations were met. Post-dredging analytical testing (see Section 4.2.2) confirmed the absence of missed inventory beneath the dredging limits, and confirmed that the quantity and concentrations of dredging residuals were within tolerances.

3.3.2 RMC Placement

Following completion of dredging activities in BST Berth 1 and Berth 2 areas, RMC was placed over the entire dredging footprint, except where engineered cap placement was to be performed. The RMC material consisted of a minimum placement of 6 inches of clean sand to manage dredge residuals generated by dredging activities. RMC material was placed over an area totaling 234,515 sf. Extents and final elevations of the RMC material are shown on Figure 11.

The QA procedures used for verifying the specified thickness and extent of RMC placement were identical to the procedures used for engineered cap placement, as described in Section 3.2.4.

3.3.3 Engineered Capping

To minimize the risk of recontamination of Berth 1 from adjacent contaminated sediments not yet capped, approximately 14,787 sf of engineered cap was placed over the transition area between the Outer Waterway and the Inner Waterway. The engineered cap design for this area considered potential propwash forces associated with vessel traffic in the Berth 1 and federal channel areas. The cap design included an isolation layer of sand, overlain by a gravel filter layer and a top layer of armor rock. Details of the cap type used (including placement thicknesses and tolerances, and placement slopes) are documented in the Construction Drawings (Appendix C). The extents and final elevations of the engineered cap are illustrated on Figure 11.

Similar to the QA procedures used in the Inner Waterway (described in Section 3.2.4), third-party post-dredging bathymetric surveys were submitted to and reviewed by the construction manager upon completion of cap placement activities in areas defined by the Contractor within the BST.

The post-dredging and post-capping surveys were reviewed by a geotechnical engineer to identify areas of excessive settlement or potential cap instability. The final cap elevations were observed to be within the over-dredge and cap placement tolerance set forth in the Contract documents. There was no evidence of excessive cap settlement and/or cap instability of Outer Waterway areas.

3.4 Log Pond Construction

Work completed in the Log Pond included debris and structure removal and engineered capping. Each of these work elements is described in greater detail below. Figures 12 and 13 summarize the work performed in this area.

3.4.1 Debris and Structure Removal and Disposal

Debris and structure removal in the Log Pond area was completed prior to the construction of the engineered cap:

- Debris armoring was removed from the shoreline, including concrete, asphalt, masonry, and treated timber.
- Structures were removed, including dozens of treated timber pilings and dolphins and portions of a treated timber bulkhead. Pilings and dolphins were extracted using a vibratory hammer operated by the Contractor's derricks. Pilings were temporarily stockpiled with other treated timber debris for landfill disposal. The upper portion of the treated timber bulkhead along the west side of the Log Pond was removed. The lower portions of the bulkhead remain in place consistent with the EDR, and were covered by the engineered cap placed in this area.
- One previously inactive pipe was encountered along the shoreline in the southeast portion of the Log Pond. The pipe appeared to have been previously plugged. The end of the pipe was cut and then re-plugged with concrete prior to the construction of the engineered cap in that location.

Removed materials were stockpiled in the GP West Site SSA pending reuse or landfill disposal. Size-reduced concrete was added to existing concrete stockpiles along the southeast corner of the GP West Site for future use by the Port on other projects. Other materials were recycled (i.e., metal debris) or disposed of at the WM Greater Wenatchee Landfill (unsuitable debris and treated wood).

A former log loader located along the shoreline was not removed. That structure was designated by the Port for retention as part of Waterfront District historical preservation activities.

3.4.2 Engineered Capping

Following debris and structure removal in the Log Pond area, 95,739 sf of engineered cap was constructed to stabilize the existing shoreline cap edges and prevent future cap erosion and recontamination. The extents and final elevations of the engineered cap are illustrated on Figure 13.

Two minor adjustments to the cap design were conducted to respond to identified field conditions. First, the pre-construction survey differed slightly from the 2008 design survey. In response, the cap contours were adjusted as documented in Appendix C. A small amount of soil excavation (approximately 60 cy) was also removed from the upper slope of the shoreline to optimize capping grades. These soils were chemically tested (Appendix G). Ecology approved reuse of those soils as subgrade backfill within the clarifier foundation.

The engineered cap was composed of four different cap types, as shown on the Construction Drawings (Appendix C), to address different site conditions present throughout the area:

- In areas with clean surface sediment, the cap was constructed using a two-layer system of gravel filter and armor rock material to stabilize the shoreline and protect the existing sediment cap against erosion.
- In the southwestern corner of the Log Pond, with contaminated surface sediment, the cap was constructed using three material layers of sand, gravel filter, and armor rock.
- Capping materials were placed from the existing cap surface to the existing top-of-bank. The top-of-bank elevations vary along the Log Pond shoreline.

The post-capping surveys were reviewed by a geotechnical engineer to identify areas of excessive settlement or potential cap instability. The final cap elevations were observed to be within the over-dredge and cap placement tolerance set forth in the Contract documents. There was no evidence of excessive cap settlement and/or cap instability in the Log Pond capping area.

4 ENVIRONMENTAL MONITORING

Environmental monitoring conducted during and immediately following construction of the Project included protection monitoring and performance monitoring. Monitoring activities were performed as described in the CMCRP and WQMP contained in the EDR (Anchor QEA 2015), and the SQAPP (Anchor QEA 2016) associated with the CMCRP.

Protection monitoring documented protection of human health and the environment from construction-related impacts. Monitoring principally included water and air quality, and showed that Contractor BMPs implemented during the work were protective of water quality and there were no air quality impacts during the Project.

Performance monitoring included sediment and tissue testing, and documented that the construction activities met Ecology requirements as defined in the EDR. Sediment was tested following dredging and placement of the residuals management cover. This testing demonstrated that dredging and residuals management activities were effective at meeting Project requirements. Tissue testing was also performed to evaluate whether sediment disturbance during construction resulted in increases in mercury levels in the food chain. Results of that testing did not show any significant impacts to the aquatic food chain.

Figure 14 shows the environmental monitoring locations for sediment and tissue. Appendices E, F, and G contain detailed summaries of the environmental monitoring data for water quality, air quality, and sediment/tissue monitoring, respectively.

4.1 Protection Monitoring

Protection monitoring during the Project included water quality and air quality monitoring activities, as described in the following sections.

4.1.1 Water Quality

Water quality monitoring activities were conducted according to the Ecology-approved WQMP contained in the EDR (Anchor QEA 2015). Water quality monitoring occurred during in-water dredging, capping, and structure removal activities, consistent with the WQMP.

Criteria

Water quality monitoring data were compared against both conventional and chemical criteria applicable at the time the Project was conducted.

Turbidity and dissolved oxygen were monitored as the primary indicators of water quality. For marine waterbodies classified as excellent, turbidity shall not exceed 5 nephelometric turbidity units (NTU) over background turbidity when the background turbidity is 50 NTU or less, or there shall not be more than a 10% increase in turbidity when the background turbidity is more than 50 NTU. The lowest 1-day minimum for dissolved oxygen in marine waterbodies designated as excellent is 6.0 milligrams per liter (mg/L) [Washington Administrative Code (WAC) 173-201A-200(1)(d) and (e)].

Acute and chronic water quality standards established under the Washington State Surface Water Quality Standards [WAC 173-201A-240(3)] applicable during the Project are listed in Attachment 1 of the WQMP, along with the findings of the reasonable potential analysis. That analysis compared the findings of the dredging elutriate test evaluation to the water quality criteria to evaluate potential dredging-related chemical concentrations that could occur during construction. Though exceedances of water quality criteria were not considered reasonable to expect, contingent chemical monitoring was included for both mercury and dioxin. For mercury, the acute and chronic criteria were 1.8 micrograms per liter (µg/L) and 0.025 µg/L, respectively. For dioxin, acute and chronic water quality criteria were 0.0001 µg/L and 0.00001 µg/L, respectively.

Methodology

Monitoring methods were performed in accordance with the WQMP. Monitoring was conducted from a research vessel located at specific distances from construction activities, measured using radii of 100 feet (Early Warning Station), 150 feet (Acute Compliance Stations) and 300 feet (Chronic Compliance Stations). Monitoring was also performed at two reference locations at least 500 feet from construction activity. At each station, conventional criteria were measured at three depths: 3 feet from the surface, the midpoint, and 3 feet from the bottom.

Conventional monitoring was performed in-situ using a YSI 6290V2 multi-probe water quality sonde. Chemistry samples were collected from three depths using a Van Dorn sampler and composited at the lab to create a single sample.

Monitored Activities and Results

Water quality monitoring was performed between August 10, 2015, and March 21, 2016. Monitoring took place during pile removal, capping, and dredging activities consistent with the requirements of the WQMP. Detailed monitoring data are provided in Appendix E.

During the 8 months of monitoring, over 2,125 compliance measurements of dissolved oxygen and turbidity were taken. Of the 2,125 turbidity readings taken, confirmed exceedances of the background-based total suspended solids limit were observed during only five events (see Appendix E, Table E2):

- Three events (September 21, 25, and 30, 2015) were short-term exceedances of background turbidity levels at the AS-1 station only. At the 1-hour recheck after the Contractor implemented additional BMPs, turbidity returned to background levels.
- One event (September 29, 2015) was a short-term exceedance of background turbidity levels at the AS-1 and CS-1 station. At the 1-hour recheck after the Contractor implemented additional BMPs, turbidity returned to background levels.
- One event (October 27, 2015) included a 2-hour turbidity exceedance at the AS-1 station. Turbidity returned to background levels within 3 hours.

All of the exceedances took place during low tide or slack tide while dredging the Inner Waterway. These exceedances were attributable to the shallow-water conditions and challenging dredging conditions in these areas. However, application of additional BMPs by the Contractor were sufficient to return conditions to required levels.

No confirmed dissolved oxygen criteria exceedances attributable to construction activities were observed during the Project. Low-oxygen conditions were noted at compliance and background stations during 16 monitoring events between August and mid-September. However, all low-oxygen conditions were attributable to low background dissolved oxygen levels, not to construction activities.

Consistent with the WQMP, chemistry samples were collected when an exceedance of turbidity criteria was sustained for more than 1 hour. Turbidity exceeded criteria at AS-1 for more than 1 hour during one event (October 27, 2015). Water samples were collected at AS-1 and BG-1 and submitted for chemical testing in accordance with the WQMP. Chemical analysis did not detect any mercury or dioxin (see Appendix E, Table E3).

Overall, water quality monitoring data demonstrated that Contractor BMPs were effective at protecting water quality during construction. Refer to Appendix E for a more detailed summary of collected water quality monitoring data.

4.1.2 Air Quality

Air quality monitoring was implemented during dredging activities in the Inner Waterway to verify that no volatile organic compounds were being released by dredging activities, and to document that safety was maintained for construction workers, Port of Bellingham tenants, or other waterfront users. This work was performed out of an abundance of caution, because the Whatcom Waterway sediments had never been shown to contain any volatile organic compounds.

Two comprehensive air monitoring events were conducted. The surveys were conducted during active dredging and materials handling activities. The first event was conducted on December 30, 2015, and the second was conducted on January 13, 2016. Each event included air quality measurements at 19 stations. The stations include locations adjacent to Whatcom Waterway and stations next to stockpile areas and haul routes used during the Project. Air quality monitoring was performed using a calibrated photo ionization detector (PID). The PID tests for the presence and concentration of volatile organic hydrocarbons. Testing results are summarized in Appendix F.

All PID readings were below typical ambient levels (0.2 parts per million), confirming that dredging and stockpiling activities were not adversely impacting air quality within or adjacent to the Whatcom Waterway Site.

4.2 Sediment Monitoring

Sediment monitoring was used to document post-dredge/pre-cap sediment quality in the Inner Waterway, and the performance of dredging and residuals management activities in Unit 1C. Sampling activities were performed in accordance with the SQAPP (Anchor QEA 2016). The sediment data summarized in this section are provided in Appendix G.

4.2.1 Inner Waterway Pre-Cap Samples

Samples were collected at five stations in Units 2A and 3B following the completion of dredging and prior to cap placement. Samples were collected from the apparent undredged sediment layer (i.e., below the apparent residuals layer). Dredging activities in these areas were not expected to reach clean native sediments. The collected data were intended to supplement existing data and document the chemical concentrations remaining in the sediments being capped.

Sediment sampling in the Inner Waterway was conducted in 1996, 1998, 2002 as part of the RI/FS, and 2008 in support of remedial design. Results for previous surface sediment quality from the first two sampling events (1996 and 1998) and sediment quality data collected in 2002 are presented in the Supplemental RI/FS (RETEC 2006), and data from 2010 are available in the PRDI Data Report (Anchor QEA 2010).

Methods

Samples were collected using a gravity-driven Van Veen grab sampler onboard a research vessel in accordance with Puget Sound Estuary Program (PSEP) protocols using methods outlined in the SQAPP (PSEP 1997; Anchor QEA 2016). Dredge residuals were removed from the top of each sample prior to collection of the underlying sediment. The apparent residuals layer was thin, averaging only 2 cm thick in the sediment samples.

Chemical analyses were conducted at Analytical Resources Inc. (ARI), a laboratory accredited through the Ecology Laboratory Accreditation Program. Surface sediment samples were analyzed for total solids, total organic carbon (TOC), mercury, polycyclic aromatic hydrocarbons (PAHs), phenolic compounds, and D/Fs.

Results and Discussion

Post-dredge sampling of sediments in the Inner Waterway (Units 2A and 3B) revealed constituent concentrations similar to previously measured values:

- Mercury concentrations ranged from 0.18 to 3.19 mg/kg.
- Concentrations of 2,4-dimethylphenol and/or 4-methylphenol exceeded SQS values in multiple samples.
- PAH concentrations were elevated in two of the five samples.
- Dioxin/furan concentrations exceeded surface sediment regional background concentrations (15 ng TEQ/kg) in four of the five analyzed samples.

Following sediment testing, these Inner Waterway sediments were capped with a two-layer cap containing sand and filter materials (waterway bottom sediments) or a two-layer cap containing sand, filter, and armor materials (waterway side-slopes). The newly collected data did not conflict with the previous data evaluated during engineering design of these caps.

4.2.2 Unit 1C Post-Dredge Samples

Samples were collected at six locations in Unit 1C following the completion of dredging activities and prior to management of dredging residuals. As this area was not to be capped following dredging, these samples were collected to verify that: 1) the thickness and chemical composition of dredging residuals did not exceed anticipated values; and 2) dredging achieved full removal of target sediments, and that there was no missed inventory (undredged contaminated sediments) remaining in the dredge area.

Methods

Samples were collected from six locations using a gravity-driven Van Veen grab sampler onboard a research vessel in accordance with PSEP protocols using methods outlined in the SQAPP (PSEP 1997; Anchor QEA 2016). The thickness of the apparent residuals layer was recorded, and then the dredge residuals were sampled from the apparent residuals layer present in the surface of each grab. Then the remaining dredge residuals were removed and a sample of the underlying sediment was collected.

Because penetration of the grab sampler was less than 30 cm, the vertical separation achieved between the residuals layer and the underlying sediment sample (less than 5 cm) was less than that called out for in the SQAPP (10 cm separation). This deviation could cause the measured chemical concentrations to be biased high due to partial mixing with the sediment residuals layer.

Chemical analyses were conducted at ARI, a laboratory accredited through the Ecology Laboratory Accreditation Program. Surface sediment samples were analyzed for total solids, TOC, mercury, and D/F.

Results and Discussion

Results for the dredging residuals layer and the underlying sediment both demonstrated that dredging had achieved target objectives:

- **Dredging Residuals Thickness and Composition:** Dredging residuals were found to be consistent with the anticipated thickness and chemical composition. No modifications to the planned residuals management procedures were required:
  - The thickness of the dredging residuals layer was within the anticipated range. The thickness varied from 2 to 7 cm in depth, averaging 4.2 cm.
  - The chemical composition was within expected ranges. Mercury concentrations ranges from 0.75 to 2.3 mg/kg, averaging 1.5 mg/kg. The D/F concentrations ranged from 2.1 to 26.2 ng TEQ/kg, with an average of 15.1 ng TEQ/kg.
- **Quality of Underlying Sediment:** The underlying sediment layer was found to be free of contamination, confirming that there was no missed inventory (undredged contaminated sediment) located beneath the residuals layer. Therefore, no contingency re-dredging was required.
  - Mercury concentrations ranged from 0.0088 to 0.19 mg/kg, averaging 0.066 mg/kg. There were no exceedances of the SQS (0.41 mg/kg).
  - Dioxin/furan concentrations in all underlying sediment samples were very low, ranging from 0.15 ng TEQ/kg to 2.79 ng TEQ/kg, averaging 0.800 ng/kg. These values are below Bellingham Bay regional background (15 ng TEQ/kg) and natural background (4 ng TEQ/kg) values (Ecology 2015).

4.2.3 Unit 1C Samples Following Residuals Management

Samples were collected at six locations in Unit 1C after placement of RMC. These samples were used to verify that the surface sediment concentrations complied with cleanup objectives following management of dredging residuals.

Methods

Samples were collected from each of the six target locations with a gravity-driven Van Veen grab sampler onboard a research vessel in accordance with PSEP protocols and using methods outlined in the SQAPP (PSEP 1997; Anchor QEA 2016). The surface sediments were then removed from the sampler, homogenized, and submitted for chemical analysis.

Penetration of the grab sampler was less than the target depth of 12 cm. Actual penetration depths ranged between 0 to 8 cm (station P1PM-05) and 0 to 10 cm (remaining stations). Some residuals material was also noted on top of the placed cover, likely due to sediment disturbance during placement.

Chemical analyses were conducted at ARI, a laboratory accredited through the Ecology Laboratory Accreditation Program. Surface sediment samples were analyzed for total solids, TOC, mercury, and D/F.

One sample (station P1PM-05) was recollected and reanalyzed to confirm initial mercury results and to provide sufficient material for contingent bioassay testing. Bioassay testing was performed by Ramboll Environ. Test methods followed guidance provided by the Puget Sound Estuary Program (PSEP 1995), the Sediment Cleanup User's Manual II (Ecology 2015), and the various updates presented during the Sediment Management Annual Review Meeting. The following tests and species were used:

- 10-day amphipod mortality (*Eohaustorius estuaries*)
- 20-day juvenile polychaete survival and growth (*Neanthes arenaceodentata*)
- 48-hour benthic larval development (*Mytilus galloprovincialis*)

Appendix G provides the Ramboll Environ laboratory report and statistical analysis.

Results and Discussion

Results of chemical and contingent bioassay testing confirmed compliance with the SQS for mercury at all six stations:

- Concentrations of mercury in the five samples excluding P1PM-05 ranged from 0.03 to 0.33 mg/kg.
- Station P1PM-05 had an initial mercury concentration of 0.65 mg/kg. The recollection and reanalysis resulted in roughly the same concentration of 0.66 mg/kg. Bioassay testing was performed at station P1PM-05. No exceedances of SQS interpretive criteria were noted. Therefore, station P1PM-05 complies with the SQS.
- The average mercury concentration of all six stations was 0.24 mg/kg.

D/F concentrations ranged from a concentration of 0.20 ng TEQ/kg to 4.64 ng TEQ/kg in five of the six samples. In the sample from station P1PM-05, the D/F concentration was 16.29 ng TEQ/kg. The average D/F concentration of all six stations was 4.28 ng TEQ/kg. This value is very close to the natural background concentration of D/F (4 ng TEQ/kg) and well below the Bellingham Bay regional background concentration of D/F (15 ng TEQ/kg) (Ecology 2015).

Results of testing demonstrated that dredging and residuals management activities complied with the SQS for mercury (i.e., no stations exceeded the mercury SQS or bioaccumulation screening level), as well as with antidegradation provisions for D/Fs (i.e., average concentrations were 4.28 ng TEQ/kg, well below the pre-dredge average concentration of 15.1 ng TEQ/kg).

4.3 Tissue Monitoring

Tissue monitoring was performed during June and July 2016. The tissue monitoring was performed to assess whether short-term sediment disturbance associated with construction activities resulted in significant releases of mercury to the aquatic food web. This was evaluated by monitoring levels of mercury in adult and juvenile Dungeness crab, and by monitoring levels of mercury in caged clams deployed within the construction areas and nearby MNR areas. Tissue data were compared to previous testing data and to data from samples collected in clean reference areas.

4.3.1 Crab Tissue

Adult and juvenile Dungeness crab *(Metacarcinus magister)* tissue was collected as part of performance monitoring, consistent with methods defined in the SQAPP. Scientific collection permits were obtained from the Washington Department of Fish and Wildlife (WDFW) prior to crab collection.

Adult Crab

Adult crab were collected using crab traps deployed at three locations within the Site, and at two locations within the Samish Bay reference areas. Adult Dungeness crabs utilize a large home range (estimated at approximately 10 square kilometers, which is larger than the Site). Therefore, the adult Dungeness crab collected at any one station within the Site are representative of the overall Site, not the individual sampling station. Similarly, the adult crab collected at either of the Samish Bay reference areas are representative of the overall reference area and not the individual sampling station.

Crab were collected using baited crab traps deployed from a research vessel. Three adult male Dungeness crabs were collected at each station. Adult crabs with a carapace width of 16.5 cm or greater were targeted for collection to represent animals suitable for human consumption. Two individuals measuring just under this target size were collected as allowed under the SQAPP protocol, but all individuals exceeded the minimum WDFW size limit (15.9 cm). Composite samples for each station were created by homogenizing sternal plate, leg, and claw muscle tissue. Two replicate samples were created for each MNR station and three replicates for each reference sampling station, yielding six composite samples from the Site and six composite samples from the Samish Bay reference area. See Table 1 for a summary of crab tissue samples.

Results did not demonstrate any increases in adult crab tissue concentrations relative to historic data. Average mercury concentrations in adult crabs collected from the Site were 0.084 mg/kg wet weight. This concentration was slightly higher than average concentration for the Samish Bay crab (0.057 mg/kg wet weight; Table 2). However, the site crab tissue concentrations represented a significant decrease from historical values. Figure 15 shows the 2016 tissue data compared to comparable data collected from the site in 1991 and 1997.

Results demonstrate a decreasing trend in overall mercury concentration in the Site crab tissue. Reference area mercury concentrations remained unchanged between 1997 and 2016.

The tissue mercury concentrations from the Site remain well below the U.S. Environmental Protection Agency's (USEPA's) consumption guideline for seafood tissue (0.3 mg/kg wet weight), and they are more than 50% lower than the tissue concentration identified as protective of tribal seafood consumption (0.18 mg/kg wet weight) (Anchor Environmental and Hart Crowser 2000).

Results of adult crab monitoring did not identify any significant short-term adverse impacts to harvestable Dungeness crab from the dredging and other cleanup activities. Follow-up sampling of adult crab tissue was performed during 2017 in accordance with the SQAPP.

Juvenile Crab

Juvenile crab tissues were collected and analyzed for mercury concentrations to provide a more sensitive indicator of potential short-term impacts to the aquatic food chain from dredging activities. Because of their young age, small size, and more-localized home range, the juvenile crabs are more sensitive to short-term pollutant exposures than are corresponding adult crab.

The juvenile crab were collected from the Log Pond, which was located in between the Inner Waterway and Outer Waterway dredging areas. The Log Pond also had historic juvenile tissue monitoring data between 2001 and 2005. Reference area juvenile crab were collected from a location near Brant and Portage Islands. This area had also been used as a reference area during prior juvenile crab tissue monitoring activities.

Crab were collected using baited ring nets deployed from a vessel. Juvenile Dungeness crabs ranged in carapace length from 5 to 9 cm, indicating that the individuals were between 1 and 2 years old (Pauley, Armstrong, and Heun 1986). Five replicate samples for the Log Pond and five replicate samples from the reference area were created from whole-body composites prior to analysis at the laboratory. The use of composites likely reduced observed variability in the testing data for each area.

Mercury concentration data for the juvenile crab are summarized in Table 3 and Figure 16. The average mercury concentration in crabs from the Log Pond was 0.031 mg/kg. This value was slightly higher than the average concentration measured in the reference area (0.024 mg/kg wet weight). However, it was within the range measured in 2005 for the Log Pond (0.0194 to 0.0375 mg/kg wet weight).

The reference area average tissue mercury concentration (0.024 mg/kg wet weight) was within the range measured historically for the reference area (0.0199 to 0.0365 mg/kg wet weight).

Results of juvenile crab monitoring indicated that any increase in mercury bioavailability during the cleanup work was low. A slight increase (29%) was detected between the Log Pond juvenile crabs and the reference area crabs, but the average mercury concentration in the Log Pond crab remained within the range measured historically for the reference area. Therefore, it is not clear whether the observed increase is significant. Follow-up sampling of juvenile crab tissue was performed during 2017.

4.3.2 Caged Clam Tissue

Monitoring activities included an in situ bioaccumulation study using caged clams. This testing also included co-located testing of mercury in porewater and sediment.

Methods

Five test stations were located within the Site (Figure 14) and five stations were located in the Samish Bay reference area. Two of the test stations established at the Site were located in Phase 1 construction areas, and three were located in Site areas being managed by MNR.

Sample collection, processing, and analysis were conducted in accordance with the methods described in the SQAPP (Anchor QEA 2016). Divers deployed three cages of clams at each of the test stations during June of 2015. Clams *(Venerupis japonica)* were purchased from Taylor Shellfish in Bow, Washington, and placed into predator-exclusion cages. Three replicate cages were deployed at every station, each containing 30 clams, for a minimum of 90 clams per station. Cages were buried 10 cm into the sediment surface and left in situ for 30 days in

accordance with ASTM Method E2122-02. Clams were retrieved by divers and depurated in clean saltwater for approximately 12 hours before being shipped to the analytical laboratory for cleaning and shucking. Soft body tissue samples were composited from each cage separately and then an overall station composite was created for analysis. An additional 'time zero' sample was analyzed to measure potential background contaminant concentrations.

A set of nylon mesh diffusion samplers were also deployed at each test location to measure porewater mercury concentrations. Sediment porewater was collected near clam cages using nylon mesh diffusion samplers following methods used by the U.S. Geological Survey and U.S. Environmental Protection Agency (USGS and USEPA 2003). Nylon mesh diffusion samplers were constructed using 250-milliliter (mL) polypropylene jars fitted with 120-micron mesh and screw-on lids. Nylon mesh diffusion samplers were buried 10 cm into the sediment and left in situ to equilibrate. Nylon mesh diffusion samplers located at Site stations were retrieved after 6 to 8 days, and those located at reference stations were retrieved after 21 days. Upon retrieval, porewater was extracted using a 60-mL disposable syringe and shipped to the laboratory for analysis.

Surface sediment samples were collected from each deployment area. Surface sediment was collected near clam cages and porewater samplers at each of the Site and reference stations, with the exception of P1CM-07. The predominance of gravel and cobble prevented a suitable sample from being collected at this station. Samples were collected in accordance with PSEP protocols using methods outlined in the SQAPP (PSEP 1997; Anchor QEA 2016). Surface sediment samples were analyzed for mercury, total solids, and TOC content.

Results and Discussion

Figure 17 and Table 4 present the mercury concentrations reported in clam tissue and in porewater.

Tissue monitoring data did not demonstrate any difference between the mercury levels in clams deployed at the Site and those deployed in clean reference areas (see Figure 17). No mercury was detected in clam tissue at four out of the five Site stations or any of the

reference stations. The only mercury detection occurred at the laboratory limit of quantitation (0.02 mg/kg wet weight) in clam tissue collected from P1CM-01.

As with tissue, the results for porewater did not demonstrate any difference between the Site and the clean reference areas. Concentrations of detected total mercury in porewater ranged from 0.0055 to 0.0085 µg/L, with no significant differences between Site construction areas (average 0.0073 µg/L), Site MNR areas (average 0.0060 µg/L), or the clean reference areas (average 0.0072 µg/L). Detected concentrations of dissolved mercury in porewater ranged from 0.0020 µg/L to 0.0053 µg/L, with no significant differences noted between the test and reference areas. Concentrations of porewater mercury did not necessarily correlate with concentrations of total mercury in surface sediments.

Taken together, the in situ bioaccumulation testing data developed using caged clams and co-located porewater and sediment testing did not demonstrate a significant increase in mercury bioavailability between the Site and clean reference areas. Results did not indicate any residual impacts to the aquatic food chain from construction activities.

5 REFERENCES

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TABLES

Table 1
Crab Tissue Monitoring Data

Station ID	Sample ID	Mercury (mg/kg ww)	Carapace Length (cm)
Adult Dungeness Crab – Whatcom Waterway Site Areas			
MNR-03	WW-MNR-03-CM-COMP1-160610	0.07	16.3, 17, 17.5
	WW-MNR-03-CM-COMP2-160610	0.077	
MNR-04	WW-MNR-04-CM-COMP1-160610	0.075	17.6, 18.6, 18.1
	WW-MNR-04-CM-COMP2-160610	0.073	
MNR-07	WW-MNR-07-CM-COMP1-160610	0.098	19.6, 17.2, 18.4
	WW-MNR-07-CM-COMP2-160610	0.111	
	Mean Site Areas	**0.084**	
Adult Dungeness Crab – Samish Bay Reference Areas			
REF-01	WW-REF-01-CM-COMP1-160610	0.045	17.3, 16.6, 16.4
	WW-REF-01-CM-COMP2-160610	0.05	
	WW-REF-01-CM-COMP3-160610	0.047	
REF-05	WW-REF-05-CM-COMP1-160610	0.068	16.6, 19.1, 18.3
	WW-REF-05-CM-COMP2-160610	0.06	
	WW-REF-05-CM-COMP3-160610	0.072	
	Mean Reference Areas	**0.057**	
Juvenile Dungeness Crab – Reference Area			
REF-06	WW-REF-06-CM-COMP1-160610	0.024	8.5, 8, 7.3
	WW-REF-06-CM-COMP2-160610	0.024	
	WW-REF-06-CM-COMP3-160610	0.023	
	WW-REF-06-CM-COMP4-160610	0.024	
	WW-REF-06-CM-COMP5-160610	0.023	
	Mean Reference Areas	**0.024**	
Juvenile Dungeness Crab – Log Pond			
P1CM-12	P1CM-12-CM-COMP1-160610	0.032	5.7, 5.3
	P1CM-12-CM-COMP2-160610	0.031	
	P1CM-12-CM-COMP3-160610	0.03	
	P1CM-12-CM-COMP4-160610	0.032	
	P1CM-12-CM-COMP5-160610	0.03	
	Mean Log Pond	**0.031**	

Notes:
cm = centimeter
kg = kilogram
mg = milligram
MNR = monitored natural recovery
ww = wet weight

Table 2
Mercury Concentrations in Adult Crab Tissue

Location	Whatcom Waterway Site Areas			Samish Bay Reference	
Sampling Year	1991	1997	2016	1997	2016
Adult Crab Tissue Mercury Concentrations					
	0.16	0.1	0.07	0.081	0.045
	0.15	0.119	0.077	0.027	0.05
		0.211	0.075	0.031	0.047
		0.204	0.073		0.068
		0.1	0.098		0.06
		0.108	0.111		0.072
Summary Statistics					
Number of Samples (n)	2	6	6	3	6
Average Total Mercury (mg/kg ww)	0.155	0.140	0.084	0.046	0.057
Standard Deviation (mg/kg ww)	0.007	0.053	0.017	0.030	0.011

Notes:
kg = kilogram
mg = milligram
n = number
ww = wet weight

Table 3
Mercury Concentrations in Juvenile Crab Tissue

Location	Log Pond Area				Reference Area	
Sampling Year	2001	2002	2005	2016	2002	2016
Measured Mercury Levels in Juvenile Crab (mg/kg wet wt)						
	0.0150	0.0095	0.0375	0.032	0.0365	0.024
	0.0167	0.0143	0.0359	0.032	0.0199	0.024
	0.0171	0.0152	0.0354	0.031	--	0.023
	0.0176	0.0187	0.0291	0.030	--	0.024
	0.0207	0.0215	0.0284	0.030	--	0.023
	0.0237	0.0216	0.0233	--	--	--
	0.0237	0.0234	0.0225	--	--	--
	0.0258	0.0285	0.0214	--	--	--
	0.0487	0.0289	0.0194	--	--	--
Summary Statistics						
Sample Number (n)	9	9	9	5	2	5
Average Total Mercury (mg/kg ww)	0.0232	0.0202	0.0281	0.0310	0.0282	0.0236
Standard Deviation (mg/kg ww)	0.010	0.006	0.007	0.001	0.012	0.001

Notes:
kg = kilogram
mg = milligram
n = number
ww = wet weight

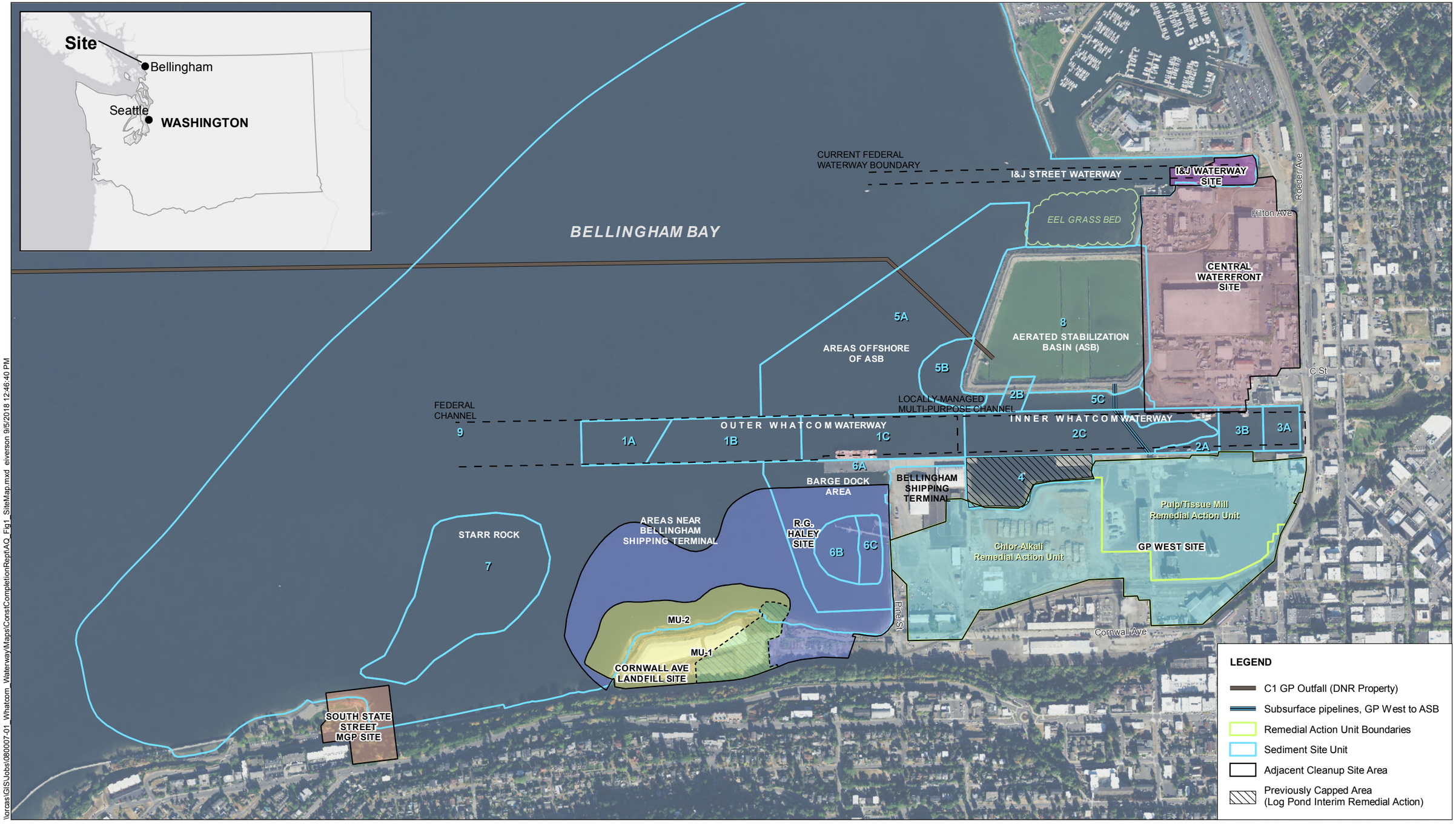
Table 4

Co-Located Clam Tissue, Porewater, and Sediment Mercury Concentrations

Area	Clam Tissue	Porewater		Sediment
	Total Hg (mg/kg ww)	Total Hg (ng/L)	Dissolved Hg (ng/L)	Total Hg (mg/kg ww)
Construction Areas				
P1CM-01	0.02	8.50 J	5.60 J	0.18
P1CM-07	0.02 U	6.00 J	3.00 J	--
MNR Areas				
MNR-03	0.02 U	5.50 J	2.00 U	0.26
MNR-04	0.02 U	5.60 J	5.10 J	0.19
MNR-07	0.02 U	7.00 J	2.80 J	0.64
Reference Areas				
REF-01	0.02 U	7.40 J	2.00 U	0.09
REF-02	0.02 U	--	--	0.03 U
REF-03	0.02 U	7.00 J	4.20 J	0.10
REF-04	0.02 U	--	--	0.04 U
REF-05	0.02 U	7.10 J	5.30 J	0.10
REF-04	0.02 U	--	--	0.04
REF-05	0.02 U	7.1 J	5.3 J	0.1

Notes:
kg = kilogram
L = liter
mg = milligram
ng = nanogram
ww = wet weight

FIGURES



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NOTES:
1. Site units are shown based on those in Figure 2-3 Cleanup Action Plan, Whatcom Waterway Site, September 2007. Unit 9 boundary updated based on PRDI findings.
2. Horizontal datum: Washington State Plane North, NAD 83 U.S. Survey Feet.
3. Unit 2B was established in the Cleanup Action Plan based on the anticipated marina access channel location. This location will be adjusted during final design.
4. Remedial Action Unit (RAU) boundaries were defined in the Final Cleanup Action Plan for the GP West Pulp and Tissue Remedial Action Unit (Aspect 2014).
5. Aerial imagery from National Agriculture Imagery Program (NAIP), September 2, 2017.
6. Gray inset base map from ESRI.

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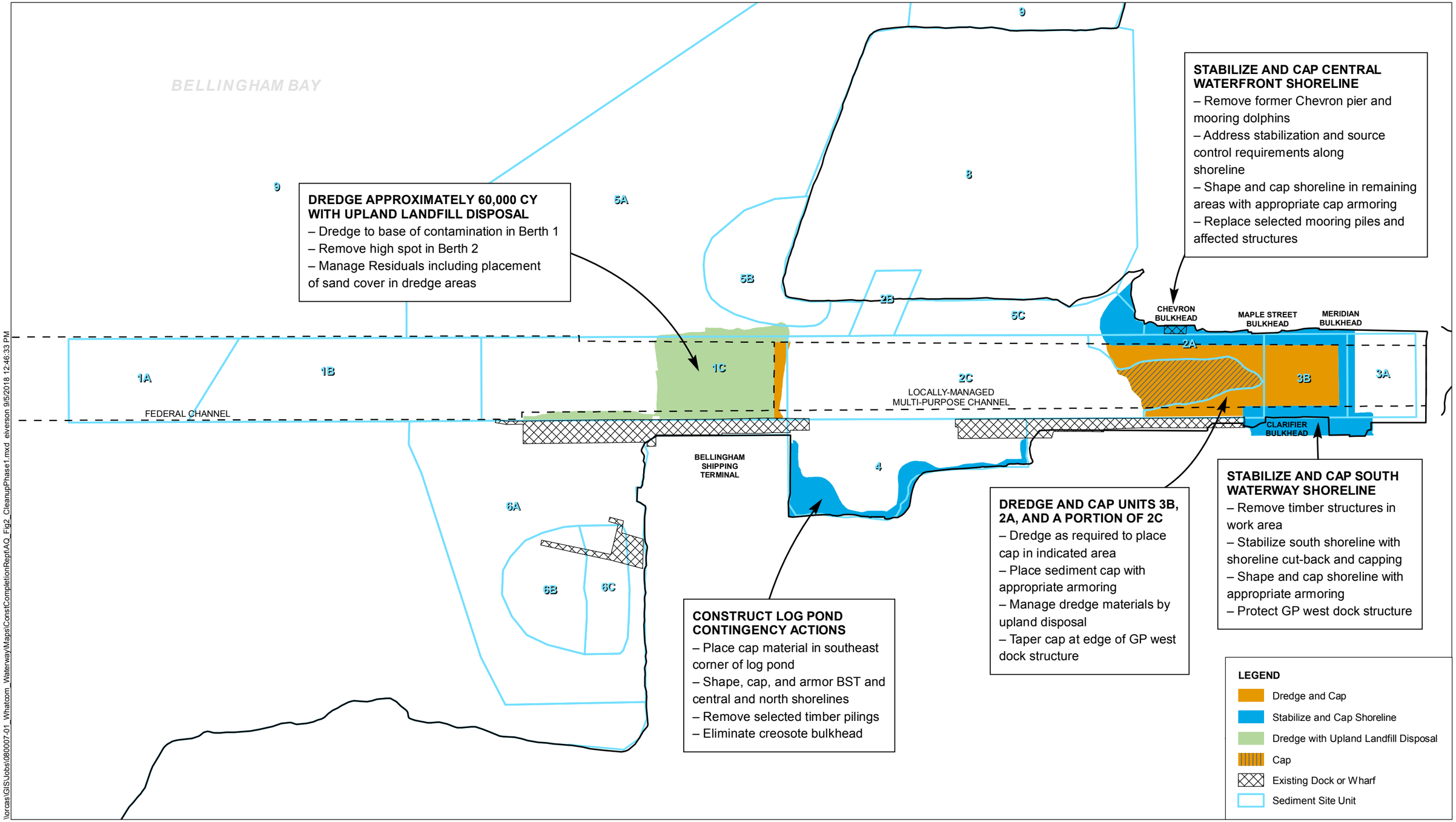
Figure 1
Site Vicinity Map and Pre-Construction Conditions
As-built Report
Whatcom Waterway Cleanup in Phase 1 Site Areas



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NOTES:
1. Site units are shown based on those in Figure 2-3 Cleanup Action Plan, Whatcom Waterway Site, September 2007. Unit 9 boundary updated based on PRDI findings.
2. Unit 2B was established in the Cleanup Action Plan based on the anticipated marina access channel location. This location will be adjusted during final design.
3. Horizontal datum: Washington State Plane North, NAD 83 U.S. Survey Feet.
4. Aerial imagery from National Agriculture Imagery Program (NAIP), September 2, 2017.

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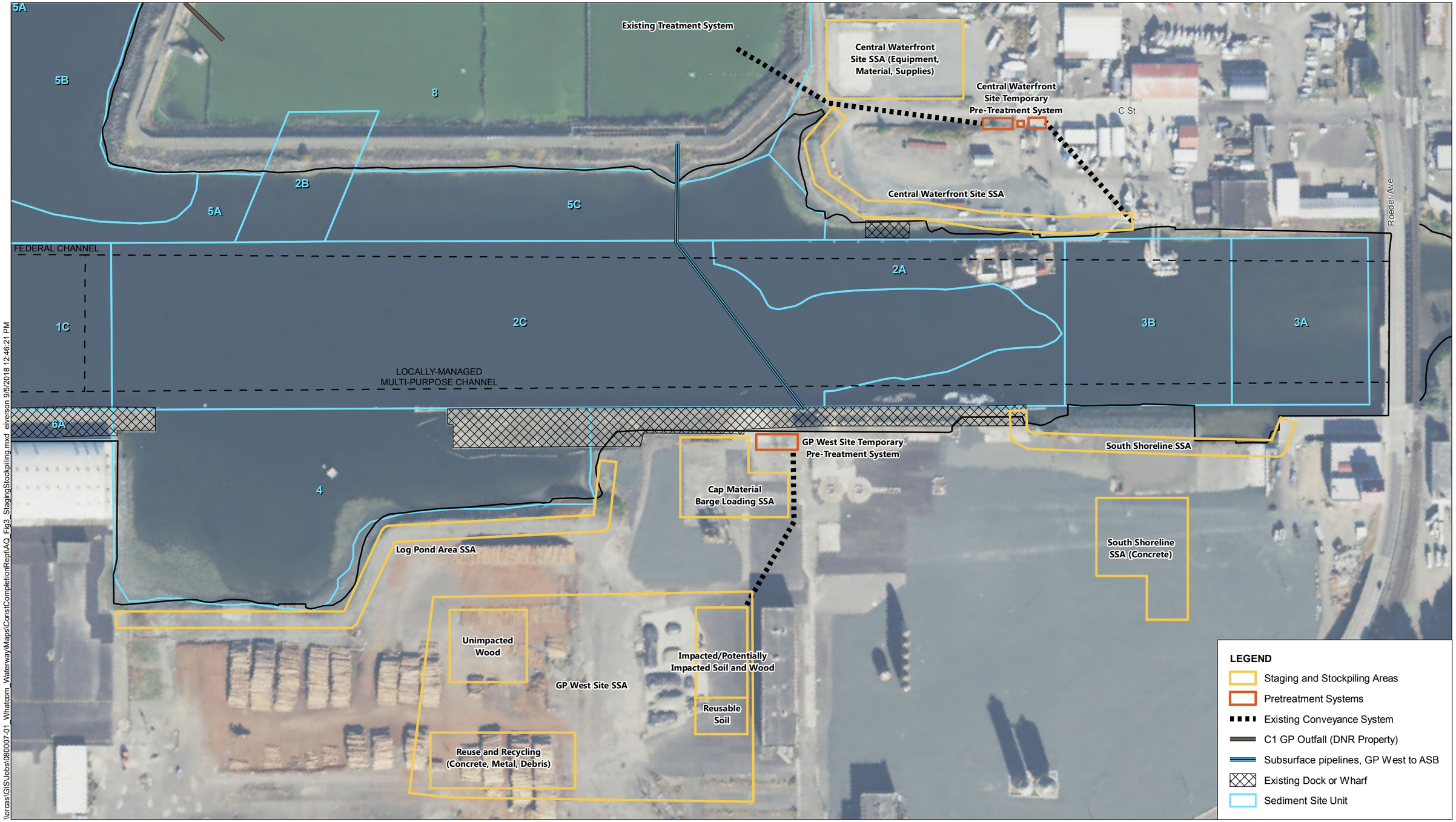
Figure 2
Cleanup Elements in Phase 1
As-built Report
Whatcom Waterway Cleanup in Phase 1 Site Areas



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NOTES:
1. Staging and stockpile areas were developed, maintained, cleaned, and removed upon completion of the Work.
2. Schematic, not to scale.
3. Sediment was loaded directly on to barges; it was not stockpiled.
4. Site units are shown based on those in Figure 2-3 Cleanup Action Plan, Whatcom Waterway Site, September 2007. Unit 9 boundary updated based on PRDI findings.
5. Unit 2B was established in the Cleanup Action Plan based on the anticipated marina access channel location. This location will be adjusted during final design.
6. Horizontal datum: Washington State Plane North, NAD 83 U.S. Survey Feet.
7. Aerial imagery from National Agriculture Imagery Program (NAIP), September 2, 2017.

Feet
0 100 200

ANCHOR QEA

Figure 3
Staging and Stockpiling Areas
As-built Report
Whatcom Waterway Cleanup in Phase 1 Site Areas

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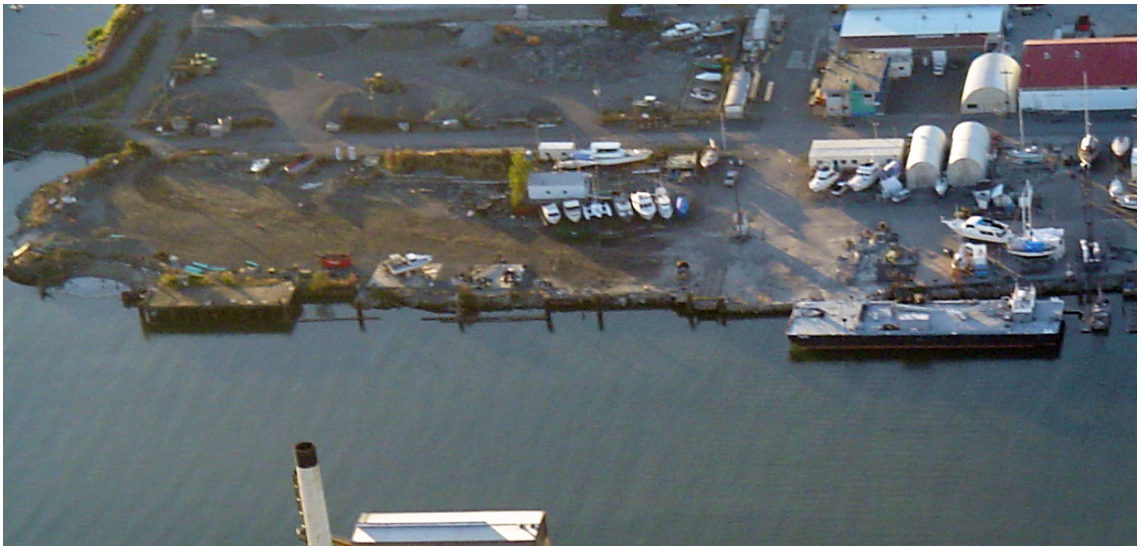

Before Construction: The Central Waterfront shoreline was characterized by unstable shoreline conditions, including extensive infill with concrete and rubble debris, failing concrete and creosote-treated timber bulkheads, and areas of eroding soils. The Chevron pier and dozens of other creosote-treated timber pilings and dolphins were present in shoreline areas. Soil and groundwater source control concerns posed risks for recontamination of sediments.

After Construction: Creosote-treated pilings, dolphins, and the former Chevron pier have been removed. Concrete and rubble debris has been removed, and the shoreline has been cut back to provide a stable sloping shoreline with improved aquatic habitat conditions. Soil and groundwater source control concerns have been addressed with the installation of over 700 feet of containment wall, most buried below grade. Pilings and dolphins required for continued operation of marine trades activities have been replaced with structures that serve the same function but are constructed of environmentally friendly materials.

\\fuji\anchor\Projects\Port of Bellingham\080007-01 Whatcom WW Cleanup and Marina\Construction Management\Task 12 - Project Closeout and Reporting\Construction Completion Report\Figures\Section_3\Figure 5.docx

Before Construction: The shoreline was unstable with a damaged concrete bulkhead. Creosote-treated pilings and unauthorized floats were present in the offshore area.

After Construction: The creosote-treated pilings and unauthorized floats were removed. The exposed bulkhead was eliminated and the shoreline was stabilized with a sloping engineered cap.

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Before Construction: The South Shoreline consisted of a vertical bulkhead and fill area occupied by the abandoned clarifier structure. Numerous creosote-treated timber dolphins and unused structures were present.

After Construction: Unused in-water structures were removed. The clarifier and associated creosote-treated timber bulkhead were removed. A shoreline cutback was performed to create a gently sloping, stable shoreline. The shoreline and subtidal areas were capped to safely contain residual impacted sediments.

\\fuji\anchor\Projects\Port of Bellingham\080007-01 Whatcom WW Cleanup and Marina\Construction Management\Task 12 - Project Closeout and Reporting\Construction Completion Report\Figures\Section_3\Figure 7.docx

Before Construction: Most of the South Shoreline area consisted of a vertical creosote-treated timber bulkhead supporting an area of fill and the abandoned concrete clarifier structure.

After Construction: The bulkhead in the South Shoreline area was removed along with the clarifier and other structures. The slope was cut back to provide a stable, sloping shoreline and enhance habitat quality and quantity in this area.

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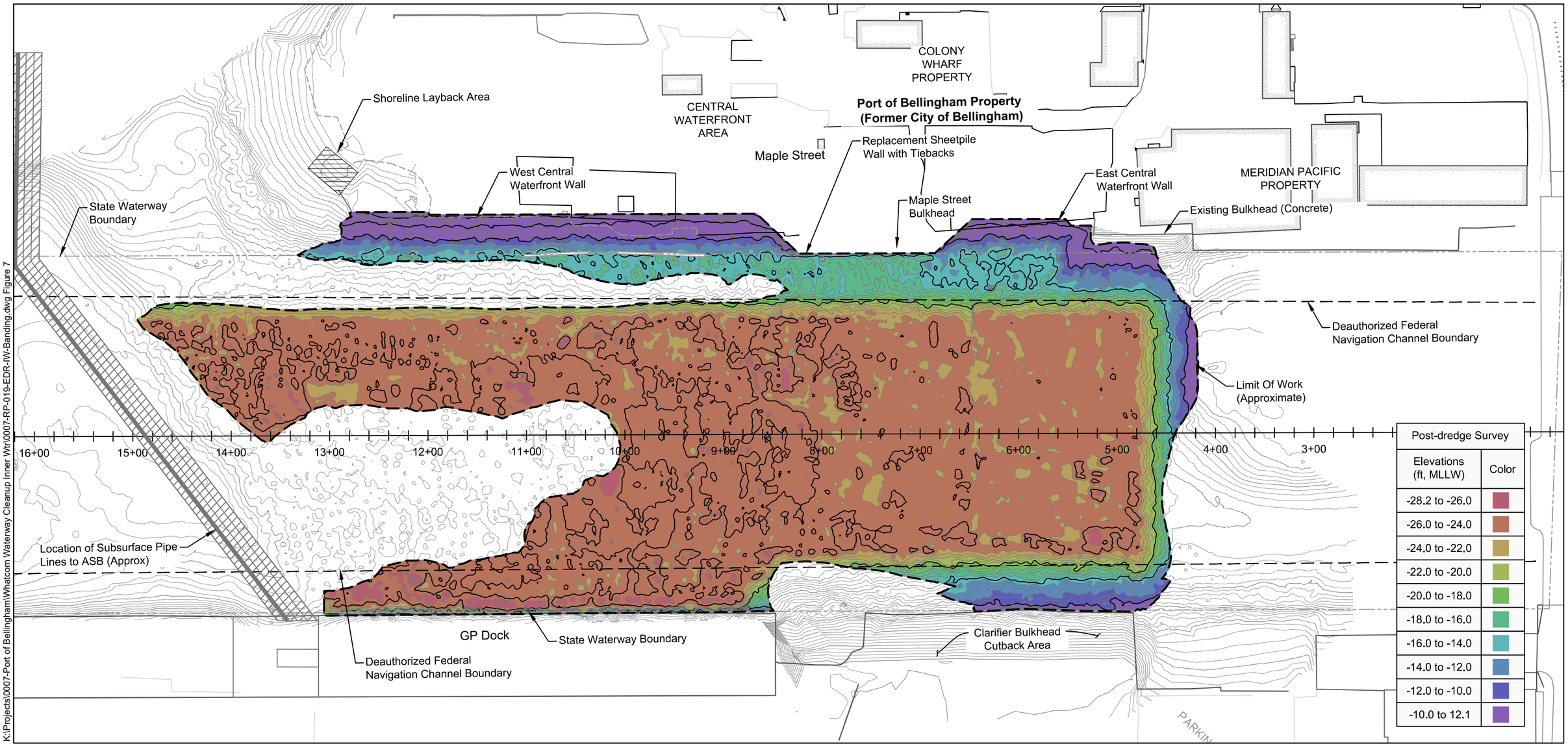
Figure 7
Project Results – South Shoreline Cutback
Adjacent to Clarifier (facing southwest)
As-Built Report/Whatcom Waterway Cleanup in Phase 1 Site Areas



K:\Projects\0007-Port of Bellingham\Whatcom Waterway Cleanup Inner Wtr\0007-RP-019-EDR-IW-Banding.dwg Figure 7

Jan 09, 2017 11:50am tgriga

SOURCE: Bathymetric survey from 2016 provided by Northwest Hydro, Inc.
HORIZONTAL DATUM: Washington State Plane North, NAD83, Feet.
VERTICAL DATUM: Mean Lower Low Water (MLLW), Feet.

NOTE:
1. Figure does not show excavation/backfill behind containment wall.

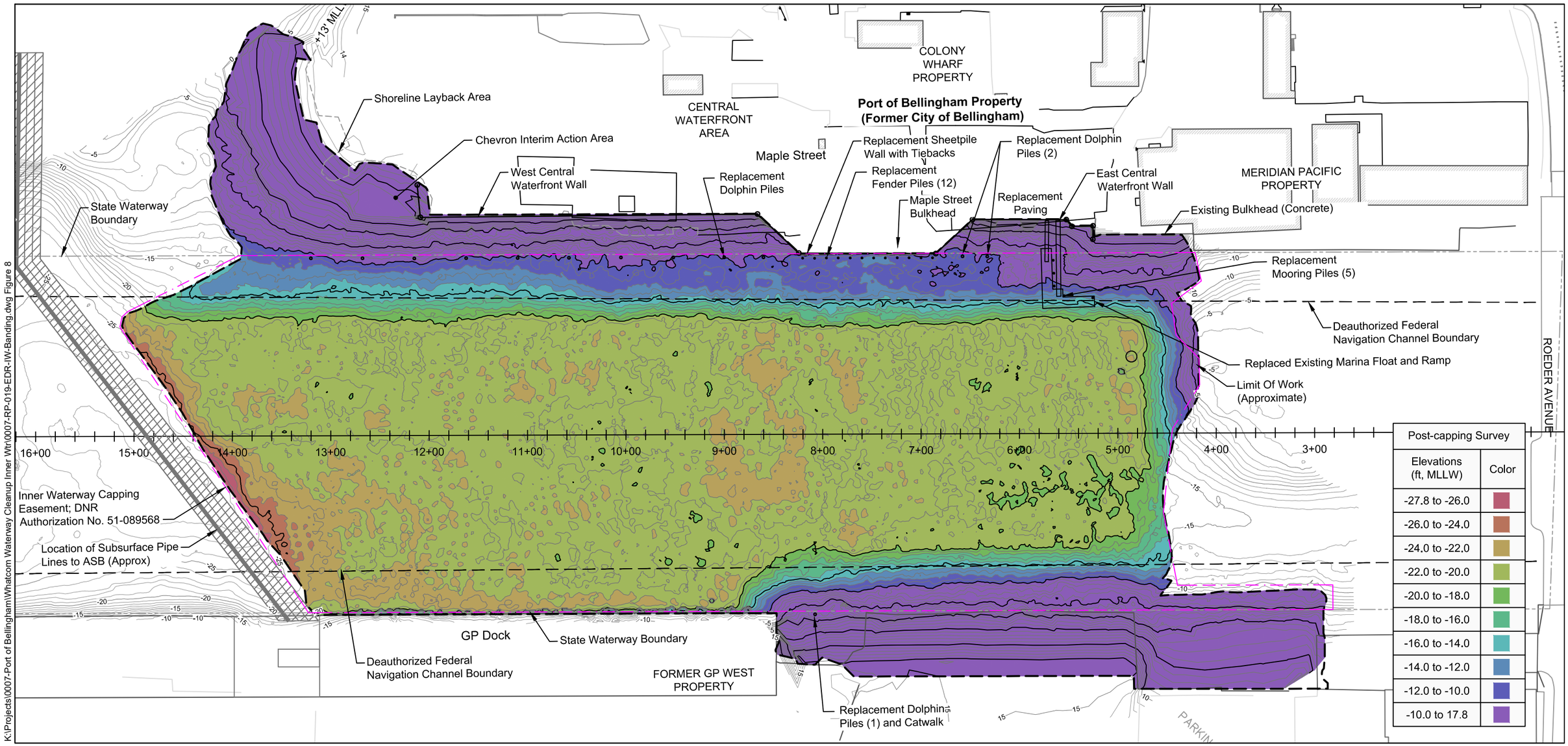
LEGEND:

- Existing Major Contour (5' Interval)
- Existing Minor Contour (1' Interval)
- Area of Dredging
- Post-dredge Major Contour (5' Interval)
- Post-dredge Minor Contour (1' Interval)

0 100
Scale in Feet

ANCHOR QEA

Figure 8
Inner Waterway Elevations Following Dredging
As-built Report
Whatcom Waterway Cleanup in Phase 1 Site Area



K:\Projects\0007-Port of Bellingham\Whatcom Waterway Cleanup Inner Wtr\0007-RP-019-EDR-IW-Banding.dwg Figure 8

Jan 09, 2017 12:01pm tgriga

SOURCE: Bathymetric survey from 2016 provided by Northwest Hydro, Inc.
HORIZONTAL DATUM: Washington State Plane North, NAD83, Feet.
VERTICAL DATUM: Mean Lower Low Water (MLLW), Feet.

LEGEND:

- Existing Major Contour (5' Interval)
- Existing Minor Contour (1' Interval)
- Inner Waterway Capping Easement (DNR Authorization No. 51-089568)
- Area of Capping
- Post-cap Major Contour (5' Interval)
- Post-cap Minor Contour (1' Interval)

0 80
Scale in Feet

ANCHOR QEA

Figure 9
Inner Waterway Elevations Following Cap Placement
As-built Report
Whatcom Waterway Cleanup in Phase 1 Site Area

K:\Projects\0007-Port of Bellingham\Whatcom Waterway Cleanup Inner Wtr\0007-RP-017-EDR-BST-LogPond-Banding.dwg Figure 9

Jan 09, 2017 11:46am tgriga

SOURCE: Bathymetric survey from 2016 provided by Northwest Hydro, Inc.
HORIZONTAL DATUM: Washington State Plane North, NAD83, Ft.
VERTICAL DATUM: Mean Lower Low Water (MLLW), Ft.

NOTES:
1. Eelgrass Survey Conducted in October 2008.

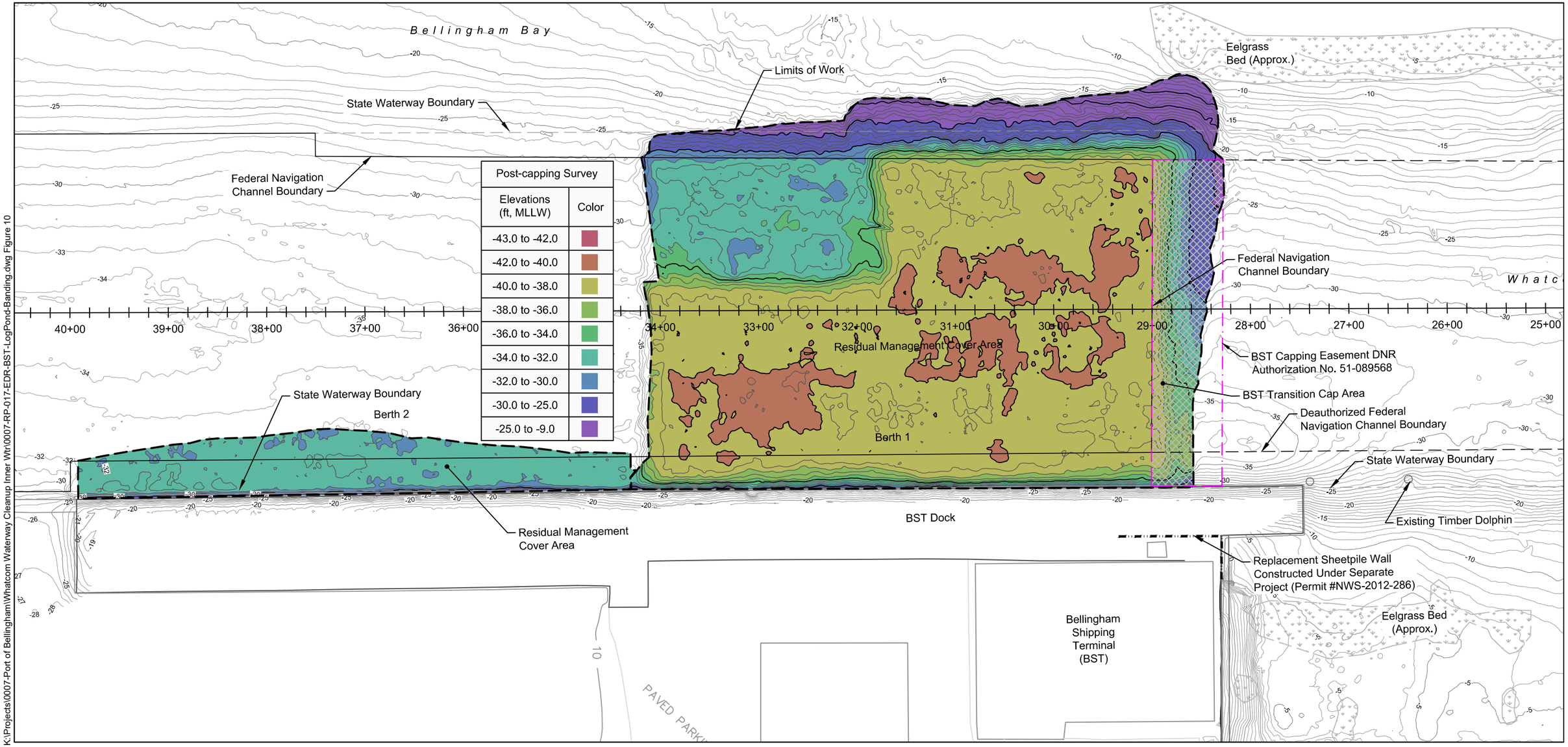
LEGEND:

- Existing Major Contour (5' Interval)
- Existing Minor Contour (1' Interval)
- Eelgrass Bed
- Post-dredge Major Contour (5' Interval)
- Post-dredge Minor Contour (1' Interval)
- Area of Dredging

0 100
Scale in Feet

ANCHOR QEA

Figure 10
Outer Waterway Elevations Following Dredging
As-built Report
Whatcom Waterway Cleanup in Phase 1 Site Area



K:\Projects\0007-Port of Bellingham\Whatcom Waterway Cleanup Inner Wtr\0007-RP-017-EDR-BST-LogPond-Banding.dwg Figure 10
Jan 18, 2017 9:59am tgriga

SOURCE: Bathymetric survey from 2016 provided by Northwest Hydro, Inc.
HORIZONTAL DATUM: Washington State Plane North, NAD83, Ft.
VERTICAL DATUM: Mean Lower Low Water (MLLW), Ft.

NOTES:
1. Eelgrass Survey Conducted in October 2008.
2. Residuals Management Finished Grade not Presented in this Figure. See Details (Figure 8c) for Residuals Management Cover and Transition Slope Area Cap.

LEGEND:

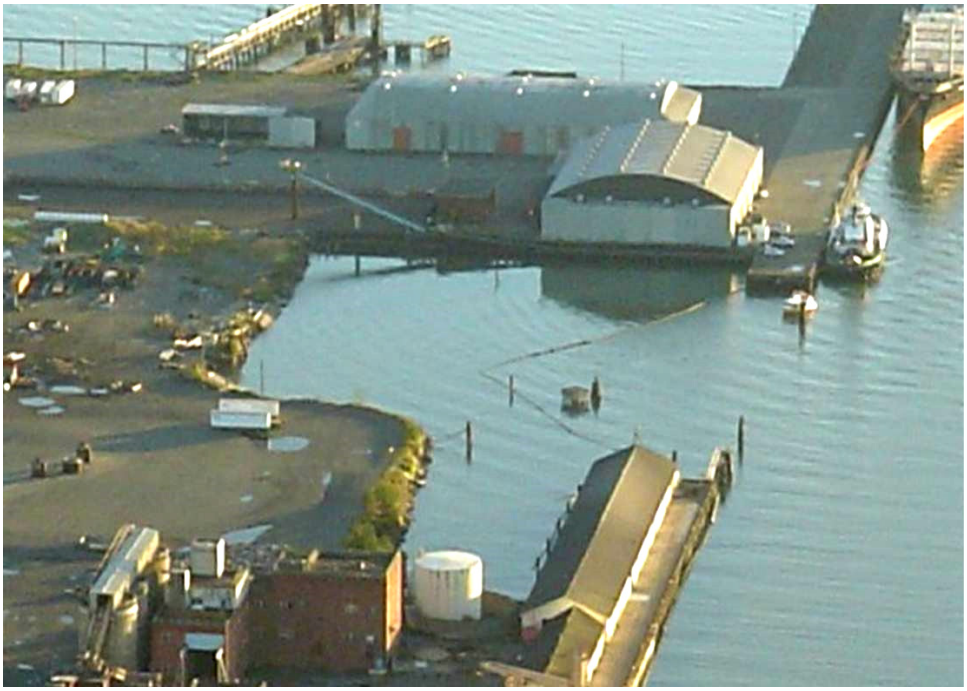
- Existing Major Contour (5' Interval)
- Existing Minor Contour (1' Interval)
- Eelgrass Bed
- Post-cap/RMC Major Contour (5' Interval)
- Post-cap/RMC Minor Contour (1' Interval)
- BST Capping Easement (DNR Authorization No. 51-089568)
- Residual Management Cover Area
- BST Transition Cap Area

0 100
Scale in Feet

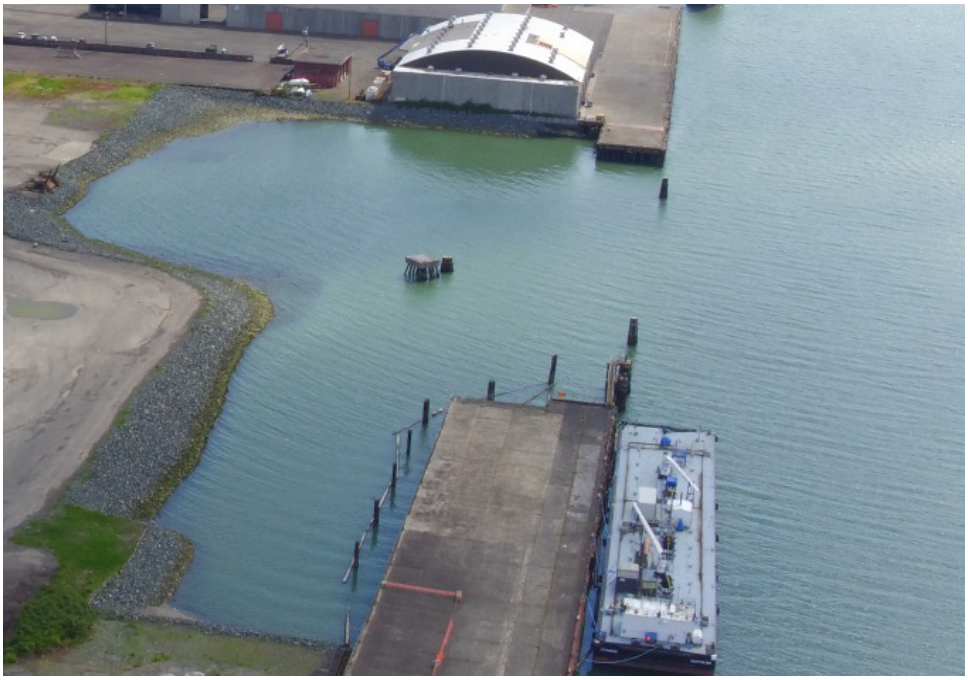
ANCHOR QEA

Figure 11
Outer Waterway Elevations Following Residuals Management and Cap Placement
As-built Report
Whatcom Waterway Cleanup in Phase 1 Site Area

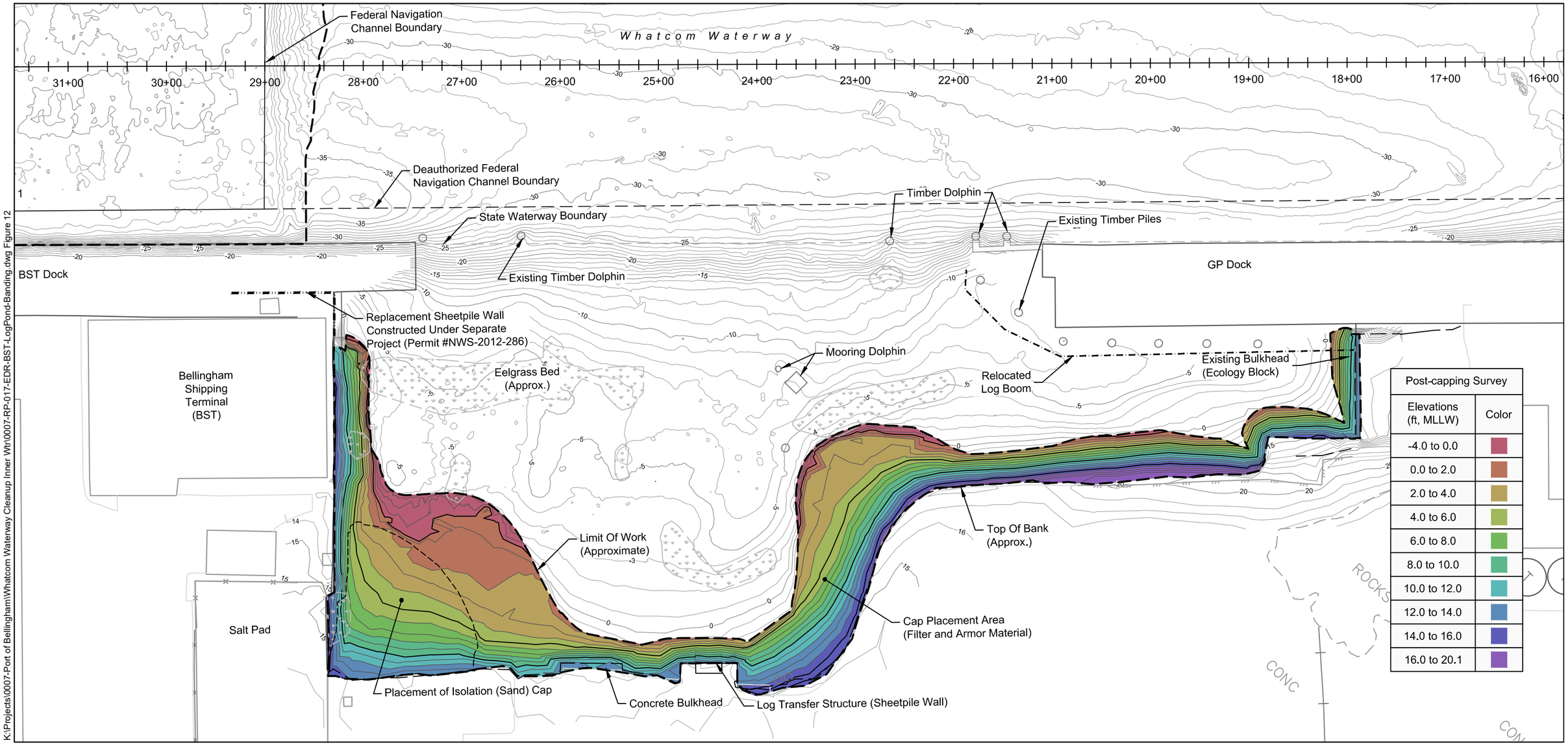
\\fuji\anchor\Projects\Port of Bellingham\080007-01 Whatcom WW Cleanup and Marina\Construction Management\Task 12 - Project Closeout and Reporting\Construction Completion Report\Figures\Section_3\Figure 12.docx



Before Construction: The Log Pond shoreline was unstable and eroding. Extensive concrete debris, numerous unused creosote-treated pilings, and timber structures were present. A creosote-treated bulkhead was present along the BST shoreline.



After Construction: Debris and unused treated wood structures were removed. The Log Pond shoreline was capped and stabilized against potential future erosion. The creosote-treated bulkhead present along the BST shoreline was eliminated.



K:\Projects\0007-Port of Bellingham\Whatcom Waterway Cleanup Inner Wtr\0007-RP-017-EDR-BST-LogPond-Banding.dwg Figure 12

Jan 18, 2017 10:34am tgriga

SOURCE: Bathymetric survey from 2016 provided by Northwest Hydro, Inc.
HORIZONTAL DATUM: Washington State Plane North, NAD83, Ft.
VERTICAL DATUM: Mean Lower Low Water (MLLW), Ft.

LEGEND:

- Existing Major Contour (5' Interval)
- Existing Minor Contour (1' Interval)
- Eelgrass Bed
- Post-cap Major Contour (5' Interval)
- Post-cap Minor Contour (1' Interval)
- Area of Capping
- Isolation (Sand) Cap Placement Area

0 100
Scale in Feet

ANCHOR QEA

Figure 13
Log Pond Elevations Following Cap Placement
As-built Report
Whatcom Waterway Cleanup in Phase 1 Site Area

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NOTES:
1. Site units are shown based on those in Figure 2-3 Cleanup Action Plan, Whatcom Waterway Site, September 2007. Unit 9 boundary updated based on PRDI findings.
2. Horizontal datum: Washington State Plane North, NAD 83 U.S. Survey Feet.
3. Aerial imagery from National Agriculture Imagery Program (NAIP), September 2, 2017.

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ANCHOR QEA

Figure 14
Sediment and Tissue Environmental Monitoring Stations
As-built Report
Whatcom Waterway Cleanup in Phase 1 Site Areas

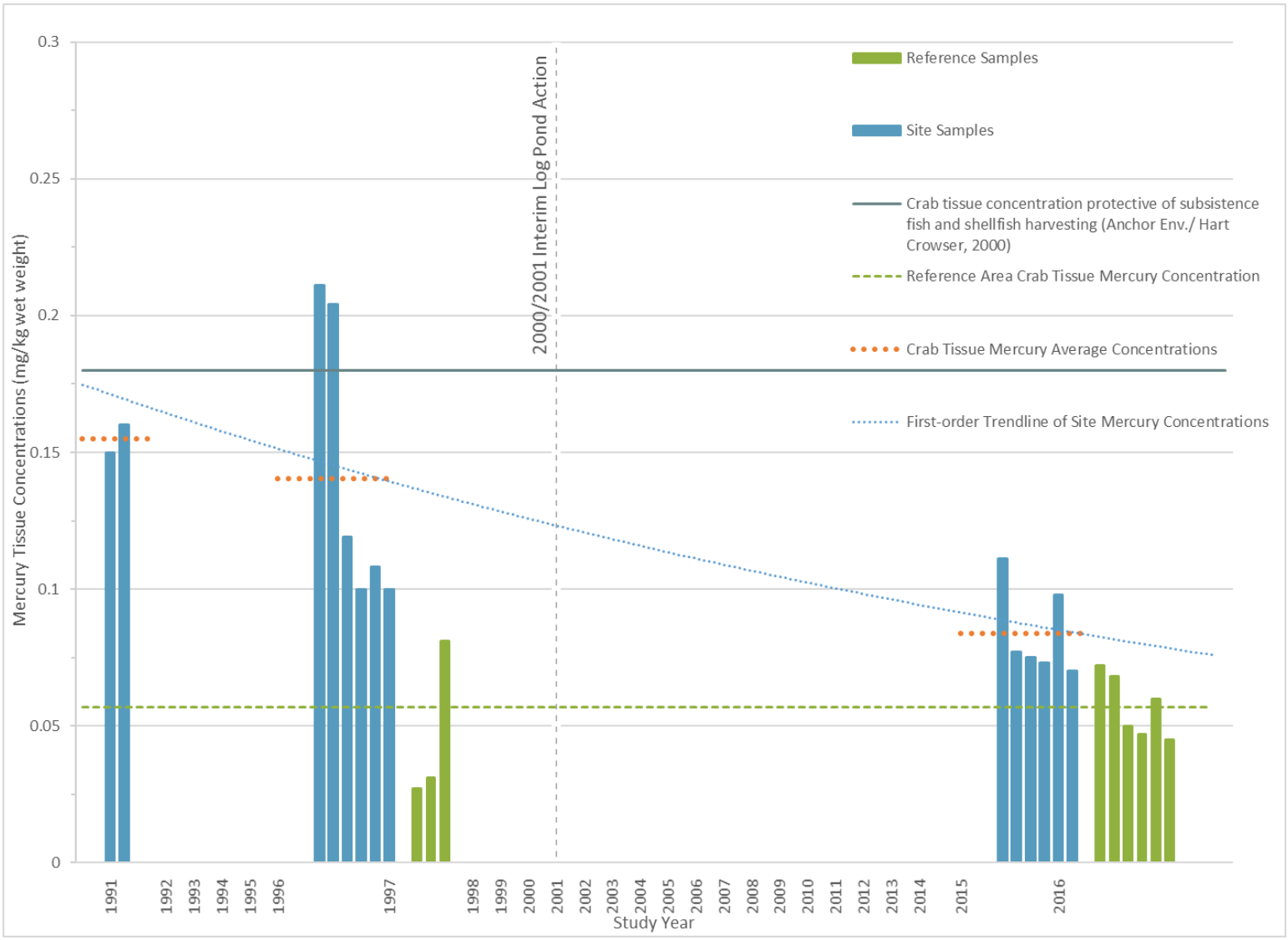

Figure 15
Mercury Concentrations in Adult Dungeness Crab Tissue
As-Built Report
Whatcom Waterway Cleanup in Phase 1 Site Areas

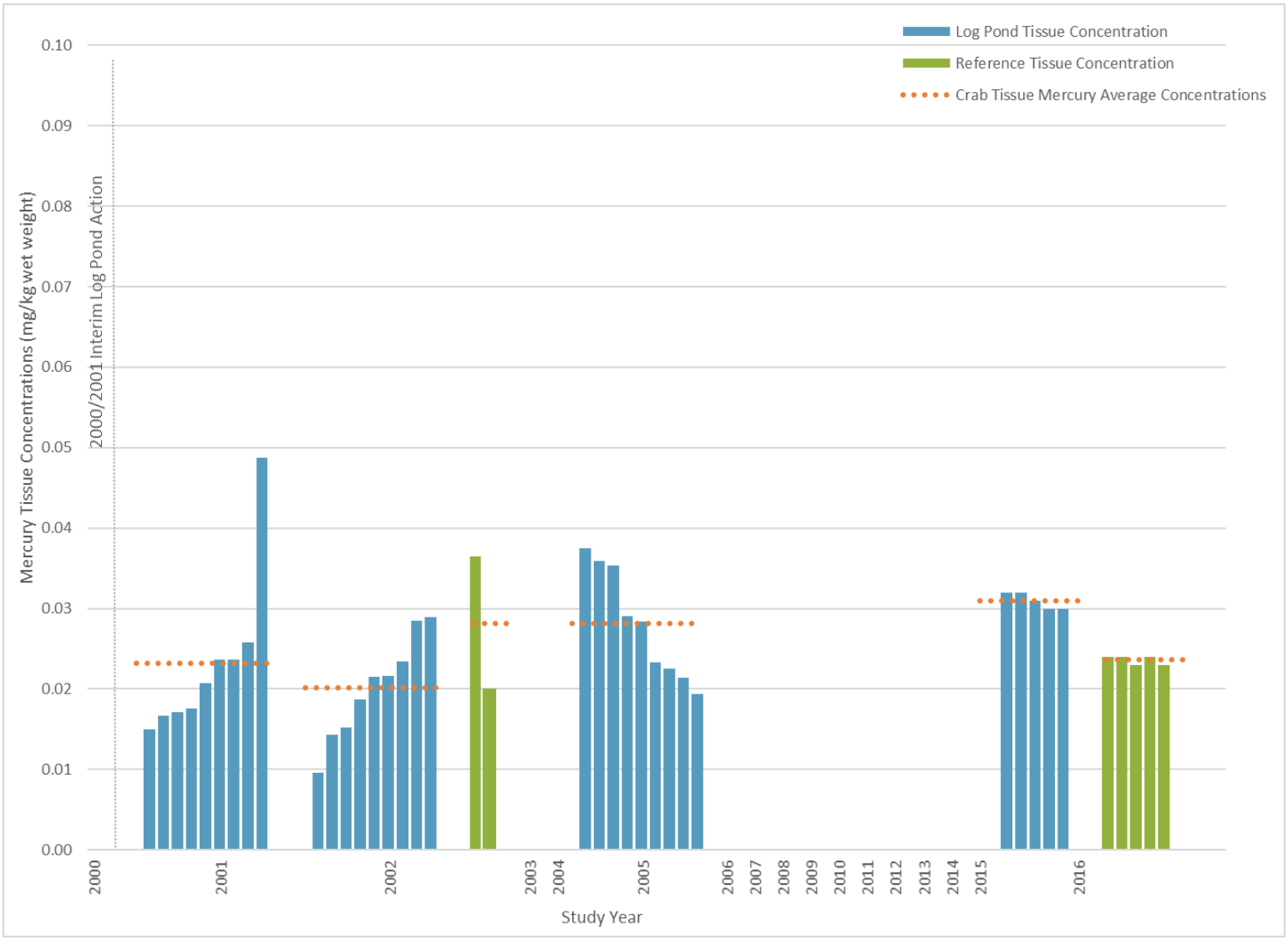

Figure 16
Mercury Concentrations in Juvenile Dungeness Crab Tissue
As-Built Report
Whatcom Waterway Cleanup in Phase 1 Site Areas

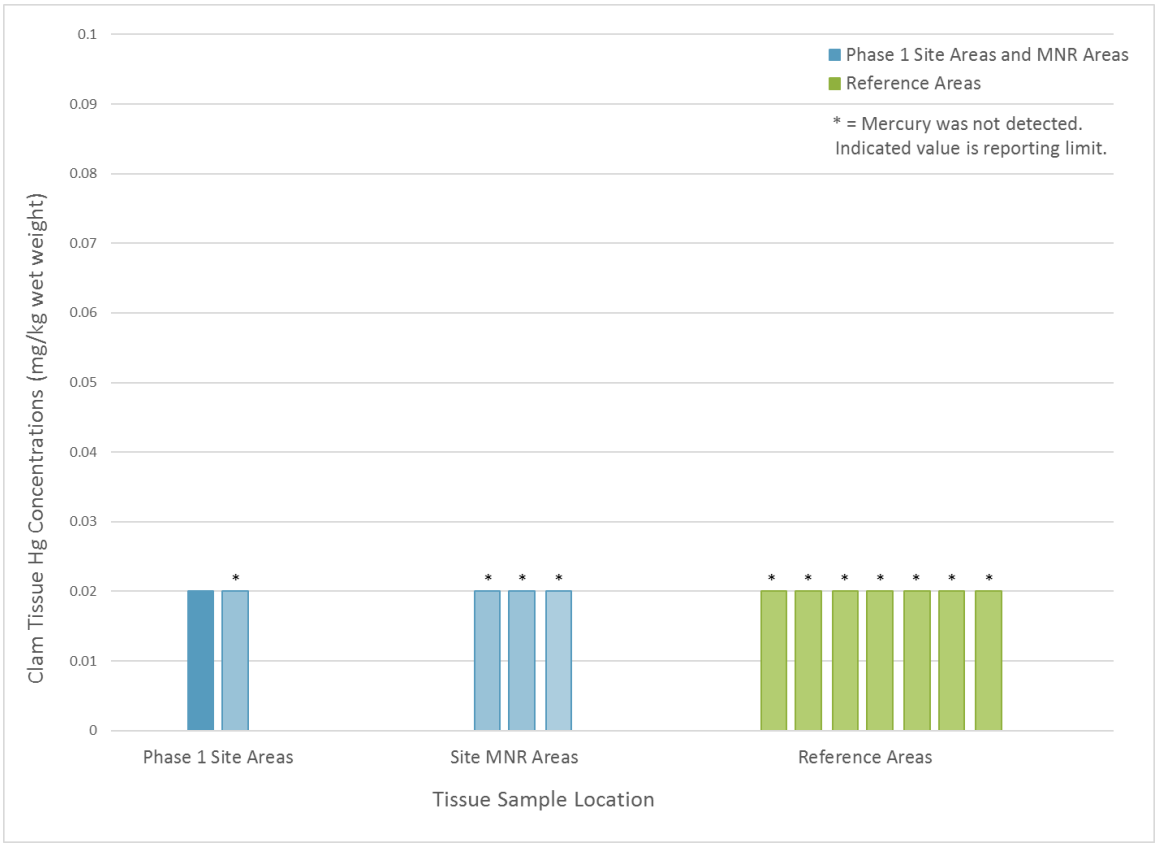

Figure 17a

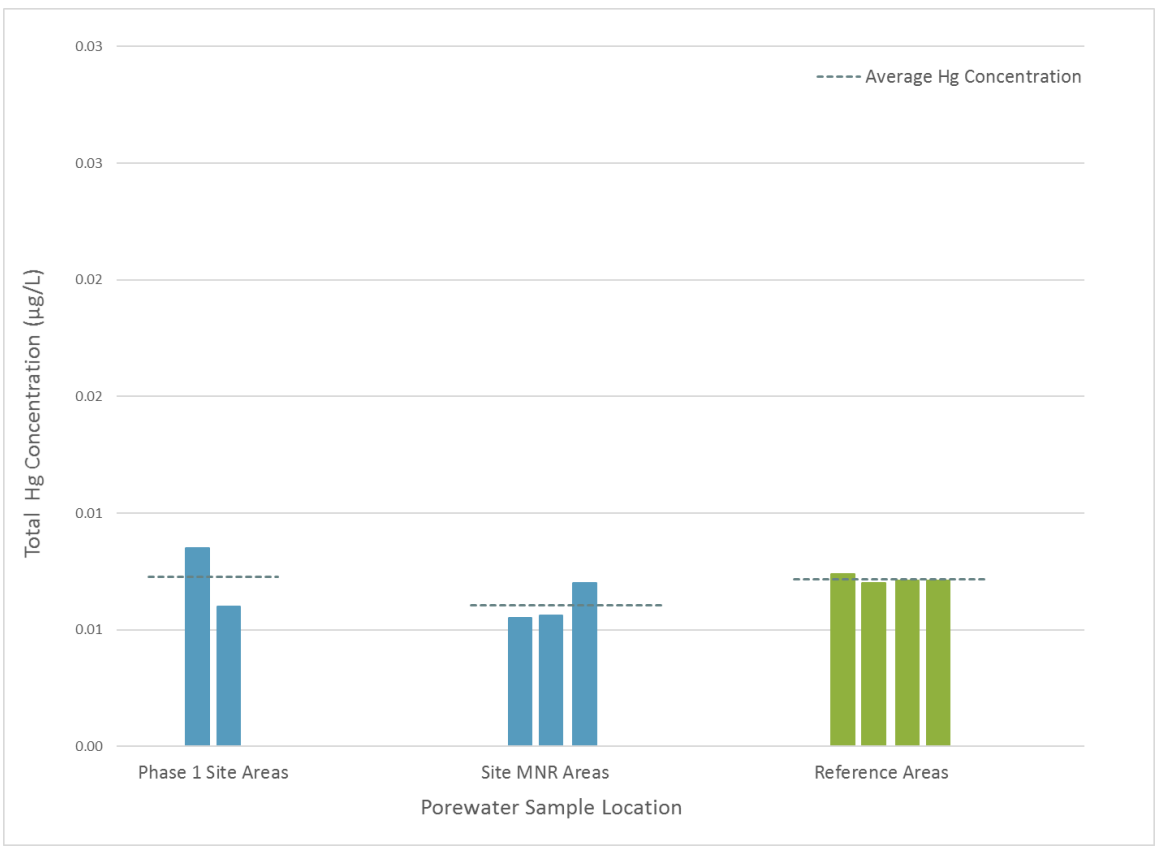

Figure 17b

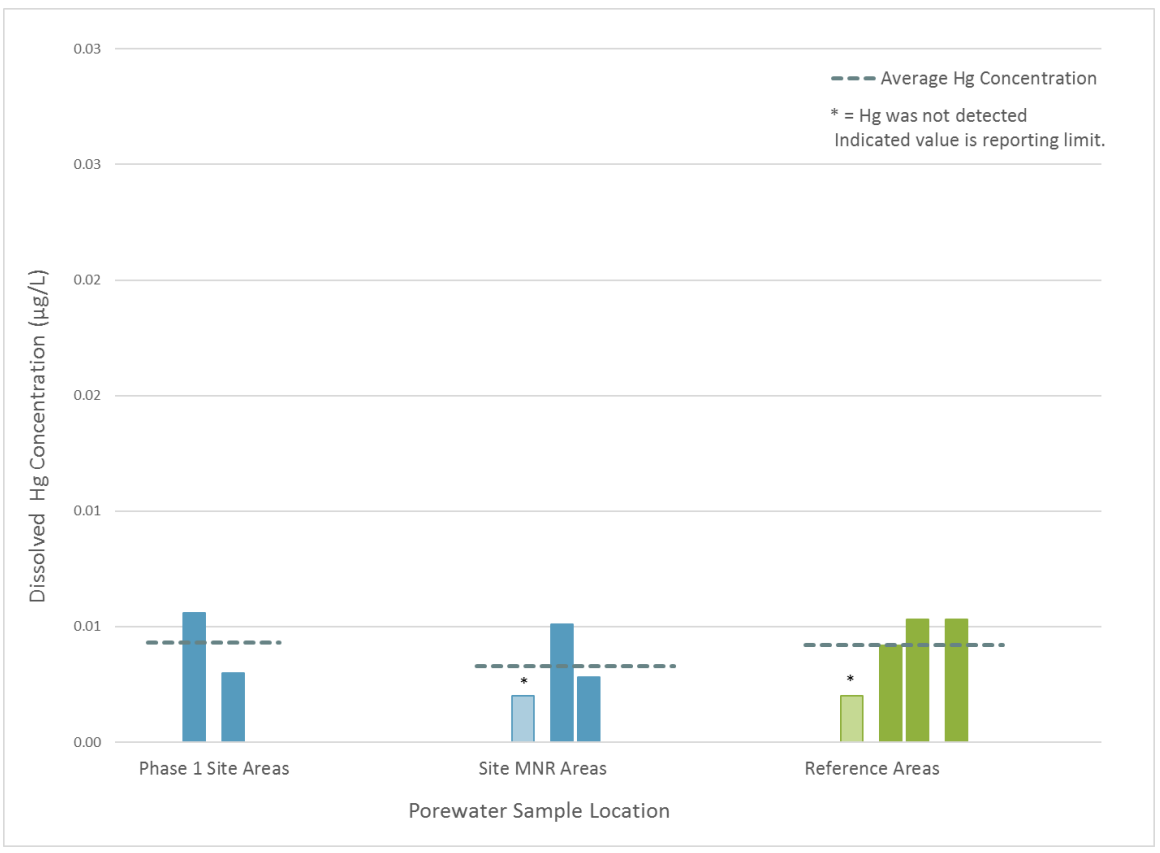

Figure 17c