FEASIBILITY STUDY REPORT

Industrial Container Services, WA, LLC

(Former NW Cooperage Site)

Seattle, Washington

Prepared for:

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Public Review Draft: September 2024

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Glossary and List of Acronyms

AET	Apparent Effects Threshold
AO	Agreed Order
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	Below ground surface
BaPEq	Benzo(a)pyrene equivalent concentration
cfs	Cubic feet per second
cis-1,2-DCE	cis-1,2 Dichloroethene
CLARC	Cleanup Levels and Risk Calculations (Ecology on-line database)
CMP	Corrugated Metal Pipe
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
cPAHs	Carcinogenic PAH
CPF	Carcinogenic Potency Factor
CSL	Cleanup Screening Level (sediment)
CUL	Cleanup Level
CWA	Clean Water Act
dCAP	Draft Cleanup Action Plan
DCA	Disproportionate Cost Analysis
DCE	Dichloroethene
DL	Detection Limit
DNAPL	Dense Non-Aqueous Phase Liquid
DOF	Dalton, Olmsted & Fuglevand, Inc.
DRO	Diesel Range Organics (petroleum hydrocarbons)
ED	East Drum Reconditioning Bldg. Remedial Area

Ecology	Washington State Department of Ecology
EF	Exposure Frequency
ENR-ULs	Enhanced Natural Recovery-Upper Limits (in EPA 2014 ROD)
EPA	United States Environmental Protection Agency
FDDA	Filled Drainage Ditch Area (Remedial Area)
foc	Fraction Organic Carbon
FOE	Frequency of Exceedance
FS	Feasibility Study
gpd	Gallons per day
GPR	Ground Penetrating Radar
GW	Groundwater
HG	Hazard Quotient
HH	Human Health
ICS	Industrial Container Services, WA, LLC
Kg	Kilogram
LDW	Lower Duwamish Waterway
LNAPL	Light (Less Dense) Non-Aqueous Phase Liquid
mg/kg	Milligrams per kilogram
mg/l	Milligrams per liter
MHHW	Mean Higher High Water
MLLW	Mean Lower Low Water
MNA	Monitored Natural Attenuation
MOU	Memorandum of Understanding
MTCA	Model Toxics Control Act (Chapter 173-340 WAC)

msl	Mean Sea Level
N	Number of samples
NAVD88	North American Vertical Datum 1988
ng/l	Nanogram per liter
NTR	National Toxics Rule
NWC	Northwest Cooperage
OCN	Organic Carbon Normalized
PA	Peripheral Remedial Area
PAH	Polycyclic Aromatic Hydrocarbon
PCBs	Polychlorinated Biphenyls
PCDD/PCDF	Polychlorinated dibenzo-p-dioxins/dibenzofurans
PCE	Tetrachloroethene
PLP	Potentially Liable Person (or entity)
POC	Point of Compliance
PQL	Practical Quantitation Limit
RAL	Remedial Action Level (under CERCLA)
RAO	Remedial Action Objective
REL	Remediation Level (under MTCA equivalent to RAL under CERCLA)
RL	Reporting Limit
RI	Remedial Investigation
ROD	Record of Decision
RRO	Residual Range Organics (heavy oil petroleum hydrocarbons)
RRTF	Reasonable Restoration Time Frame
SCe-COC	Ecologic (wildlife) Soil Contact COC

SCO	Sediment Cleanup Objective
SCw-COC	Utility Worker Soil Contact COC
SED	Sediment
SL	Screening Level
SMS	Sediment Management Standards
SQS	Sediment Quality Objectives
SVOC	Semivolatile Organic Compounds
TCE	Trichloroethene
TEE	Terrestrial Ecologic Evaluation
TEF	Toxicity Equivalency Factors
TEQ	Toxicity Equivalency Quotient
ug/l	Micrograms per liter
UCL95%	Upper 95% Confidence Limit on the True Mean
VC	Vinyl Chloride
VOC	Volatile Organic Compound
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This Feasibility Study (FS) was prepared for the Industrial Container Services, WA, LLC (ICS) site (formerly known as Northwest Cooperage Inc. herein NWC). The site vicinity is shown on Figure 1-1. The purpose of a Remedial Investigation/Feasibility Study (RI/FS) "*is to collect, develop, and evaluate sufficient information regarding a site to select a cleanup action under WAC 173-340-360 through 173-340-390" [WAC 173-340-350(1)]*.

A report titled "*Technology Screening and Development of Remedial Alternatives, Feasibility Study*" was submitted to Ecology on November 6, 2018 (DOF 2018). Comments were received in a letter dated May 17, 2019 (Ecology 2019) and were incorporated into the initial full draft of the FS submitted in early March 2020. Comments on the complete draft FS were received from Ecology on February 1, 2021, and this draft FS was revised based on these comments and other comments received via e-mail on August 23, 2023. Revised Sections 1 to 6 were previously submitted to Ecology on July 12, 2021. In addition to working towards completion of the main body of the FS report, Ecology and DOF resolved issues concerning the base numerical model prepared by Keta Waters (2021 in Appendix A) and most of the issues associated with analysis of the fate and transport of PCBs in groundwater by DMD Inc. (Appendix B). A final version of the base model report was submitted to Ecology on January 5, 2022, along with final responses to comments. Most of the comments concerning the DMD reports have been resolved with resolution of comments submitted to Ecology on January 5, 2022. Resolution of the remaining comments were achieved with revision of the November 2023 draft FS. With a change in Ecology site managers, additional comments were received on April 30, 2024. This "Public Review Draft" incorporates resolution of those comments.

The FS was prepared to meet the requirements of Agreed Order (AO) DE6720. The FS is supported by 1) a RI report prepared by Dalton, Olmsted & Fuglevand, Inc. (DOF 2020), 2) Additional groundwater data (collected in February 2019 and discussed in Section 4.0 below), 3) Hot-spot characterization report submitted to Ecology in May 2021 and revised based on Ecology comments received on December 3, 2021 (DOF 2022 in Appendix D), 4) Technical memoranda describing the site specific fate and transport properties of PCBs in groundwater (DMD [2019, 2020, 2021a, 2022b in Appendix B), and 5) Results of numerical groundwater modelling (Keta Waters 2021, 2022a, 2022b in Appendix A).

The FS covers the ICS/NWC upland and ICS/NWC-Douglas embayment intertidal areas as defined in the Lower Duwamish Waterway (LDW) Record of Decision (ROD) (Figure 1-2). Under an interagency Memorandum of Understanding (MOU 2004), the Washington State Department of Ecology (Ecology) is generally responsible for completing upland source control cleanups while the U.S. Environmental Protection Agency (EPA) is responsible for in-water remediation. The dividing line for source control vs. sediment remediation is mean higher high water (MHHW; +12 feet mean lower low water or MLLW). However, the MOU provides flexibility in apportioning responsibility, and, in this case, Ecology has assumed the lead with respect to intertidal sediments within a tidally affected marine embayment located within the site.

The LDW ROD (EPA 2014) is based on a RI/FS completed for the LDW. This process completed by EPA, including public review, selected a remedy for the embayment portion of the site generally consisting of contaminated sediment removal and capping. The selected intertidal embayment remedy is incorporated into this FS to allow integration of the intertidal and upland portions of the site. The focus of this FS is the embayment and ICS/NWC upland property. Data associated with the Douglas property (described in Subsection 1.2.2) is discussed so that the impact to the Douglas property can be generally assessed. A supplemental FS for the Douglas property will be completed once characterization data gaps are addressed.

For purposes of this FS, the ICS upland and the embayment are divided into two areas that include 1) embayment and southern embayment shoreline (Embayment Area), and 2) ICS upland generally located south of the embayment area and beneath the eastern portion of the ICS upland property (Figure 1-3). This was done because cleanup of the southern shoreline requires integration with the embayment cleanup, as soil/sediment contamination appears contiguous. In addition, cleanup of the local LDW main channel is to some degree dependent on cleanup of the Embayment Area and the permitting requirements are different as compared to upland areas. Cleanup of the remainder of the upland site is not directly dependent on the Embayment Area or LDW main channel cleanup. In this FS, these two areas were assessed separately to identify cleanup alternatives and preferred remedies. The boundaries of the two areas may be adjusted during engineering design.

The remainder of this FS is divided into eleven sections.

- **Section 1 –** Provides information on site location and generally describes the project area.
- **Section 2 –** Presents the conceptual site model including descriptions of the site hydrogeology, exposure pathways and potential receptors.
- **Sections 3 to 6 –** Describe development of screening levels, contaminants of concern (COCs), areas of concern and migration pathways, ARARs[i], and Remedial Action Objectives (RAOs).
- **Section 7 –** Presents and evaluates several remedial configurations for the Embayment Area remedy generally based on the LDW ROD. The remedial configurations were evaluated, and a preferred remedial configuration is proposed.
- **Sections 8 and 9 –** Section 8 consists of a discussion of possible remedial technologies that could be applied to the ICS Upland portion of the site. Potentially applicable technologies were formed into remedial alternatives that are presented in Section 9.
- **Section 10 –** Presents an evaluation of the identified upland remedial alternatives.

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[i] Applicable or Relevant and Appropriate Requirements

- **Section 11 –** Presents a preferred remedial alternative for the embayment and ICS Upland portions of the site.
- **Section 12 –** Presents references cited in this FS.

1.2 LOCATION AND GENERAL DESCRIPTION

The Site consists of several properties located on the west side of the LDW near the 1st Ave. South Bridge (Figure 1-1). The properties are designated herein as the ICS/NWC property and the Douglas property as described below.

1.2.1 ICS/NWC PROPERTY

The primary focus of this FS is the former NWC property, now operated by ICS, located at 7152 1st. Avenue South, Seattle, Washington (herein termed *"ICS/NWC property"*) (Figure 1-2). The property is owned by Herman and Jacqueline Trotsky and consists of three King County tax parcels with the following parcel identification numbers - 2924049108, 2924049030 and 2924049004 (Figure 1-4). The property has the following Ecology site identifier numbers:

- Facility (FS) ID – 2154
- Cleanup Site ID – 62

The ICS/NWC property is approximately 7.1 acres in size and includes two general areas:

- Upland Area (main facility and paved storage yard – Figure 1-5), and
- Portion of an embayment (north of main facility – Figures 1-3, 1-5, 1-7, and 1-6). The embayment is located at approximate river mile 2.2 of the LDW.

The upland area comprises approximately 6.3 acres and the embayment portion is approximately 0.8 acre in size. The upland land surface slopes gently downward in a northerly direction from an elevation of approximately 20 feet MLLW[ii] at the southern property line to approximately 15 feet MLLW adjacent to the embayment[iii].

The property is zoned IG1/IG2 General Industrial. King County's tax assessment web page indicates the current use (manufacturing) being the highest and best use. As discussed in the 2019 Land Use Memorandum (DOF 2019 – herein included as Appendix C), the site meets the

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ii In this report elevations are referenced to two datum's: Mean Lower Low Water (MLLW) and North American Vertical Datum 1988 (NAVD88). In the RI it was assumed that MLLW = NAVD88 plus 2.435 feet based on an older conversion value. The conversion value is not static and changes periodically. A more recent survey of the embayment by Bush, Roed & Hitchings, Inc. indicated a conversion of MLLW=NAVD88 plus 2.39 feet, a difference of 0.045 feet. The difference between the two conversion factors does not affect completion of this FS. For clarity, the specific conversion factor on which MLLW elevations are based is shown on the appropriate figures.
iii Property lines were surveyed in December 2009 by Continental Survey Company and earlier site topography was determined from aerial photogrammetric mapping by David C. Smith Associates in March 2010.

definition of an industrial property under the Model Toxics Control Act (MTCA)[iv] rules and can be used to develop and evaluate cleanup alternatives in the FS to assess protectiveness via the direct contact and terrestrial ecologic exposure pathways.

Administrative activities and drum manufacturing/refurbishing occur in several buildings located generally within the central and northwest portions of the site (Figures 1-3, 1-5 and 1-8a,b). Drum storage generally occurs within the southern and eastern portions of the property (Figure 1-8a).

Most of the site is paved and storm water is collected, treated, as necessary, and discharged under permit to the sanitary sewer. Storage of storm water before discharge occurs in several storage tanks (Baker tanks) located near the northeast corner of the facility (Figure 1-8b). There is a buried storm water conveyance that runs along the western margin of a filled in drainage ditch along the eastern site boundary (Figures 1-7 and 1-8b). The conveyance receives storm water from properties to the south and discharges to the embayment at the 2nd Ave. Outfall. No ICS storm water drains to this conveyance. Two control manholes are present near the southeast corner of the site.

The head of the embayment lies at an elevation of approximately 10 feet MLLW and slopes downward to approximately -1.0 feet MLLW at the mouth. Remnants of a former wharf (primarily pilings), wooden training walls, horizontal large timbers, and concrete/metal/wood debris are present in the embayment (Figures 1-6). An ecology block wall supports a portion of the north embayment shoreline, and the partially pile supported floor of a demolished building is present on the west side of the wall. The shoreline beneath the floor appears to be composed of a rockery type wall. Along with the 2nd Ave. Outfall discussed above; a Seattle reservoir overflow outfall exists at the head of the embayment.

The sediment surface along the north shoreline is composed of a relatively hard "*precipitate cap*" as shown on Figure 1-6. This feature appears to have been created by discharges from a cement plant that was formerly present on the Douglas property. The precipitate cap was remapped by DOF in June 2021 (DOF 2021b)

1.2.2 DOUGLAS PROPERTY

The Douglas property is located at 7100 1st Ave. South, Seattle, Washington, adjacent to the LDW and north of the ICS/NWC property (Figures 1-2 and 1-3). The property includes the north portion of the Embayment Area. The property was created in the mid- to late-1960s by placing fill over a former turning basin.

Discussion of this property is included because there is evidence (discussed in Section 6.3 of the RI) that past releases from the ICS/NWC property migrated beneath what is now the Douglas

iv Chapter 173-340 WAC

property footprint. A separate RI and FS are being completed by the property owner under Agreed Order DE 8258. A draft RI report (GeoEngineers 2016) was submitted to Ecology and pertinent information contained in the Douglas RI draft report have been incorporated into the RI for this site.

The Douglas property is owned by 7100 1st Ave. S. Seattle LLC and consists of one King County tax parcel with the following parcel identification number 2924049090 (Figures 1-2, 1-3 and 1-4). Alaska Marine Lines currently operates on the property as a freight management facility for the transfer of shipping containers between barge and truck, and for container and equipment storage. The property has the following Ecology site identifier numbers:

- Facility (FS) ID – 97573251
- Cleanup Site ID – 6967

The Douglas property is approximately 3.1 acres in size and includes two general areas:

- Upland Area (transfer facility and paved storage yard), and
- Portion of an embayment (south of main facility)

The upland area comprises approximately 2.5 acres and the embayment portion is approximately 0.55 acre in size. The upland land surface is paved and ranges in elevation from +20 feet MLLW on the west to approximately +18 feet MLLW on the north and east.

Alaska Marine Lines leases property owned by the Washington State Department of Transportation (WSDOT). The property is generally located between the Douglas west property line and 1st Ave. South and includes the head of the embayment as illustrated on Figure 1-3.

2.0 CONCEPTUAL SITE MODEL

2.1 SITE HYDROGEOLOGY

The project area lies within the Duwamish River valley (Figure 1-1). Uplands are present on the eastern and western sides of the valley. Regionally, groundwater recharge occurs on the uplands with groundwater discharge to the valley and LDW.

The geology and groundwater zones have been characterized and consist of the following units/zones. Figures 2-1a and 2-1b generally illustrate the subsurface conditions. Unit designations are summarized in Table 2.1 below.

Table 2.1 – Hydrogeologic Units

ICS-NWC Property		Embayment		Boyer Towing (a)		Douglas Property	
Geologic Unit	**GW Zone**	**Geologic Unit**	**GW Zone**	**Geologic Unit**	**GW Zone**	**Geologic Unit**	**GW Zone**
Upper Sand	Water Table	Upper Sand	-----	Upper Sand	Water Table	Dredge Sand	Water Table/Upper
Fine Grained Unit	Aquitard (where present)	Fine Grained Unit	Aquitard (where present)	Not present		Fine Grained Unit	Aquitard (where present)
Lower Sand	Upper/ Lower	Lower Sand	Lower	Lower Sand	Upper/ Lower	Lower Sand	Lower

Note: (a) – Boyer Towing property is located on the east side of the ICS property.

In general, the geologic materials beneath the site consist of interbedded finer-grained sands and silts. The embayment was created by placing dredge fill to the north of the ICS/NWC property, now the Douglas Property. A fine-grained aquitard (silt/clay) deposit underlies the western portion of the ICS/NWC property, the embayment and southern portion of the Douglas property (Figure 2-2). Where present, the aquitard retards the vertical migration of groundwater. The designated groundwater zones are present as follows:

- The water table zone is present beneath the entire site. It lies within the Upper Sand unit.

- The upper zone lies beneath the aquitard and directly below the water table zone where the aquitard is not present. For discussion and analytical purposes, where the aquitard is absent, the water table zone extends to a depth of approximately fifteen feet below ground surface (bgs) and the upper zone is present from depths of approximately 15 feet to 20/25 feet bgs. These zones lie within the upper sand and upper portion of the lower sand units.

- The lower zone lies beneath the upper zone and lies within the lower sand unit.

Water levels in the groundwater zones are affected by tides, except within the water table zone above the aquitard. Water levels in monitoring wells screened above the aquitard are not influenced by LDW tidal fluctuations based on water level measurements made during low/high tides in April 2016 and February 2018. During higher tides surface water and groundwater flow into both properties while during lower tides flow reverses towards the embayment and LDW. Figures 2-1a and 2-1b show estimated average flow directions.

Using available data, a groundwater model was developed by Keta Waters (Dr. Joel Massmann P.E.) to assist in assessing remedial alternatives. The base model is described in a report by KetaWaters (2021) that is presented in Appendix A. Average modeled flow directions in the upper sand (water table zone) and upper portion of the lower sand (upper zone) are towards the embayment in the area along the shoreline and towards the LDW elsewhere beneath the ICS/NWC and Douglas properties. Average (net) modeled flows in the lower zone portion of the lower sand are towards the LDW (beneath the entire site including the embayment). Approximately 7.1% (300 ft3/day or 1.6 gallons per minute - gpm[v]) of the total recharge to the modelled area discharges to the embayment while the remaining 92.9% (3,899 ft3/day) discharges the LDW.

Vertical hydraulic gradients are present, the direction of which changes with tidal levels. Generally upward gradients are present during high tides and downward gradients are present during low tides. The pattern of groundwater level fluctuations indicates that a hydraulic barrier, which restricts horizontal flow, is present along the central ICS/NWC embayment shoreline. This barrier likely consists of buried bulkheads and other features.

An analysis of conventional ions (Cl, Na, SO_4, Ca and Mg) for the ICS/NWC property indicates that mixing of fresh groundwater with saline estuarine water occurs beneath the property. Shallow groundwater is fresh and becomes more saline with increasing depth and proximity to estuarine surface water. Deeper groundwater (45 to 50 feet bgs) has dissolved solids concentrations between 8,366 and 13,646 mg/l. Groundwater beneath the site is classified as non-potable using applicable MTCA criteria (see Section 4.7 of Draft RI Report – DOF February 2020).

2.2 EXPOSURE PATHWAYS AND RECEPTORS

2.2.1 ICS/NWC PROPERTY AND EMBAYMENT

Potential receptors, exposure pathways and the status of the pathways (complete, not complete) are summarized below in Table 2.2 for the ICS/NWC property and embayment. For FS purposes, the pathway/receptor analysis assumes an industrial land use and that existing paving will be maintained for the ICS-NWC property. The basis for assuming an industrial land use is

[v] This equates to, on average, approximately 0.27 ft3/day (0.0014 gpm) per linear foot of embayment shoreline.

presented in a DOF (2019a) memorandum to Ecology that is included as Appendix C. Complete exposure pathways are further illustrated on Figures 2-3a and 2-3b.

Table 2.2 - Potential Receptors and Exposure Pathways – ICS/NWC/Embayment

Receptor	Media	Pathway	Status
Humans	Upland Soil and Embayment Sediment	Ingestion and dermal contact – upland soils - on-site buried-utility workers	**Complete**
		Inhalation of soil/sediment particles	Not complete – main site is paved, and sediments are wet when exposed
		Ingestion and dermal contact - embayment sediments (recreational exposure – during shellfish harvesting, beach play)	**Complete** – While potential exposure is remote, the LDW ROD indicates the pathway should be considered complete.
	Groundwater	Ingestion and dermal contact – on-site buried-utility workers	**Complete**
		Indoor air vapor inhalation	Incomplete (see below)
	Surface Water	Ingestion of fish and shellfish (note Duwamish Waterway is not classified as a potable water supply)	**Complete** – In surface water affected by groundwater discharges
		Dermal contact and incidental ingestion of marine water during clamming, beach play or other water activities such as kayaking.	**Complete –** In surface water affected by groundwater discharges, although the potential for significant exposure is remote
Terrestrial Organisms	Upland Soil	Contact and incidental ingestion	**Complete** –A small portion of property remains uncovered where potential exposures could occur.
Aquatic Organisms	Surface water and sediment	Contact with or ingestion of estuarine water and embayment sediments	**Complete –** In surface water/sediment affected by releases to the embayment including groundwater discharge to surface water/sediment.

Testing of shallow groundwater on the ICS upland site detected the presence of several volatile organic compounds as indicated on the following figures from the draft RI (February 2020) including benzene (Figure 5-11a,b), tetrachloroethene (PCE - Figure 5-12a,b), trichloroethene (TCE – Figure 5-13a,b), cis-1,2-dichloroethene (1,2-DCE – Figure 5-14a,b), vinyl chloride (Figure 5-15a,b) and naphthalene (Figure 5-16a,b). The presence of VOCs in shallow groundwater raised the possibility of vapor intrusion into site structures which might impact indoor air. A site-specific analysis of this issue (DOF 2021c – Appendix E) indicated that this possible exposure pathway is incomplete based on the following evidence.

- Volatile compounds were generally not detected in vadose zone soils, and where detected, concentrations were low and not widely distributed beneath the site. Benzene, toluene, ethylbenzene, and total xylenes were most commonly detected beneath the main manufacturing building (locations P11 to P15 on Figure 2-2) at concentrations less than 100 ug/kg (most concentrations were less than 10 ug/kg).

- Concentrations of tetrachloroethene (Figure 4-13a), trichloroethene (Figure 4-14a), and naphthalene in groundwater were below Method C screening levels (SLs) to protect in-door air (obtained from February 2023 LDW Workbook- PCE= 104 ug/l; TCE=8.6 ug/l; naphthalene=88.8 ug/l).

- Most other shallow groundwater locations have concentrations below Method C SLs including those for benzene (23.9 ug/l) and vinyl chloride (3.3 ug/l). Note there is no SL for 1,2-DCE. This compound was not detected in shallow groundwater samples from beneath the main building (Figure 4-15a).

- Two locations on the east side of the main manufacturing building exceeded the Method C SL for benzene: P12 (48 ug/l) and DOF-MW8 (60 to 70 ug/l). The estimated net flow of groundwater is in an easterly direction, away from the building. Data from push-probes within the building indicate benzene concentrations well below the Method C SL (Figure 4-10a).

- Similarly, two locations on the north side of the main manufacturing building exceeded the Method C SL for vinyl chloride: P15 (8.8 ug/l) and SA-MW1 (2.5 to 19 ug/l). However, data from push-probes within the building indicate shallow groundwater concentrations below the Method C SL.

- The manufacturing building is an unheated wide-open internal structure with substantial air flow which would not allow the concentration of vapors, even if they were to intrude into the building.

- Painting of drums occurs within the building. VOC levels and possible worker exposure within the building are regulated based on worker occupational requirements under WISHA and OSHA.

2.2.2 DOUGLAS PROPERTY

As illustrated on Figure 2-3a, former LDW turning basin buried sediment has potentially been impacted by historic releases from the former NW Cooperage facility. This sediment is buried beneath over twenty feet of dredged fill. Potential receptors, exposure pathways and the status of the pathways (complete, not complete) are summarized below in Table 2.3 for the Douglas property. Complete exposure pathways are further illustrated on Figure 2-3a.

Human contact with soil or groundwater affected by releases from the former NW Cooperage facility is not indicated because these releases were buried by sediment and are now present below fifteen feet, the point of compliance. Soil leaching into groundwater with discharge to surface water is a complete pathway.

Table 2.3 - Potential Receptors and Exposure Pathways – Douglas Property

Receptor	Media	Pathway	Status
Human	Surface water/ sediment	Ingestion of fish and shellfish (note Duwamish Waterway is not classified as a potable water supply)	**Complete** – From surface water/sediment affected by groundwater discharge.
	Surface Water	Dermal contact and incidental ingestion with marine water during clamming, beach play or other water activities such as kayaking.	**Complete –** In surface water affected by groundwater discharges, although the potential for significant exposure is remote
Aquatic Organisms	Surface water/ Sediment	Contact with or ingestion of estuarine water and embayment sediments	**Complete –** In surface water/sediment affected by groundwater discharge to surface water

3.0 CLEANUP LEVELS AND CONTAMINANTS OF CONCERN (COCS)

Contaminants of Potential Concern (COPCs) were identified in the RI for each media and complete exposure pathway listed above in Tables 2.2 and 2.3. The identified COPCs and screening levels (SLs) used in the RI were updated to include the results of hot spot soil analyses (DOF 2022 – Appendix D) herein termed "*Contaminants of Concern*" (COCs) and "C*leanup Levels*" (CULs), respectively. A summary of COCs and CULs are discussed below for each exposure pathway and by site area.

3.1 ICS-NWC UPLAND AREA

3.1.1 SOIL CONTACT COCS AND CULS

Site Workers. The draft RI identified eleven COPCs assuming an unrestricted land use site. When an industrial land use is considered, seven of the COPCs are eliminated including arsenic, chromium, zinc, pentachlorophenol, cPAHs, 4,4'-DDE and dieldrin. Lead, gasoline range organics (GRO), diesel- + residual oil range-organics (DRO+RRO) and total PCBs are identified as subsurface utility worker soil contact COCs (SCw-COCs) in this FS. Direct contact CULs are listed in attached Table A3.1 for these four constituents.

Site workers installing or repairing subsurface utilities is a complete SCw exposure pathway. SCw-COCs were identified assuming an industrial land use and a Point of Compliance (POC) of fifteen-feet bgs. Lead, GRO, DRO+RRO and total PCBs exceed CULs as summarized below in Table 3.1. The CULs were applied using the three performance criteria in WAC 173-340-740(7) that specify that soil concentrations cannot exceed the CUL based on the Upper 95% Confidence Level on the Mean (UCL95%), no more than 10% of the samples can exceed the CUL (%>SC-CUL), and no single sample can exceed 2-times the CUL (N>2xCUL). The UCL95% concentration and the 10% criterion exceeded the SCw-CUL for GRO, DRO+RRO, and total PCBs. The four identified SCw-CULs exceeded the 2x criterion.

Terrestrial Birds and Animals. Consistent with WAC 173-340-7492(2)(b) "*For commercial or industrial properties, only potential exposure pathways to wildlife (e.g., small manuals, birds) need be considered. Only exposure pathways for priority chemicals of ecological concern listed in Table 749-2 at or above the concentrations provided must be considered*". Soil concentrations were compared to the values in Table 749-2. A greater number of COCs were identified for possible soil contact ecologic (wildlife) exposures (SCe) as compared to those for site workers assuming an unpaved industrial land use site as summarized in attached Table A3.1 and below in Table 3.2. Potential exposures could occur below a small area along the eastern property line that is unpaved (Figure 1-7). Those constituents whose concentrations are above wildlife CULs beneath this area include arsenic, total chromium, lead, zinc, sum 4,4'-DDE, -DDD, -DDT, and total PCBs. Concentrations of DRO, pentachlorophenol and dieldrin were below CULs or not detected and were eliminated as COCs for wildlife receptors. Most of the exceedances occur at a depth of 6.5 to 10-feet bgs near the bottom of the filled-in drainage ditch that was formerly used as a settling lagoon.

Table 3.1 – ICS/NWC Site Utility Worker Soil Contact COCs (a)

Constituent	SC-CUL (mg/kg)	UCL95% (mg/kg)	% >SC-CUL	N>2x CUL
Lead	1000	314	5.3	13
Gasoline Range Organics (GRO)	30	290	12.1	10
Diesel + Residual Oil Range Organics (DRO+RRO)[vi]	2000	11074	10.9	29
Total PCBs	10	56	15.7	34

Notes: SC=Soil Contact; SL = Screening Level; N=Number of Samples. , (a) – These statistics were updated to include hot-spot sampling data collected in January 2021.

Table 3.2 – ICS/NWC Wildlife Soil Contact COCs

Constituent	SCe-CUL (mg/kg)	Maximum Soil Concentration in Unpaved Area (mg/kg)(a)
Arsenic	20	21 (LP1@6.5'-8')
Total Chromium	135	910 (LP3@6'-8')
Lead	220	448 (LP1 @6.5'-8'); 3600 (LP3@6'-8'); 748 (LP4 @8'-10')
Zinc	570	2120 (LP1@6'-8')
DRO	15000	6200 (LP3@6'-8')
Pentachlorophenol	11	5.3 (LP3@6'-8')
Dieldrin	0.17	Not detected in any of the samples
4,4'-DDE, + -DDD + -DDT	1	1.4 (LP1 @6.5'-8'); 5.9 (LP3@6'-8'); 1.4 (LP4 @8'-10')
Total PCBs	2	10.5 (LP1 @6.5'-8'); 113 (LP3@6'-8'); 15.3 (LP4 @8'-10'); 9.2 (P21@6'-8'); 4.3 (P21@12'-14'); 3.8 (P25@1'-3')

Notes: SC=Soil Contact; CUL = Cleanup Level; N=Number of Samples; (a) – soil data from soil probes LP1, LP3, LP4, P20, P21, P23 and P25 (Figure 2-2).

[vi] Residual Oil Range organics include heavy oil (e.g., motor oil) carbon ranges.

3.1.2 INCIDENTIAL INGESTION OF GROUNDWATER BY SUBSURFACE UTILITY WORKERS

Groundwater COCs (GW-COCs) were identified in the RI based on surface water criteria via the groundwater discharge to surface water pathway. GW-COCs are listed in attached Tables A3.1 and A3.2. Drinking water CULs are generally higher than those surface water criteria protective of aquatic organisms as summarized in attached Table A3.1 (compare columns titled "*Aquatic Organisms*" and "*Human Visitors*" under ICS Upland).

During repairs of subsurface utilities below the water table and above the POC (15-feet), workers could possibly ingest or contact NAPL and groundwater in the SA-MW1 area or contaminated groundwater elsewhere on the ICS Upland site. Uncontrolled contact/ingestion of NAPL poses an unacceptable risk to site utility workers, primarily because of the presence of PCBs and other constituents (e.g., GRO, DRO+RRO, vinyl chloride).

Table 3.3 below compares the maximum detected ICS upland concentration generally away from the area where NAPL was detected with CULs protective of drinking water. As a first cut, it is assumed that utility workers would be protected from incidental ingestion (and dermal contact) if the highest ICS upland concentration is below the drinking water CUL. The highest concentration of toluene, ethylbenzene, 1,4-dichlorobenzene, naphthalene, chromium, copper, mercury, BEHP[vii], 4,4'-DDE, 4,4'-DDD, and trans- and cis-chlordane pose no unacceptable incidental risk to site utility workers based on this comparison. The highest concentrations of GRO, DRO/RRO, benzene, vinyl chloride, 2-methylnaphthalene, pentachlorophenol, dieldrin and PCBs exceed drinking water CULs and are further evaluated below.

Direct application of drinking water criteria substantially overstates possible exposures to utility workers from incidental ingestion because development of drinking water criteria assumes much higher consumption rates over longer periods of time than would occur to typical utility workers. MTCA Method B drinking water criteria assume a consumption rate of between 1 and 2 liters per day for extended periods of time (see WAC 173-340-720). The duration default assumptions are 6 years for noncarcinogens and 30 years for carcinogens.

DOF is not aware of Ecology approved exposure assumptions to assess the incidental groundwater exposure pathway for utility workers. To provide perspective, an analysis of possible risks was made for those constituents whose highest concentrations exceeded drinking water criteria using the MTCA standard equations in WAC 173-340-720. These include equation 720-1 used to set Method B groundwater cleanup levels to protect drinking water for noncarcinogens, and equation 720-2 used for carcinogens. For noncarcinogens, a hazard quotient (HQ) was calculated where values less than 1.0 indicate an acceptable risk, and for carcinogens, a risk level less than one additional cancer case in one million persons (less than 1 in 1,000,000

[vii] While the highest BEHP concentration (10 ug/l) exceeded the drinking water CUL (6 ug/l), concentrations exceeding the CUL were only detected in one push-probe sample (P14) collected below the aquitard.

or 1.00E-6) indicates an acceptable risk. HQs could not be estimated for GRO and DRO+RRO because suitable data are not available.

Table 3.3 – Comparison of ICS Upland Highest Detected Groundwater Concentrations w/ Drinking Water CULs (away from SA-MW1 LNAPL)

Contaminant	Highest Concentra-tion (ug/l)	Drinking Water CULs (ug/l)(a)	Highest Conc. At or Below DW CUL?	Comment
GRO	1800	800	No	Exceeds DW CUL at only 1 push-probe location – P15
DRO/RRO	740	500	No	At well MW-Ju
Benzene	70	5	No	At well DOF-MW8
Toluene	480	640	Yes	
Ethylbenzene	420	700	Yes	
Vinyl Chloride	8.8	0.29	No	At push-probe P15
1,3-Dichlorobenzene	5.2	Na	-----	
1,4-Dichlorobenzene	14	75	Yes	
Naphthalene	25	160	Yes	
2-Methylnaphthalene	59	32	No	At well DOF-MW7 in 1 of 4 spls.
Chromium	75	100	Yes	
Copper	19	640	Yes	
Mercury	0.026	2	Yes	For monitoring purposes
Pentachlorophenol	240	1	No	At well DOF-MW7 in 1 of 4 spls.
Bis(2-ethylhexyl) phthalate (BEHP)	10	6	No	Detected in only one sample below aquitard.
4,4-DDE	0.058	0.26	Yes	
4,4-DDD	0.04	0.36	Yes	
Trans-chlordane	0.016	0.25	Yes	
Cis-chlordane	0.03	0.25	Yes	
Dieldrin	0.14	0.0055	No	Detected in only two push-probes (P16, P27B)
Total PCBs	1.5	0.44	No	At DOF-MW1

Note: (a) – CUL not adjusted based on utility worker possible incidental (reduced) exposure.

To make the calculations, the MTCA default exposure assumptions were modified as follows:

- Human exposures – Subsurface utility workers were assumed to be adults working on the ICS upland.

- Dermal contact – calculated risk levels used very conservative (probably unrealistic) exposure assumptions for incidental ingestion of water. It was assumed that any dermal contact risk would be captured in the ingestion risk calculations. Furthermore, typical utility workers work-clothes would minimize dermal contact.

- Reference doses (Rfds) and carcinogenic potency factors (CPFs) were obtained from CLARC (Ecology's on-line data base updated February 2021).

- Average body weight – 70kg was used in Equation 720-1 for adult subsurface utility workers.

- Number of days exposed to groundwater – 10 days per year. The exposure duration (ED) was assumed to be 20 years.

- Incidental groundwater ingestion rate – 0.24 liters per day exposed (equivalent to about 1 cup of water or 10 cups per year). This ingestion rate is very conservative.

- Other MTCA default exposure assumptions (volatile/nonvolatile – 2/1), carcinogenic averaging time – 75 yrs.), and drinking water fraction (1.0) were not modified.

The results are summarized in attached Table A3.3 along with Method B and LDW Preliminary Cleanup Levels (PCULs as of May 2021) to protect drinking water. The findings are listed below:

- NAPL – ingestion/contact with NAPL in the SA-MW1 area containing PCBs, DRO+RRO and other contaminants was assumed to represent an unacceptable risk for utility workers.

- Data was not available to calculate HQs for GRO and DRO+RRO. These constituents are mostly associated with NAPL, and any incremental risk is included with possible exposure with NAPL in the SA-MW1 area.

- Incidental ingestion of the COC noncarcinogen 2-methylnaphthalene, under the indicated exposure assumptions, was found to be acceptable because the calculated HQ was calculated to be well below 1.0.

- The risk levels caused by incidental groundwater ingestion of the COC carcinogens including total PCBs, benzene, vinyl chloride, and dieldrin were calculated not to exceed the acceptable risk level of 1.00E-06, even assuming the very conservative exposure assumptions.

- The calculated carcinogenic risk level for pentachlorophenol (2.4E-06) slightly exceeded the acceptable risk level. Actual risk levels are likely much lower. The results summarized in Table A3.3 assume long term exposure to the highest detected ICS site concentration. The assumed concentration for pentachlorophenol (240 ug/l) was detected in the first of four groundwater samples from monitoring well DOF-MW7. PCP was only detected in one of three later samples at a concentration of 0.4 ug/l. Assuming a concentration of 0.4 ug/l would reduce the calculated risk level to below the acceptable level.

3.1.3 GROUNDWATER DISHCARGE TO SURFACE WATER COCS AND CLEANUP LEVELS

GW-COCs and CULs are listed in attached Tables A3.1 and A3.2 based on the groundwater to surface water discharge pathway. The CULs were updated from the most recent revision of the LDW preliminary cleanup level (PCUL) workbook dated August 2022. Table A3.2 groups GW-COCs by association and site area. Potential exposures would occur in sediment and surface water of the embayment affected by such discharges including:

- Exposure of aquatic organisms,
- Ingestion of aquatic organisms by humans that are impacted by groundwater discharges via bioaccumulation, and
- Visitor recreational exposure (dermal contact/ingestion) to embayment marine water impacted by groundwater discharges via beach play and/or clamming.

COCs that exceed CULs are discussed below.

- Total PCB is the most frequently detected GW-COC. It is associated with NAPL in the SA-MW1 area and soils containing PCBs along the former drainage ditch alignment and embayment shoreline. The primary and predominant current migration mechanism of PCBs into the embayment is with mobile NAPL.

- Several other identified GW-COCs and higher concentrations are associated (grouped) with NAPL in the SA-MW1 area. These constituents include gasoline-, diesel- and residual-range organics (GRO/DRO+RRO); several VOCs (benzene, toluene, ethylbenzene, and vinyl chloride); and several SVOCs (1,3- and 1,4-dichlorobenzenes, naphthalene, and 2-methylnaphthalene). In the RI, tetrachloroethene, trichloroethene and cis-1,2-dichloroethene were identified as COPCs because they appear to be degrading to vinyl chloride. They are not identified as COCs in this FS because their concentrations are below CULs. However, in addressing vinyl chloride their presence needs to be considered.

- A second grouping of GW-COCs is present beneath and east of the drum reconditioning building. These constituents include benzene and vinyl chloride.

- A third grouping of GW-COCs represent minimal risk to surface water or sediment based on exceedance locations (i.e., interior to property), low number of exceedance locations (generally less than two), were not consistently detected in monitoring well samples, and/or were detected in push-probe samples and not confirmed in monitoring well samples. These constituents include dissolved chromium, copper, and mercury;

pentachlorophenol (PCP); bis(2-ethylhexyl)phthalate (BEHP); sum 4,4'-DDE/DDD; trans- and cis-chlordane; and dieldrin.

3.2 EMBAYMENT SEDIMENT AND SURFACE WATER

3.2.1 COCS AND CLEANUP LEVELS TO PROTECT AQUATIC ORGANISMS

Twenty-one sediment constituents were identified as COCs based on protection of aquatic organisms. The COCs include metals, semivolatile organic constituents (SVOCs), PCBs and polychlorinated dibenzo-p-dioxins (PCDD)/polychlorinated dibenzofurans (PCDF) as summarized in attached Table A3.1 and A3.4. PCDDs/PCDFs are associated with PCBs as low-level contaminants in commercial PCB mixtures based on input from DMD, Inc. (geochemical consultant) and Hutzinger et al (1985). Cleanup levels (from the LDW ROD) and exceedance factors (EFs) are also summarized on the table. PCBs exceeded CULs most frequently and by the greatest amount in sediment samples.

3.2.2 RECREATIONAL CONTACT WITH EMBAYMENT SEDIMENT AND SURFACE WATER

Human visitors to the embayment may have incidental contact with sediment during beach play or clamming. The EPA ROD (2014) includes CULs based on recreational human direct contact for four contaminants as listed in Table 3.4 below.

Table 3.4 – CULs for Human Direct Contact – LDW ROD

Constituent	LDW-Wide	Clamming Areas	Individual Beaches
Point Compliance	0-10 cm	0-45cm	0-45cm
PCBs (mg/kg-dw)	1.3	0.50	1.7
Arsenic (mg/kg-dw)	7	7	7
cPAH (mg TEQ/kg-dw)	0.38	0.15	0.09
Dioxins/Furans (ng TEQ/kg-dw)	37	13	28

Notes: From EPA ROD (2014); dw – dry weight; TEQ – Toxicity Equivalency Quotient

DOF is not aware of Ecology approved exposure assumptions to assess risks associated with incidental recreational contact with sediment. To provide perspective, on other contaminants, MTCA Method B unrestricted site use CULs listed in CLARC were compared with CULs protective of aquatic organisms (Table A3.1). Method B CULs are very conservative because they assume much greater exposures than would occur during recreational visits to the embayment. CULs protective of aquatic organisms would also be protective of recreational visitors to the embayment.

Groundwater discharge impacts to surface water that would pose unacceptable risks to recreational visitors from incidental ingestion appear unlikely based on the following considerations:

- Surface water in the embayment is saline marine water and is not identified as a potable water supply.

- Numerical modelling indicates that groundwater discharge volumes to the embayment are low.

3.3 DOUGLAS PROPERTY GROUNDWATER

COCs potentially released from the ICS/NWC property underlie the Douglas upland property are at depths greater than 15- to 20-feet and are in contact with groundwater. Complete exposure pathways are listed below in Table 3.5.

Table 3.5 - Potential Receptors and Exposure Pathways – Douglas Upland Property

Receptor	Media	Exposure Pathway	Status
Human	Groundwater	Ingestion of fish and shellfish collected from embayment potentially impacted by groundwater discharge	**Complete** – Groundwater to surface water/sediment pathway
Aquatic Organisms	Groundwater	Groundwater discharge to sediment and surface water	**Complete –** Groundwater to surface water/sediment pathway

COCs were identified for possible adverse groundwater impacts to sediment and surface water along the Douglas embayment shoreline. Petroleum hydrocarbons (DRO+RRO), benzene, naphthalene, benzo(a)anthracene, chrysene, benzo(a)pyrene, indeno(1,2,3-cd) pyrene and total PCBs exceeded RI SLs in the lower zone beneath the southern Douglas property. Most of the exceedances occurred in well DMC-MW-A located near the head of the embayment. PCBs exceeded SLs most frequently and by the greatest amount in groundwater samples and are associated with leaching from contaminated oil present in soil. Available data indicate that total suspended solids concentrations in collected samples are affecting the PCB analytical results reported for groundwater (discussed in Section 4.1.3 below).

3.4 SOIL LEACHING COCS

Soil constituents may be leaching from soil when in contact with groundwater. Those groundwater COCs are also identified as soil COCs via leaching as follows:

- **LNAPL Leaching –** Those constituents associated with NAPL will directly migrate with NAPL into the embayment and will potentially leach from the NAPL with contact by groundwater. The specific constituents are listed in attached Table A3.2.

- **Soil Leaching –** PCBs, GRO, benzene, ethylbenzene and PCP will potentially leach into groundwater to varying degrees upon contact with soil containing these constituents.

Available data indicate that vinyl chloride is being created by the degradation of PCE, TCE and cis-1,2-DCE. While not specifically a leaching process, soils that contain these constituents are source materials for vinyl chloride.

3.5 COC SUMMARY AND AREAS OF CONCERN

Overall, available data indicate that PCBs will be the primary focus of the FS, and drive cleanup of soil and groundwater beneath the ICS/NWC property, sediment within the embayment and deeper Douglas property groundwater. Migration of mobile Lighter (less dense) Non-Aqueous Phase Liquid (LNAPL) containing PCBs is also a primary concern along a portion of the ICS/NWC shoreline. Table 3.6 below provides a summary for each of the site areas that are discussed in Section 4.0 below.

Table 3.6 – Primary COC Summary

Locations	COCs
ICS/NWC Property: Along south embayment shoreline including SA-MW1 Area	**Soil contact:** PCBs, DRO+RRO, lead, and GRO **LNAPL Contact Upland Subsurface Utility Workers:** PCBs, DRO+RRO. **Mobile LNAPL: Groundwater Migration:** PCBs, GRO, DRO+RRO, benzene, toluene, ethylbenzene, vinyl chloride, 1,3- and 1,4- dichlorobenzene, naphthalene and 2-methynaphthalene. **Groundwater Migration:** PCBs, benzene, vinyl chloride.
ICS/NWC Property: Filled former settling lagoon and east drainage ditch (along east property line)	**Soil contact:** PCBs, DRO+RRO, lead and GRO (Also wildlife contact – see Table 3.2). **Groundwater Migration:** PCBs, benzene, vinyl chloride.
ICS/NWC Property: Beneath and East of Upstairs (Drum) Reconditioning Building	**Eastward Groundwater Migration:** Benzene, vinyl chloride.
Embayment Sediment (both properties)	**Sediment Contact and Erosion:** Primarily PCBs (see attached Table A3.4).
Douglas Property: Constituents Associated with Deeper Soils Beneath Douglas Upland Property	**Groundwater Migration to Embayment and LDW:** PCBs, DRO+RRO, benzene, naphthalene, benzo(a)anthracene, chrysene, benzo(a)pyrene, indeno(1,2,3-cd) pyrene.

4.0 AREAS OF CONCERN AND CONSTITUENT MIGRATION

The primary locations of concern are where waste materials were historically managed, treated, and released to the environment (i.e., primarily along the filled-in drainage ditch alignment along the eastern property line, the ICS shoreline adjacent to the embayment, and the embayment itself. As noted in Section 1 above, the area of concern was divided into two areas including the Embayment Remedial Area and the ICS Upland Remedial Area as illustrated on Figure 1-3.

Since the draft RI was completed, a "*hot-spot*" sampling program was implemented to refine the estimation of areas where soil CULs were exceeded. The results of this sampling were submitted to Ecology in January 2022 (DOF 2022) and are incorporated into this FS[viii]. A compilation of sample locations is presented on Figure 4-1a. The sample density is greatest along the embayment shoreline generally within the Embayment Remedial Area. South shoreline and embayment sample locations on a larger scale map are shown on Figure 4-1b, along with the refined outline of the embayment precipitate cap.

4.1 ICS/NWC UPLAND PROPERTY

4.1.1 SOIL CONTAMINATION AND COC ASSOCIATIONS

Attached Table A4.1 presents a summary of the primary ICS/NWC upland property COC associations in soil. For grouping purposes, Method A soil CULs were used to illustrate the co-location of contaminants in soil. A Method A value for PCP is not available, so the upper 15 to 20% of the sample concentrations (those concentrations greater than 100 ug/kg) were used to illustrate the associations. Figures 4-2a to 4-2e (PCB base) and 4-4a to 4-4e (DRO+RRO base) present the locations of COCs in soil by approximate depth below ground surface (0 to 3 feet; 3 to 5 feet; 5 to 10 feet; 10 to 15 feet; 15 to 20 feet) using the soil concentrations highlighted in Table A4.1, based on the indicated grouping concentrations. The subsurface COC associations are shown on sections G-G' (Figures 4-3a[ix] and 4-5a) that trends along the ICS shoreline and F-F' (Figures 4-3b and 4-5b) that trends along the filled in drainage ditch. Section trends are shown on Figure 4-1a.

Available data indicate a former unpaved "*working surface*" was present along the ICS south shoreline (Figures 4-2a and 4-4a). In most areas, the working surface contamination extends to a depth of 2 to 3 feet. In three areas along the shoreline, soil contamination extends to deeper depths centered on locations P17, SA-MW1, and MW-Ju (Figures 4-2b, 4-2c, 4-4b and 4-4c) as illustrated on section G-G' (Figures 4-3a and 4-5a).

[viii] The hot-spot report is presented in Appendix D.

[ix] Note the colored concentration ranges shown for PCBs in Figure 4-3a differ from those shown on Figure 4-3b. In Figure 4-3a, a range of <100 to 1000 ug/kg (blue color) was added to show the concentration pattern more clearly.

Along the filled in drainage ditch, most of the soil contamination is associated with the former settling lagoon at approximate depths of 5 to 10 feet bgs. This is illustrated on Figures 4-2c, 4-4c, and section F-F' (Figures 4-3b and 4-5b).

PCB concentrations in soil greater than 10 mg/kg (10,000 ug/kg) and DRO+RRO concentrations greater than 2,000 mg/kg are generally associated with higher concentrations of lead, PCP, GRO, and ethylbenzene located in shallower soil along the south embayment shoreline and filled-in ditch. A second group of soil contaminants generally associated with benzene include PCP, GRO, and ethylbenzene generally located on the east side of the main building.

4.1.2 MOBILE LNAPL

Mobile LNAPL has only been detected in well SA-MW1 as illustrated on Figure 4-6. The LNAPL includes high concentrations of PCBs as well as GRO, DRO, and RRO as outlined in Section 5.4.3.1 of the RI. Groundwater samples from well SA-MW1 also suggest that LNAPL includes constituents typically associated with gasoline (GRO constituents, benzene, toluene, and ethylbenzene), vinyl chloride, 1,3- and 1,4-dichlorobenzene and constituents typically associated with diesel fuel (DRO constituents naphthalene and 2-methylnaphthalene). PCB concentrations detected in SA-MW1 groundwater samples are well above PCB solubility limits (discussed in Section 4.1.3 below) which indicates small amounts of LNAPL, and suspended solids were likely present in the samples delivered to the laboratory.

Some small leakage of mobile LNAPL into the embayment may be occurring that poses elevated risk to surface water and sediment, as the SA-MW1 area is located immediately adjacent to the embayment. High concentrations of DRO+RRO that comprise the major portion of the LNAPL extend to depths of approximately eight feet in the SA-MW1 area as illustrated on Figure 4-5a. Site geochemical evaluations presented in DMD (2018, revised 2021) show a clear association of PCBs with TPH identified as mineral oil dielectric fluids.

Leakage of mobile LNAPL represents the pre-dominant current COC migration pathway into the embayment. Some COC migration to the embayment (dissolved) in groundwater may also be occurring but to a far lesser degree as compared to mobile LNAPL. This finding is based on a site-specific geochemical evaluation of PCB mixture fates and distributions presented in DMD 2018 (revised 2/24/21 – presented in Appendix B). That evaluation identified a strict association of source-material PCBs with mineral oil dielectric fluids in LNAPL, contaminated soils, sediments and (source-area) groundwaters. PCB levels in NAPL and associated oils found in soils, sediments, and groundwaters ranged from approximately 0.1% to as much as 5%. The geochemical evaluation concluded that "*PCBs in site soils and sediments are clearly associated with non-aqueous phase petroleum liquids (NAPLs) and oils. … site-specific data indicates that PCBs groundwater contamination in source areas is primarily a result of the mixing and solubilization of contaminated oils found in soils, resulting in enhanced or facilitated solubility of PCBs in groundwater in the vicinity of source areas. Differential phase partitioning across media in source areas is <u>not</u> evident*." For example, a sample of LNAPL from well SA-MW1 collected in 2012 had a PCB concentration of approximately 1,670 mg/kg (0.17%)(DOF 2000, RI Section 5.4.3.1). Oil migrating into the embayment would have a high concentration of PCBs and there would be no significant partitioning of PCBs into sediment (a direct discharge). Conversely, PCBs are highly hydrophobic (very high potential to partition to soil) and have very low solubilities in water. In addition, cap modelling completed by Keta Waters (2022 – presented in Appendix A) illustrates the migration characteristics of PCBs in groundwater. Assuming a starting sediment PCB concentration of 44 mg/kg, a starting groundwater concentration of 0.98 ug/l, an organic carbon concentration of 0.5%, a migration distance of [only] 2 feet, and a 100-year travel time, the resulting sediment PCB concentration was estimated to be no higher than 7.9E-05 ug/kg. The PCB concentration in LNAPL is estimated to be many times higher (approximately 2.2E10 times higher) than the resulting sediment concentration caused by groundwater migration into the embayment. In other words, management of LNAPL and NAPL-contaminated media significantly reduces site PCB levels and source materials with the potential for contributing to surface water and sediment contamination.

4.1.3 SOIL LEACHING AND GROUNDWATER MIGRATION

Outside of the mobile LNAPL area, the primary RI groundwater COPCs were GRO, ethylbenzene, pentachlorophenol, benzene, vinyl chloride and PCBs. The physical and chemical properties of these GW-COCs affect, to a large degree, their fate and transport in groundwater, the risk they pose to surface water/sediment, and applicable remedial technologies. PCE and TCE are included in Table 4.1 as degradation of these compounds are the likely source of vinyl chloride in groundwater. Table 4.1 below summarizes pertinent chemical properties based on data presented in Ecology’s data base CLARC, a geochemical evaluation of PCBs by DMD Inc. (DMD 2018, 2019b) and other standard reference sources (ATSDR 1995a, 2000, 2001, 2006, 2007; 2010; EPA 1998; MacKay et. al. 1992).

Table 4.1 – GW-COC Properties – ICS/NWC Property (c)

Constituent	Solubility (mg/l)x	Organic Carbon-Water Partition Coefficient (Koc) (l/kg)xi	Degradation Potential
Benzene	1750	62	Moderate to high under aerobic conditions
Ethylbenzene	169	204	
GRO	nd	na	
PCP	1950	592 (adsorption is highly dependent on pH)	Degradation occurs in both aerobic and anaerobic environments. By reductive dechlorination in anaerobic environments.
PCE	200	265	High – under anaerobic conditions by reductive dechlorination to vinyl chloride
TCE	1100	94	
Vinyl Chloride	2760	18.6	High – under aerobic and methanogenic (highly reducing) conditions.
Aroclor 1248	0.052 to 0.32 (d)	863,337 (a)	Low – PCBs are very persistent in the environment
Aroclor 1254	0.012 (b)	2,247,362 (a)	
Aroclor 1260	0.0027 (b)	7,708,355 (a)	

Notes: (a) DMD (2020); (b) ATSDR 2000; (c) Data from CLARC unless otherwise noted; (d) Mackay et. al. (1992).

In this FS, GW-COCs are addressed in the following groups. Groundwater concentrations are plotted on Figures 4-7 to 4-10 and 4-12 to 4-17. SLs are shown in the legend in the bottom of the figures and concentrations that exceed SLs are highlighted in orange type. Colored circles illustrate whether the available concentration data is interpreted to be below or above SLs; green circles indicate concentrations below SLs while orange circles indicate concentrations above SLs. Concentrations of some constituents (e.g., PCP- Figures 4-9a, 4-9b) were intermittently detected above the SL and were interpreted as follows:

- If the detection above the SL was the first detection, and later samples were below the SL, it was interpreted that the concentrations were below the SL (e.g., benzene in DOF-MW6, Figure 4-10b).

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[x] The referenced solubilities are based on single constituent solutions in pure water at a given temperature. Constituent effective solubilities of complex mixtures are substantially less than those in pure water (Cohen and Mercer 1993).

[xi] Koc is a measure of how strongly a constituent will partition to organic carbon in soil and sediment. Low Koc values indicate little partitioning occurs which indicates greater mobility in groundwater. Conversely, high Koc values indicate the potential for higher partitioning, which indicates lower potential mobility in groundwater.

- If the constituent was intermittently detected above the SL, the location was flagged with a dark blue circle (e.g., PCP in DOF-MW7).

- For Aroclor PCB concentrations (Figures 4-17a to 4-17c), detections below the Practical Quantitation Limit (PQL) (0.01 ug/l) were flagged with light blue text and colored circle.

GRO and ethylbenzene are grouped with the SA-MW1 area based on data from probe P-15 that lies immediately upgradient of well SA-MW1. Groundwater concentrations are plotted on Figures 4-7 a,b,c and 4-8 a,b,c. These constituents are contained in LNAPL with the potential to migrate to the embayment with LNAPL or leach from soil/LNAPL and migrate with groundwater to surface water.

The source of some of the reported GRO in groundwater at the site appears to be gasoline. Gasoline is a mixture of alkanes, alkenes, isoalkanes, cycloalkanes, cycloalkenes and aromatics (benzene, toluene, ethylbenzene, xylenes) (ATSDR 1995). Solubilities, mobilities, and susceptibility to degradation in groundwater vary by individual constituent, however, gasoline is relatively soluble and mobile in groundwater and susceptible to natural degradation, primarily under aerobic conditions.

Ethylbenzene is relatively soluble (169 mg/l) and moderately mobile (Koc 204 l/kg) in groundwater. Microbial degradation primarily occurs under aerobic conditions (ASTDR 2010).

Pentachlorophenol (PCP) is not considered a remedial driver in this FS because this constituent does not pose a significant risk to surface water via groundwater migration based on available data. PCP will be addressed by actions implemented for other constituents such as PCBs and by post-remedial monitoring.

PCP is relatively soluble and mobile in groundwater at neutral to alkaline pH conditions (ASTDR 2001). It also degrades under both aerobic and anaerobic conditions; under anaerobic conditions degradation occurs by reductive dechlorination (which appears to be occurring on the site based on the occurrence of vinyl chloride derived from chlorinated solvents). PCP groundwater concentrations are plotted on Figure 4-9 a,b,c. PCP was inconsistently detected at one of four water table well locations, at ten of eighteen upper zone well locations, and was not detected in any of the nine deeper well locations. Where detected, PCP was detected at concentrations generally between 0.015 and 0.40 ug/l (the reporting limit is 0.025 ug/l). The initial sample from DOF-MW7 had a PCP concentration of 240 ug/l. However, in three later samples, PCP was detected in only one sample at a concentration of 0.4 ug/l. PCP was not detected in the most recent sample from this well.

Benzene is a GW-COC specifically addressed in this FS. Benzene is associated with the SA-MW1 area where concentrations exceeded the surface water CUL (1.6 ug/l); concentrations up to 12 ug/l were detected (Figure 4-10b). Benzene concentrations also exceeded the CUL in groundwater beneath and immediately east of the drum reconditioning building (Figures 4-10 a,b,c) where the highest concentrations (60 ug/l to 70 ug/l) were detected.

Benzene is relatively soluble in water (1,750 mg/l) and mobile with a low Koc of 62 l/kg. It readily degrades in the environment under aerobic conditions (ASTDR 2007). Concentrations of 48 ug/l were detected at probe location P12, and 60 to 70 ug/l were detected in samples from well DOF-MW8. Some leaching from soil in the vicinity of P12/DOF-MW8 appears to be occurring with potential migration towards the east property line. Benzene concentrations in this area have been detected in soil at between 11 and 1,600 ug/kg. Figure 4-11 (Section B-B') shows the interpreted vertical extent of benzene soil concentrations east of the drum reconditioning building. Figure 4-5b (Section F-F') illustrates that the highest benzene concentration in soil is associated with the buried settling lagoon bottom sediments (probe location LP3). Benzene was not detected in groundwater samples from probes and wells located downgradient of the east property line which indicates that benzene is being attenuated with migration.

Vinyl chloride is a GW-COC specifically addressed in this FS. Based on the groundwater concentration patterns (Figures 4-12a,b,c), vinyl chloride will be primarily addressed with the SA-MW1 area. Vinyl chloride will also be addressed by actions implemented for other constituents such as PCBs and by post-remedial monitoring.

Vinyl chloride is relatively soluble (2,780 mg/l) and highly mobile (very low Koc of 18.6 l/kg) in groundwater. Vinyl chloride undergoes microbial degradation under aerobic conditions (ASTDR 2006). It has also been shown to degrade under methanogenic reducing conditions. Vinyl chloride is relatively soluble in water and does not partition strongly to soil. As summarized in Table A4.1, vinyl chloride was only detected in three soil samples (32 ug/kg at P15, 15 ug/kg at HC-B2 [also EPA-B2 in RI] and 0.7 ug/kg at P-14). It is likely being created by reductive dechlorination (EPA 1998) of PCE and TCE to cis-1,2-DCE and then to vinyl chloride which are present in some soil and groundwater samples. Groundwater concentrations are plotted on Figures 4-12a,b,c. The highest concentrations are associated with the SA-MW1 area where concentrations of 8.8 ug/l were detected at P15, and 2.5 to 19 ug/l were detected at SA-MW1. Much lower concentrations were detected elsewhere, and data indicate vinyl chloride is not migrating off-site beyond the east property line at concentrations above the CUL (0.18 ug/l).

PCE, TCE, and cis-1,2-DCE concentrations in groundwater (Figures 4-13a,b,c; 4-14a,b,c; 4-l5a,b,c) appear to be degrading to vinyl chloride. Figures 4-16a,b,c show soil concentrations of PCE and TCE in soil with depth. PCE is present in two soil samples from HC-B1 (350 to 420 ug/kg) while TCE concentrations are present in soil within the area upgradient of SA-MW1 (120 ug/kg in a sample from DOF-MW7). The highest TCE concentration (2,000 ug/kg at LP3 – Figure 4-16b) was detected in buried settling lagoon residues, however this material does not appear to be impacting groundwater to a significant degree as TCE or its degradation products were not detected above CULs in downgradient groundwater samples from wells located on the eastern side of the filled-in settling lagoon (Figures 4-14b and 4-14c). TCE was also detected in a soil sample (lagoon residues) from LP-4 (200 ug/kg – Figure 4-16c).

PCBs are the primary remedial driver evaluated in this FS because of the high concentrations detected in soil and sediment on the site. Site PCBs principally consist of commercial Aroclor mixtures 1248, 1254 and 1260. As summarized in Table 4.1 above, PCBs have very low aqueous solubility and partition strongly to soil containing organic carbon (they are very hydrophobic). The physical and chemical properties of PCBs are discussed in more detail in the geochemical assessments prepared by DMD (2020, 2021a, 2021b) that are presented as Appendix B.

PCB concentrations in groundwater are plotted on Figures 4-17a,b,c, and Figure 4-18 across the former settling lagoon along Section W-E, the trend of which is shown on Figure 4-17. The plots include the results of PCB congener analyses of samples collected in February 2019 by DOF. The February 2019 results are summarized in the May 8, 2019, validation report prepared by DMD Inc. (2019) and is included as an attachment to DMD (2021b) in Appendix B. PCB concentrations appear to exceed the CUL in wells located along the embayment shoreline and along the former east ditch alignment. The exceedances occur, for the most part, in wells screened in source materials. Soil particles entrained in the samples appear to be affecting the sample results.
Most of the monitoring wells are screened in soil that contain PCBs. Because of the hydrophobic nature of PCBs (very high Koc's), there is a high potential for even small amounts of suspended solids (contaminated soil particles) entrained in samples to bias high the groundwater analytical results. It is not possible to totally remove soil particles from groundwater samples, and filtering of samples for most organic chemical analyses has not been technically validated for common usage and is not accepted by most regulatory agencies. To assist in the evaluation of this issue, field measurements were made for turbidity so that samples can be collected with the lowest practical bias by suspended solids.

During the February 2019 sampling round, fourteen groundwater samples were obtained in a manner to minimize collection of suspended solids. Field measurements were made for turbidity and laboratory analyses were conducted for total suspended solids (TSS). A comparison of the results indicates a high correlation between turbidity and TSS (R=0.86) which is graphically shown on Figure 4-19. This analysis indicates that turbidity is a generally reliable field measure for TSS in groundwater samples submitted to the laboratory.

Figure 4-20 shows total PCBs vs turbidity for ICS property monitoring wells where PCBs were detected within the upland remedial areas. Some TSS effect and potential bias in contaminant results are indicated in samples from DOF-MW6, SA-MW2 and DOF-MW1, while turbidity does not appear to be substantially affecting the results from wells MW-Eu and DOF-MW7. However, a geochemical partitioning analysis by DMD (2021b) indicates that even at very low turbidity levels, any amount of suspended solids in groundwater samples introduces positive bias in the sample results.

Interpretation of the results from SA-MW1 groundwater samples (located in identified source materials) is further complicated by the presence of mobile NAPL. The results (up to 7 ug/l) are well above the published PCB solubilities in pure water (Table 4.1) and effective solubilities should be even lower. This data suggests that small amounts of NAPL, along with suspended solids, were entrained in the samples and bias high the analytical results for determination of soluble/dissolved PCBs.

Data and analysis presented in the RI indicate that if PCBs are present in groundwater samples above the Aroclor reporting levels (0.01 ug/l), the Aroclor and PCB congener analytical results are similar. A characteristic of the PCB congener analysis is that the reporting limit is lower (about 0.0001 ug/l). However, the reporting limit is so low that environmental and laboratory background levels need to be considered in the interpretation along with the amount of solids entrained in the groundwater samples (DMD 2019, revised 2/2021). Total PCB congener concentrations in upgradient wells were 0.0001 ug/l (DOF-MW5 – Figure 4-17b) and 0.0002 ug/l (DOF-MW4) (Figures 4-17b and 4-18). The concentration in wells SA-MW3, MW-Fu and MW-Gu located downgradient of the filled-in drainage ditch (former settling lagoon) was 0.0003 ug/l. The DMD (2019b, revised 2/2021) geochemical analysis indicates there is no measurable difference in the dissolved major PCB homolog concentrations in upgradient and downgradient groundwater samples, collected approximately 40 to 100 feet away from contaminant sources. These data and the geochemical analyses indicate that PCBs are not migrating in groundwater to any significant degree because of identified (migration) attenuation processes inherent to the site.

4.2 EMBAYMENT

The highest sediment concentrations of PCBs and DRO/RRO are present near the head of the former wharf and adjacent to the SA-MW1 area where mobile LNAPL has been detected (Figures 4-2 a,b,c and 4-4 a,b,c). Surface and subsurface sediment PCB, DRO+RRO and lead concentration patterns are further illustrated on Figures 4-21a,b,c,d and 4-22a,b,c,d, respectively. The trend of section I-I’ is presented on Figures 4-21a,b,c.

Sediment in the embayment exceeds CULs to depths that vary depending on location within the embayment. Near the former wharf, core samples indicate PCBs above CULs to depths of seven or more feet (core HSA-4). Elsewhere in the embayment, exceedances extend to approximate depths of less than two-feet (core LDW-SC40) to approximately six-feet (Core I).

4.3 DOUGLAS PROPERTY

4.3.1 POSSIBLE IMPACTS TO EMBAYMENT

The focus of this FS is the embayment and ICS/NWC upland property. The following discussion provides the basis for how alternatives presented in this FS will potentially affect conditions on the Douglas property. The Douglas property will be addressed in a supplemental FS after additional site characterization and evaluation is completed.

Available data indicate that deeper (lower zone) soil (former turning basin sediment now buried by Douglas property fill) likely was impacted by releases from the ICS/NWC property. These impacted soils lie below approximately (-)4 feet MLLW (DOF 2020 – Section 6.3.1) and are greater than fifteen feet deep (below the soil contact point of compliance). The primary concern is soil leaching and constituent migration in lower zone (deeper) groundwater of benzene, DRO/RRO, several PAHs, and PCBs to LDW surface water and sediment.

4.3.2 SOIL LEACHING AND GROUNDWATER MIGRATION

Douglas property well locations and estimated lower zone flow directions are shown on Figure 4-23 (see Keta Waters 2021a, Appendix A). Concentrations of GW-COCs in samples from deeper lower zone wells adjacent to the embayment (DMC-MWA, DMC-MWB, and DMC-MWC) and CULs are plotted on Figures 4-24a to 4-24h. COC properties are summarized in Table 4.2 below (CLARC, ATSDR 1995b, 1995c, 2005).

Table 4.2– GW-COC Properties – Douglas Property (b)

Constituent	Solubility (mg/l)[xii]	Organic Carbon Water Partition Coefficient (Koc) (l/kg)	Degradation Potential
Benzene	See Table 4.1 above		
PCBs			
DRO+RRO (a)	5	1,000-501,200	High – aerobic conditions – greatest for aromatic fractions and decreasing for aliphatic fractions with increasing carbon length.
Naphthalene	31	1190	High – aerobic conditions
Benzo(a)anthracene	0.0094	358,000	Low – Decreases with increasing number of aromatic rings.
Chrysene	0.0016	398,000	
Benzo(a)pyrene	0.0016	969,000	
Indeno(1,2,3-cd)pyrene	0.000022	3,470,000	

Notes: (a) Based on No. 2 Fuel Oil - ATSDR 1995b; (b) Data from CLARC unless otherwise noted.

Concentrations exceeding CULs were more frequent in samples from DMC-MWA (benzene, DRO+RRO, PCBs, naphthalene, benzo(a)anthracene, chrysene, and benzo(a)pyrene). Fewer exceedances were observed in samples from DMC-MWB (PCBs and possibly naphthalene) and DMC-MWC (PCBs).

As discussed in Section 4.1.3 above, suspended solids entrained in the groundwater samples appear to be affecting the PCB analytical results. The basis for this finding for the Douglas property samples is illustrated on Figure 4-25 that plots total PCB concentrations vs. turbidity. For samples from wells DMC-MWA, DMC-MWB, DMC-MW13, DMC-MW14, and DMC-

[xii] The referenced solubilities are based on single constituent solutions in pure water at a given temperature. Constituent effective solubilities of complex mixtures are substantially less than those in pure water (Cohen and Mercer 1993).

MW15, higher turbidity is associated with higher concentrations of PCBs. The slopes of the regression lines and lowest concentration turbidity values suggest that suspended solids are still impacting (bias high) the indicated concentrations for samples from wells DMC-MWA, DMC-MWB, and DMC-MWC.

DMD's geochemical assessment (DMD 2019, Revised 2/2021 – Appendix B) evaluated the partitioning of PCBs to soil particles and groundwater in selected groundwater samples. Table A to DOF 2021a summarizes the results of the DMD analysis for DMD-MW-C (and other wells on the ICS facility upland). Preliminary estimates (applying thermodynamic principles) using site data, including sample TSS levels, indicate that PCB levels are biased high by factors of 2x (or more) due to the presence of contaminated solids/soils. The soluble (dissolved) PCB concentration in the well sample from DMC-MWC was approximately one-half the reported value (5.5 ng/l[total] vs. 2.9 ng/l[dissolved]). The suspended solid PCB concentration in the DMC-MWC sample (presumably soil PCB concentration) was calculated to be on the order of 45 µg/kg (ppb).

5.0 SUMMARY OF PROPOSED CLEANUP LEVELS AND ARARS

5.1 CLEANUP LEVELS

Proposed CULs based on completed exposure pathways and screening levels are summarized in attached Table A5.1. The CULs are based on the draft RI, Sections 3.1.2 and 3.2 of this report, and were revised using the updated LDW PCUL Workbook (August 2022).

On the ICS upland portion of the site, possible receptors include wildlife beneath a small unpaved area along the eastern property line (Figure 1-6) and future subsurface utility workers. Soil contact CULs are proposed for these possible receptors. Except for exposure to NAPL, available data indicate possible utility worker exposure to groundwater would not result in unacceptable risk.

Within the embayment, CULs are proposed to protect aquatic organisms and recreational visitors. In most cases, protection of aquatic organisms would also result in protection of humans visiting the site or consuming seafood from the site. CULs protective of recreational visitors (sediment contact) for arsenic, cPAHs (TEQ) and 2,3,7,8 TCDD from EPA's ROD are proposed.

CULs to protect surface water and sediment from discharge of groundwater to the embayment are proposed. In most cases, CULs to protect surface water are also protective of sediment.

The LDW PCUL Workbook includes soil CULs to protect surface water from leaching. As a practical matter, compliance with CULs to protect surface water will be based on empirical evidence (i.e., groundwater monitoring data) as the leaching PCULs are based on an oversimplified methodology that are not representative of site conditions. For example, natural attenuation such as degradation is not considered in setting the leaching PCULs. However, to provide perspective on the potential for soil leaching, Table A5.1 summarizes soil PCULs to protect surface water and sediment, from leaching into groundwater.

5.2 APPLICABLE AND RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

Cleanup will need to meet several ARARs that are embedded in Federal, State, and local regulations. Each of the pertinent regulations are listed below, with a description of how the requirements of these regulations (ARARs) will be met.

5.2.1 MODEL TOXICS CONTROL ACT (CHAPTER 173.105D RCW), AND MODEL TOXICS CONTROL ACT REGULATION (CHAPTER 173-340 WAC)

The Model Toxics Control Act (MTCA) is the primary cleanup regulation in Washington State and is administered by Ecology. The requirements of MTCA will be met as planning for, remedy selection, and ultimate cleanup are being overseen by Ecology. A draft RI, FS, and

Cleanup Action Plan (dCAP) have or will be prepared, approved by Ecology, and sent out for public review before being finalized.

MTCA outlines primary requirements for developing remedial alternatives and a FS in WAC 173-340-350(8)(c)(i) as follows:

- *The feasibility study shall include cleanup action alternatives that protect human health and the environment (including as appropriate, aquatic, and terrestrial ecological receptors) by eliminating, reducing, or otherwise controlling risks posed through each exposure pathway and migration route* [WAC 173-340-350(8)(c)(i)(A)];

- *A reasonable number and type of alternatives shall be evaluated, taking into account the characteristics and complexity of the facility, including current site conditions and physical constraints* [WAC 173-340-350(8)(c)(i)(B)];

- *Each alternative may consist of one or more cleanup action components, including, but not limited to, components that reuse or recycle the hazardous substances, destroy or detoxify the hazardous substances, immobilize or solidify the hazardous substances, provide for on-site or off-site disposal of the hazardous substances in an engineered, lined and monitored facility, on-site isolation or containment of the hazardous substance with attendant engineering controls, and institutional controls and monitoring* [WAC 173-340-350(8)(c)(i)(C)]*;*

- *The feasibility study shall include alternatives with the standard point of compliance for each environmental media containing hazardous substances, unless those alternatives have been eliminated under (b[xiii]) of this subsection, and may include, as appropriate, alternatives with conditional points of compliance* [WAC 173-340-350(8)(c)(i)(F)].

5.2.2 CERCLA

The Lower Duwamish Waterway (LDW) is a listed site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund. EPA is the lead agency for the LDW. In November 2014, EPA published a Record of Decision (ROD) for

[xiii] WAC 173-340-350(8)(b). *Screening of alternatives. An initial screening of alternatives to reduce the number of alternatives for the final detailed evaluation may be appropriate. The person conducting the feasibility study may initially propose cleanup action alternatives or components to be screened from detailed evaluation. The department shall make the final determination of which alternatives must be evaluated in the feasibility study. The following cleanup action alternatives or components may be eliminated from the feasibility study: (i) Alternatives that based on a preliminary analysis, the department determines so clearly do not meet minimum requirements specified in WAC 173-340-360 that a more detailed analysis is unnecessary. This includes those alternatives for which costs are clearly disproportionate under WAC 173-340-360(3)(e); and (ii) Alternatives or components that are not technically possible at the site.*

the LDW Superfund Site. The ROD includes remedial action objectives, cleanup levels for PCBs, arsenic, cPAHs, and dioxins/furans, and how the cleanup levels are to be applied (by areas, compliance measures, and compliance depth). The ROD identifies that post-remedy portions of the site's embayment need to be suitable for beach play and clamming. The general proposed remedy for the embayment is also described being contaminated sediment removal with or without sediment capping and that finish elevations are to match starting elevations.

5.2.3 SURFACE WATER AND SEDIMENTS

Selection and implementation of the remedy will consider surface water and sediment quality standards as ARARs contained in the following regulations and guidance documents:

- Model Toxics Control Act (Chapter 173-340 WAC)
- Sediment Management Standards (Chapter 173-204 WAC) – Sediment quality standards were incorporated into the cleanup analysis.
- Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201A WAC)
- Federal Clean Water Act and Surface Water Quality Criteria promulgated therein (33 U.S.C 1251 et. Seq.)
- LDW Preliminary Cleanup Levels in the PCUL Workbook prepared by Ecology to provide guidance for upland cleanups adjacent to the Lower Duwamish Waterway and was most recently updated in August 2022. This document incorporates CULs embedded in most regulations that are identified as ARARs.
- Construction Stormwater General Permit – These requirements will be incorporated into the plans and specifications.

5.2.4 SOIL AND SEDIMENT DISPOSAL

- Resource Conservation and Recovery Act (RCRA) and the Washington State Minimum Functional Standards for Solid Waste Handling (Chapter 173-304 WAC) - Regulate landfills to receive solid waste. Permitted Subtitle D landfills may accept non-hazardous waste while Subtitle C landfills may accept hazardous waste (there are no Subtitle C landfills in Washington State). Wastes disposed off-site will need to meet the requirements under these laws/regulations.
- Washington State Hazardous Waste Management Act (Chapter 70.105 RCW) and Dangerous Waste Regulation (Chapter 173-303) and RCRA – Some materials slated for off-site disposal may be designated as characteristic dangerous (or hazardous) waste

(DW) and will need to be managed and disposed accordingly. Disposal site approval will be required from Ecology and the accepting facility.

- Toxic Substance Control Act (TSCA) – Most materials slated for off-site disposal will be disposed in a Subtitle D landfill regulated under TSCA. Some materials slated for off-site disposal will have PCB concentrations equal to or greater than 50 ppm and will need to be managed and disposed in a facility permitted to accept such waste. It is anticipated that a risk based cleanup approval in accordance with 40 CFR § 761.61(c) will be required from EPA. Discussions with EPA have begun and will continue as part of remedial design.

5.2.5 WORKING ADJACENT TO AND WITHIN DUWAMISH RIVER

A **Joint Aquatic Resources Permit Application (JARPA)** will be used to apply for the Hydraulic Project Approval (HPA), the Shoreline Substantial Development Permit, the Clean Water Act Section 401 Water Quality Certification/Modification, and the U.S. Army Corps of Engineers (USACE) Section 10/404 Permit.

Endangered Species Act Section 7 Consultation. The Endangered Species Act (ESA) of 1973, as amended (16 USC § 1531), provides "… a means whereby the ecosystems upon which endangered species depend may be conserved." On May 24, 1999, the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA-Fisheries) formalized the listing of Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*) as threatened under the ESA. NOAA-Fisheries has designated the coho salmon (*O. kisutch*) as a candidate for listing. The U.S. Fish & Wildlife Service (USFWS) listed bull trout (*Salvelinus confluentus*) in Puget Sound as threatened, effective December 1, 1999. The Duwamish Waterway is used as a migratory corridor to spawning areas in the Green River and its tributaries for each of these species. The presence of these species in the project area will require EPA to engage in a consultation with NOAA-Fisheries and USFWS (the Services) regarding the effects of their decision for the Project on Chinook, Coho, and Bull Trout and their habitat under Section 7 of the ESA.

A draft biological assessment (BA) will be provided to EPA, as the lead federal agency, to assist in Section 7 consultation with the Services. The BA characterizes the existing environmental conditions within the project area and addresses potential protect impacts to ESA-listed species and candidate species occurring in the project area. ICS/NW Cooperage will assist EPA in support of consultation with NOAA-Fisheries and USFWS.

State Environmental Policy Act Threshold Determination. The Project will require compliance with the Washington State Environmental Policy Act (SEPA). SEPA (Revised Code of Washington [RCW] 43.21C) is intended to ensure that state and local government officials consider environmental values when making permit decisions for project actions. The SEPA Rules (Washington Administrative Code [WAC] Chapter 197-11) establish uniform requirements and guidance for compliance with SEPA.

The SEPA process is initiated once a project proponent submits a permit application to an agency, or once the lead agency initiates formal action as defined by SEPA (e.g., public notice). For this project, an environmental checklist will be prepared that provides an evaluation of potential environmental impacts associated with the Project. The SEPA lead agency evaluates the environmental checklist and will make a threshold determination.

The threshold determination can result in three possible outcomes: a determination of non-significance (DNS), a mitigated DNS, or a determination of significance (DS). A DNS determination concludes the SEPA process. A mitigated DNS often requires the preparation of an expanded environmental checklist with more detailed information regarding the potential impacts of a proposed action. Project-specific mitigation measures and appropriate mitigation plans are also required to provide the basis for the determination that significant impacts of a proposed action can in fact be mitigated into non significance. A DS determination requires preparation of an environmental impact statement. It is anticipated that this project will result in a determination of non-significance. Ecology will be the lead SEPA agency for this project.

Shoreline Management Act. The Shoreline Management Act of 1971 (SMA; RCW 90.58) provides the basis for coastal zone management in the State of Washington. WAC 173-27 provides the provisions for implementing the requirements of RCW 90.58. This act is intended to provide for the management of the state's shorelines by planning for and fostering all reasonable and appropriate uses, and to ensure that development of state shorelines be accomplished in a manner that will promote and enhance the public interest. The SMA provides goals and policies that are implemented at the local level through detailed planning and permit procedures and, at the state level, through Ecology review and certification of local shoreline master plans.

Section 90.58.020 of the SMA states that the interest of all the people shall be paramount in the management of shorelines of statewide significance. Section 90.58.020 further states that in preparing local shoreline programs, local jurisdictions shall give preference, in the following order, to uses that:

- Recognize and protect statewide interest over local interest.
- Preserve the natural character of the shoreline.
- Result in long-term rather than short-term benefit.
- Protect the resources and ecology of the shoreline.
- Increase public access to publicly owned shoreline areas.
- Increase shoreline recreational opportunities for the public.
- Provide for any other element defined in RCW 90.58.100 as deemed appropriate or necessary.

The Project provides compliance with the intent of the SMA through several of its elements. The Project directly addresses the interests of the state through the cleanup of material in the vicinity of the ICS facility on the Duwamish Waterway. It also helps to enhance the natural character of the shoreline through the restoration of the shoreline and placement of clean backfill material in the dredge cut from the cleanup. This restoration will result in a long-term benefit to the environment and the shoreline in this area. This in turn works to protect the resources and ecology of the shoreline environment. Thus, the Project directly addresses the top four priorities of the SMA. The City of Seattle issues shoreline permits for these activities.

Corps Section 10/404 Permit. The Rivers and Harbors Act of 1899 (33 CFR 321-329) gives the USACE regulatory authority over construction activities in all navigable waters of the United States. Section 10 of the act is intended to protect these waters for purposes of navigation and public benefit. This regulation is administered through the USACE Section 10 Permit application process.

Section 404 of the Clean Water Act (33 USC 1344) prescribes procedures to be followed before dredged or fill materials can be discharged into national water resources (including wetlands) and, as such, provides regulatory guidelines and permit requirements for dredging and filling activities. Administration of the requirements of Section 404 is vested in the USACE and is managed in conjunction with the Section 10 Permit process. When both a Section 10 Permit and a Section 404 (of the Clean Water Act) Permit are required, as is the case for the Project, they are typically considered and administered together by the USACE as a Section 10/404 Permit. Excavated materials within the Project area regardless of construction sequencing (either dredged from barges in the Waterway or excavated with equipment from the shoreline) will be governed by the requirements of the Section 10/404 permit and will be managed as “dredged material” per the provisions of the Section 10/404 permit. Water generated during this work will be considered “dredge return water” and will be processed according to the requirements of the Section 10/404 permit.

Washington Department of Fish and Wildlife Hydraulic Project Approval. Any proposed action that may modify aquatic habitat (e.g., involve construction activities within the “*Waters of the State*”) is a hydraulic project. Pursuant to WAC 220-110, the Washington Department of Fish and Wildlife (WDFW) is responsible for reviewing hydraulic projects to ensure compliance with criteria established to protect marine and freshwater fishes. Application to the USACE for a Section 10/404 Permit also serves as an application for the HPA.

WDFW has established a Habitat Management Policy 410 (1990) with the following goals:

- Achieve no net loss of productive capacity of the habitat of food fish and shellfish resources.
- Restore the productive capacity of habitats that have been damaged by natural causes or the results of man’s activities.

- Improve the productive capacity of existing habitat and create new habitat.

RCW 75.20.325 specifies that WDFW "…shall not require mitigation for sediment dredging or capping actions that result in a cleaner aquatic environment and equal or better habitat functions and values, if the actions are taken under a state or federal cleanup action." Thus, compensatory mitigation should be not required for aspects of the Project related to dredging, excavation, and backfilling.

Ecology Section 401 Water Quality Certification/Modification. The Clean Water Act of 1977 (PL 95-217), which amended the Federal Water Pollution Control Act, provides for restoring national water resources and maintaining water quality. This act, which is administered by EPA, is intended to restore, and maintain the chemical, physical, and biological integrity of the nation's waters. Specific policies, programs, and regulatory procedures support the stated objective.

Section 401 of the act requires that any federal permit involving construction activities that may result in discharges into navigable waters also provide state certification that the discharges will comply with applicable provisions of Sections 301, 302, 303, 306, and 307 of the Clean Water Act. The intent of this certification is to protect water resources from degradation and to ensure compliance with water quality standards. In Washington, Ecology has been delegated authority by EPA to administer Section 401 requirements and issue certification.

5.5.6 OTHER PERMITS/APPROVALS/REQUIREMENTS

Other permits/approvals (or meeting substantial requirements thereof), listed below, may be necessary to complete the Project:

- Ecology Coastal Zone Management Act Consistency Determination.

- Air Quality - Dust from excavation of soil and sediment will be controlled as specified under the 2021 Seattle Stormwater Manual (BMP E2.45) and as required by the Puget Sound Clean Air Agency (PSCAA) Regulation 1 Section 9.15 (Fugitive Dust Control Measures).

  Potential air emissions from excavation or from vapor treatment systems (e.g. an SVE system) would be evaluated to determine if the potential to emit exceeded de minimis limits (WAC 173-460-150) or if the source controls triggered PSCAA registration or permitting [PSCAA Regulation 1, Article 5(a), and Article 6 Section 6.03(c.)(94)].

- King County Department of Natural Resources permit application for sanitary sewer discharge.

- City of Seattle grading and hauling permits.

- Washington State Department of Archaeology and Historic Preservation opinion on effects to significant cultural resources.

- EPA Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Assessment.

- Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 WAC) – Includes contractor licensing requirements and standards for the abandonment or construction of resource protection wells.

- Health & Safety – The selected contractor will be required to develop a health & safety plan to protect site workers per WAC 173-340-810. This regulation incorporates the requirements of the federal Occupational Safety and Health Act (OSHA) and Washington Industrial Safety and Health Act (WISHA).

- City of Seattle Demolition Permit – Several buildings will need to be demolished to implement the remedial action. A Demolition Permit and Construction and Development Permit may be required. A SEPA threshold determination and a shoreline permit may also be required.

6.0 REMEDIAL ACTION OBJECTIVES

Based on the accumulated RI data and information, the FS was completed to address the following Remedial Action Objectives (RAOs) listed in Table 6.1 below.

Table 6.1 -Remedial Action Objectives

RAO-1 - Sediment ➢ Reduce risk to humans and animals (e.g., river otters) via ingestion of fish and shellfish ➢ Prevent human recreational contact with sediment above cleanup levels in the ROD ➢ Reduce risk to aquatic organisms via contact with sediment	**Point of Compliance (per ROD)** ➢ 0 to 10 cm outside of clamming and beach play areas ➢ 0 to 45 cm in clamming and beach play areas
RAO-2 – Worker Contact w/ Soil and Mobile NAPL ➢ Reduce risk to site buried-utility and subsurface construction workers via contact (ICS/NWC property)	**Point of Compliance (per MTCA)** ➢ 0 to 15 feet below ground surface
RAO-3 – Wildlife Contact w/ Soil ➢ Reduce risk to terrestrial ecologic receptors - wildlife (ICS/NWC property)	**Point of Compliance (per MTCA)** ➢ 0 to 15 feet below ground surface w/o institutional controls ➢ 0 to 6 feet below ground surface w/ institutional controls
RAO-4 -Groundwater (via groundwater and NAPL discharge to embayment and LDW) ➢ Reduce risk to aquatic life (water column and sediment) ➢ Reduce risk to humans via ingestion of fish and shellfish	**Point of Compliance (per MTCA and ROD)** ➢ Closest point of groundwater discharge to surface water (shoreline) and sediment (0 to 45 cm)
RAO-5 – Groundwater (Reduce Soil Leaching into Groundwater)	**Point of Compliance** ➢ To depth below ground surface where leaching occurs

7.0 REMEDIAL AREAS AND EMBAYMENT ALTERNATIVE ANALYSES

As noted above in Section 1, the site has been divided into three remedial areas as follows. The three general areas are shown on Figure 1-3.

- Intertidal Embayment (below +12 feet MLLW);
- ICS Upland (above +12 feet MLLW; and
- Douglas Property

For purposes of this FS, these areas are addressed as separate remedial areas (or operable units in a similar manner as those identified for larger federal Superfund cleanups). The boundaries and basis thereof are described below. The boundaries between the areas may be adjusted during engineering design.

7.1 DESCRIPTION OF REMEDIAL AREAS

7.1.1 EMBAYMENT

This area includes the embayment at elevations lower than approximately +12 feet MLLW. The LDW ROD outlined the general selected alternative for this embayment, so a full technology screening step was not conducted to develop and evaluate alternatives. For this reason and that cleanup/remedial action levels (RALs[xiv]) and their application are specific to the embayment, the embayment is discussed separately from the adjacent ICS upland. However, cleanup of the upland shoreline adjacent to the embayment needs to be integrated with the embayment remedy which is addressed in assessing ICS upland alternatives. Of note is the issue of maintaining stable slopes during remedy implementation, as sediment removal is a major element of the embayment remedy.

7.1.2 ICS UPLAND SOUTH OF EMBAYMENT AND SOUTHERN SHORELINE UPLAND

Cleanup of the ICS upland area is not directly dependent on cleanup of the Embayment Area or LDW main channel and was not addressed in the LDW ROD, as the area lies above an elevation of +12 feet MLLW. This area includes the upland adjacent to the embayment, the former drainage ditch along the east ICS property line, and the general area east of the main building (between the building and eastward to the filled-in drainage ditch). Cleanup of the upland area along the embayment needs to be integrated with the embayment cleanup. For the ICS upland, a technology screening was completed to support development of remedial alternatives to evaluate in this FS (see Section 8.0 below). The identified alternatives were evaluated in the manner required by MTCA, including a disproportionate cost analysis (WAC 173-340-360).

[xiv] RAL is terminology used for Superfund sites by EPA. At the request of Ecology, Remediation Level (REL) is used herein consistent with the terminology used in MTCA, except when specifically discussing Superfund ROD sediment criteria.

7.1.3 DOUGLAS PROPERTY

The Douglas remedial area is located on the north side of the embayment and includes property leased from WSDOT. Data is not available to complete an FS for the entire property. A work plan to complete additional characterization is pending with Ecology (as of November 2023) to collect this data. Furthermore, there are issues (releases) unrelated to past ICS/NWC operations. Based on these considerations, a supplemental FS will be completed for the Douglas property once site characterization is complete. However, the Douglas property is addressed in this FS to the extent that groundwater migration to the embayment could adversely impact the embayment remedy.

7.2 EMBAYMENT REMEDY

7.2.1 SEDIMENT CLEANUP LEVELS

CULs are concentrations to be achieved, at the point of compliance, after cleanup is complete. In attached Table A5.1, sediment CULs were updated using the LDW PCUL workbook concentrations. Table 19 in the ROD presents CULs to protect human health and possible ecological receptors (based on river otter) and where/how the CULs are to be applied. The CULs are presented below in Table 7.1. Arsenic, PCB (dry weight) and cPAH–TEQ concentrations in sediment cores are summarized in attached Table A7.1. Surface sediment concentrations are not summarized herein as it is assumed surface sediment will be removed as part of the ultimate remedy. Core sample concentrations are summarized to assist in evaluating remedial alternatives.

Table 7.1 – LDW ROD Cleanup Levels to Protect Human Health and Ecologic Receptors

COC	Human Seafood Consumption	Human Direct Contact	Ecological (River Otter)	Areas	Compliance Measure	Point of Compliance
PCBs (ug/kg dry wt.)	2	1300	128	LDW-Wide	UCL-95	0 – 10 cm
	NA	500	NA	Clamming Areas		0 – 45 cm
	NA	1700	NA	Ind. Beaches		0 – 45 cm
Arsenic (mg/kg-dry wt.)	NA	7	NA	LDW-Wide	UCL95	0 – 10 cm
	NA	7	NA	Clamming Areas		0 – 45 cm
	NA	7	NA	Ind. Beaches		0 – 45 cm
cPAH (ug TEQ/kg-dry wt.)	NA	380	NA	LDW-Wide	UCL95	0 – 10 cm
	NA	150	NA	Clamming Areas		0 – 45 cm
	NA	90	NA	Ind. Beaches		0 – 45 cm

COC	Human Seafood Consumption	Human Direct Contact	Ecological (River Otter)	Areas	Compliance Measure	Point of Compliance
Dioxins/Furans (ng TEQ/kg-dry wt.)	2	37	NA	LDW-Wide	UCL95	0 – 10 cm
	NA	13	NA	Clamming Areas		0 – 45 cm
	NA	28	NA	Ind. Beaches		0 – 45 cm

Note: UCL95 is a statistical measure – upper 95% confidence limit on the true mean.

Table 20 in the ROD presents CULs to protect benthic invertebrates. The CULs are presented below in Table 7.2. Core sample concentrations of those constituents in sediments that are identified as COCs are summarized in attached Table A7.2.

Table 7.2 – LDW ROD CULS to Protect Benthic Invertebrates

Benthic COC	Cleanup Level (b)	Benthic COC (carbon normalized)	Cleanup Level (b)
Metals (mg/kg – dw)		**OC Organic Compounds (mg/kg -OCN)**	
Arsenic(a)	57	Total PCBs(a)	12
Cadmium	5.1	Benzo(g,h,i)perylene	31
Total Chromium(a)	260	Chrysene	110
Copper	390	Dibenzo(a,h)anthracene	12
Lead(a)	450	Indeno(1,2,3-cd)pyrene	34
Mercury(a)	0.41	Fluoranthene	160
Silver	6.1	Fluorene(a)	23
Zinc(a)	410	Naphthalene	99
Organic Compounds (ug/kg – dw)		Phenanthrene	100
4-methylphenol	670	Pyrene	1000
2,4-dimethylphenol(a)	29	HPAH	960
Benzoic acid	650	LPAH	370
Benzyl alcohol(a)	57	Bis(2-ethylhexyl)phthalate	47

Benthic COC	Cleanup Level (b) (ug/kg-dw)	Benthic COC (carbon normalized)	Cleanup Level (b) (mg/kg-OCN)
Pentachlorophenol(a)	360	Butyl benzyl phthalate(a)	4.9
Phenol	420	Dimethyl phthalate	53
		1,2-dichlorobenzene(a)	2.3
OC Organic Compounds (mg/kg – OCN)		1,4-dichlorobenzene(a)	3.1
Acenaphthene(a)	16	1,2,4-trichlorobenzene(a)	0.81
Anthracene(a)	220	2-methylnaphthalene(a)	38
Benzo(a)pyrene	99	Dibenzofuran	15
Benz(a)anthracene	110	Hexachlorobenzene	.38
Total benzofluoranthenes	230	n-Nitrosodiphenylamine (a)	11

Notes: OCN – Organic Carbon Normalized; (a) Identified as an embayment COC; (b) CUL is applied on an individual sample basis with a point of compliance of 0 to 10 cm.

CULs for the identified embayment sediment COCs are identified in the EPA ROD except for petroleum hydrocarbons (DRO + RRO). A DRO+RRO CUL of 2,000 mg/kg-dw was assumed in this FS based on the MTCA Method A CUL. Most of the intertidal embayment is identified as an area where clamming and beach play may occur, although such activities are highly unlikely because of access, and would only occur during lower tides during daylight hours.

7.2.2 RALS, ENR ULS, AND CONCEPTUAL EMBAYMENT REMEDY

Embayment CULs and a conceptual remedy have already been selected based on completion and public review/comment of an RI/FS (LDWG, 2010, 2012) and ROD (EPA 2014) for cleanup of the LDW. This FS assumes that the embayment remedy will consist of partial dredging with placement of an engineered cap. In assessing this remedy, ROD RALs, and Enhanced Natural Recovery Upper Limits (ENR ULs) were considered.

RALs (equivalent to MTCAs RELs) were developed by EPA based on an estimation whether natural recovery would occur through natural sedimentation and are listed in Table 28 of the ROD. The intertidal embayment falls within ROD Category 2 where natural recovery is uncertain. In Category 2 areas, if COC concentrations exceed RALs, active remediation is required (dredging, capping and/or enhanced natural recovery - ENR). A comparison of RALs with sediment core data is presented in attached Table A7.3. RAL exceedances are highlighted in yellow on the table. RALs are exceeded for metals, DRO+RRO, PCBs, and other organic chemical constituents.

If concentrations exceed ENR ULs (as listed in ROD Table 28 for intertidal sediments), dredging or capping is required as ENR was judged not to be effective. ENR ULs are listed in Table 7.3 below.

Table 7.3 – Category 2 ENR Upper Limits

COC	ENR UL (b)	Highest Conc. (c)	COC (carbon normalized)	ENR UL (b)	Highest Conc. (c)
Metals (mg/kg – dw)			**OCN Organic Compounds (mg/kg -OCN)**		
Arsenic(a)	42(d)	31	Total PCBs(a)	97(d)	**1309**
Cadmium	15.3	8.8	Benzo(g,h,i)perylene	93	21.6
Chromium(a)	780	431	Chrysene(a)	330	97.3
Copper	1170	254	Dibenzo(a,h)anthracene	36	7.1
Lead(a)	1350	4430	Indeno(1,2,3-cd)pyrene(a)	102	16.7
Mercury(a)	1.23	38.8	Fluoranthene	480	86.4
Silver	18.3	NA	Fluorene(a)	69	64.9
Zinc(a)	1230	3240	Naphthalene	297	30
Organic Compounds (ug/kg – dw)			Phenanthrene	300	50.8
4-methylphenol	2010	57	Pyrene	3000	227
2,4-dimethylphenol(a)	87	890	HPAH	2880	516
Benzoic acid	1950	620	LPAH	1110	194
Benzyl alcohol(a)	171	190	Bis(2-ethylhexyl)phthalate(a)	141	151
Pentachlorophenol(a)	1080	880	Butyl benzyl phthalate(a)	14.7	9.2
Phenol	1260	96	Dimethyl phthalate	159	4.1
cPAHs (ug/TEQ/kg)	1350(d)	717	1,2-dichlorobenzene(a)	6.9	4.4
Dioxin/Furans (ng TEQ/kg)	42(d)	NA	1,4-dichlorobenzene(a)	9.3	29
OCN Organic Compounds (mg/kg – OCN)			1,2,4-trichlorobenzene(a)	2.4	1.7
Acenaphthene(a)	48	51	2-methylnaphthalene(a)	114	25.1

COC (carbon normalized)	ENR UL (b) (mg/kg-OCN)	Highest Conc. (c) (mg/kg-OCN)	COC (carbon normalized)	ENR UL (b) (mg/kg-OCN	Highest Conc. (c) (mg/kg-OCN)
Anthracene(a)	660	39.4	Dibenzofuran	45	6.7
Benzo(a)pyrene(a)	297	35.3	Hexachlorobenzene	1.14	**3.9**
Benz(a)anthracene(a)	330	40	n-Nitrosodiphenylamine(a)	33	**97**
Total benzofluoranthenes (a)	690	**930**			

Notes: OCN – Organic Carbon Normalized; (a) Identified as an embayment COC; (b) RAL is applied on an individual sample basis: (c) – Below depth of 1.5-feet (45 cm); (d) – from ROD Table 28.

A comparison of the ENR-ULs with sediment core data (attached Table A7.4) indicate sediment removal from the embayment is required[xv]. Concentrations of the following COCs exceed ENR ULs in sediment core samples. While the ROD does not list an ENR UL for DRO+RRO, it is included in the list below because relatively high concentrations were detected in sediment.

- Lead
- Mercury
- Zinc
- 2,4-Dimethylphenol
- Benzyl alcohol
- Acenaphthene
- Fluorene
- 2-Methylnaphthalene
- 1,4-Dichlorobenzene
- n-Nitrosodiphenylamine
- Total PCBs
- DRO+RRO

A further constraint on the embayment remedy is that in habitat areas outside the federal navigation channel, post-remedy surfaces are to be maintained at their current depth. Any sediment removal from the embayment will require that a cap be placed.

[xv] Contaminant concentrations in shallower sediment are generally higher than in deeper core samples, so these sediments also exceed one or more ENR ULs.

Attached Table A7.5 summarizes the depth of sediment COC exceedances at core locations based on CULs, RELs and ENR-ULs. For the most part, one or more sediment COC concentrations exceeded ENR ULs up to depths of five- to seven-feet based on available data.

7.3 EMBAYMENT REMEDY CONCEPTUAL DESIGN

A conceptual embayment sediment removal plan was developed to evaluate environmental benefits and estimate costs. The conceptual plan is generally based on the ROD LDW remedy descriptions and is described below.

- **Structure Demolition/Debris Removal**. Several structures over embayment sediment would be demolished and removed to provide access to the embayment shoreline. Piling, horizontal timbers, and debris (metal, concrete, wood) would also be removed (estimated at 5,000 tons). Materials generated by these activities would be disposed off-site at a Subtitle D landfill.

- **Upland Structure Removal**. Several upland ICS/NWC structures would be removed to provide south shoreline access. Hazardous materials and cultural resource surveys have been completed and will be documented in the planning documents.

- **Slope Stability Control.** A structural sheet pile wall would be installed along the north embayment shoreline . The structural wall is needed to support the existing ecology block wall and embayment slopes while excavation and capping proceed. Preliminary geotechnical and structural analyses indicate the sheets need to be driven to a depth of approximately 42 feet below the top of slope. The referenced engineering analyses will be documented in the planning documents.

  The north sheet pile wall is located on the Douglas Property owned by 1st Ave. LLC. The NW Cooperage/Herman Trotsky Estate who is responsible for completing the RI/FS, believes that the current owner has a legal obligation to prevent collapse of the ecology block wall and north shoreline either by paying the cost to construct the north wall or by some other means (see Appendix F). As part of developing the cleanup action plan for embayment cleanup, this issue will need to be resolved.

  Remediation of the south embayment shoreline will need to be integrated into the embayment shoreline remedy and will likely require the shoreline to be cut back and sloped to the embayment. The possible extent of the cutback is discussed later in this FS with the ICS Upland alternative analysis.

- **Remedy Excavation/Dredging –** The ROD indicates that sediment removal is required because ENR-ULs are exceeded. To accomplish this, a temporary dam would be installed across the neck of the embayment. Out-flows from the two outfalls that discharge to the embayment would be by-passed using pumps and piping, so discharge occurs on the downstream side of the dam.

Sediment west of the dam would be excavated using land-based equipment in the dry while sediment east of the dam would be removed by land-based equipment during low tides (as possible) and by dredging (assumed below 0-feet MLLW). Sediments would be dewatered and stabilized as needed. Excavated/dredged sediment would be disposed off-site; sediment with PCB concentrations equal to or greater than 50 ppm would be disposed in a TSCA permitted (Subtitle C) landfill while remaining sediment would be disposed in a Subtitle D landfill. Testing of sediment indicates the sediment would not designate as characteristic dangerous waste (DW) based on metals TCLP testing.

Vertical depths of sediment removal were based on the ROD criteria; three-feet for non-clamming areas and four-feet for clamming areas. Data for cores L, M, and LDW-SC40 indicate CULs would be achieved with sediment removal depths between two- and three-feet. The horizontal boundaries in the embayment alternatives are based on core data and an evaluation of historic aerial photographs which indicate historic transport likely was along the north shoreline which appears consistent with data from cores I and K as indicated in the hot-spot report. The boundaries between areas defined by Core L and Cores M/LDW-SC40 was somewhat arbitrary. Some testing at the beginning of remediation may be necessary to further define some of the boundaries.

To assist in evaluating benefits and costs, three sediment removal alternatives were evaluated including the following:

- EB-1 - Removing sediment to a nominal depth of 2-feet (Figure 7-2a to 7-2d).
- EB-2 - Removing sediment to nominal depths of 2- to 3-feet (Figure 7-3a to 7-3d).
- EB-3 - Removing sediment to nominal depths of between 2- to 5-feet (Figure 7-4a to 7-4d).

Further discussion of each of the alternatives, the approach to evaluating environmental benefits, results, and estimated costs are presented in Section 7.4.1, below.

- **Final Elevations –** Approximately the same as the pre-construction grades as specified in the ROD for intertidal areas.

- **Capping –** Capping is required to meet pre-construction grades if any sediment is removed. The cap will be designed in general accordance with U.S. Army Corp of Engineers (USACE) guidance (Palermo 1998) using the CapSim transport model (Shen et al., 2018). The thickness of the cap will vary with the volume of sediment removed from the embayment. It was assumed that the bottom one-foot of the capping material would be augmented with organic carbon/granulated activated carbon (GAC) or other contaminant-sequestering agents to reduce the potential for residual contaminants to migrate through the cap. Sand and/or sand and gravel would be placed over the sequestering layer and would be designed to minimize the potential for erosion during lower tides from the Seattle reservoir outfall and the 2nd Ave. storm water outfall. The upper 45cm (1.5-feet) of the cap would be suitable for clamming habitat. It is anticipated a 3-inch rocked channel would be constructed to direct flow and minimize erosion from the outfalls during lower tides.

- **Habitat Enhancement.** Appropriate vegetation to enhance habitat would be planted on the embayment bottom and side slopes. A vegetation plan and biological assessment will be documented in the planning documents.

- **Long-Term Maintenance and Monitoring.** A maintenance and monitoring program would be developed and implemented. Annual visits would be made to the embayment to visually observe the cap surface and identify the needs for repairs caused by disturbance of the cap by erosion etc. The monitoring program would consist of collection of surface sediments (0-10 cm and 0-45cm) and cores (through bottom of cap) to monitor for top down and bottom-up contamination of the cap. The frequency of sampling will be developed as part of the cleanup action plan.

7.4 EMBAYMENT ALTERNATIVES

7.4.1 APPROACH TO EVALUATING BENEFITS

To evaluate the environmental benefits of sediment remediation, existing (bulk) concentrations of PCBs, DRO+RRO, lead, and mercury were compared to estimated concentrations assuming nominal sediment removal depths of between two- and five-feet. Each of the assumed excavation depths could be completed over a period of several months. For each of the four conditions (including existing conditions), the following were evaluated:

- Upper 95% concentration on the true mean concentration (UCL95%). This value was estimated using the EPA statistical program ProUCL (v. 4.00.04)[xvi]. In making these estimates, as sediment was removed, existing sample concentrations were replaced with clean imported fill assuming fill concentrations of 2 ug/kg total PCBs (based on Duwamish River background concentration), 13 mg/kg DRO+RRO (based on the typical reporting limit), 1.8 mg/kg lead (based on typical fill concentrations) and 0.05 mg/kg mercury (based on the typical reporting limit). In reality, imported fill concentrations will be lower than those assumed in this analysis.

- Impact on the highest remaining sediment concentration.

[xvi] In estimating the UCL95% concentration, the distribution of data (normal, log-normal etc.) was assessed. None of the data sets had discernable distributions. The non-parametric 95% Chebyshev method (in ProUCL) was used to estimate the UCL95% concentration.

- Exceedance of ENR-ULs on post-removal sediment surfaces. Surface concentrations were estimated based on core logs (material types, PID measurements, sheen observations) and sediment concentrations. Data used to estimate post-removal surface concentrations are summarized in attached Table A7.6 for available core samples.

7.4.2 EXISTING CONDITIONS

UCL95% concentrations of PCBs, DRO+RRO, lead and mercury for the existing (unremediated) condition are listed in Table 7.4 below.

Table 7.4 - Sediment Concentration Statistics - Existing Condition

Constituent	Number of Samples	Units	UCL95%	Highest Concentration	Location of Highest Detected Concentration
Total PCBs	116	ug/kg	134,404	1,600,000	SED1 (0.32’)
DRO + RRO	90	mg/kg	17,411	142,400	HSA4 (2-3’)
Lead	104	mg/kg	3,253	33,700	HS9 (0-1’)
Mercury	98	mg/kg	11.1	94	HS21 (0-1’)

Figures 7-1a to 7-1d are plots of PCB, DRO+RRO, lead, and mercury concentrations in surface sediment (<1.0-feet depth). Most samples exceed the ENR-UL concentrations for PCBs. ENR-UL concentration exceedances for lead and mercury are present, for the most part, within the upper central portion of the embayment. The highest concentrations of DRO+RRO are present in a similar area as for lead and mercury.

7.4.3 EB-1 - 2-FOOT SEDIMENT REMOVAL

UCL95% and highest estimated remaining concentrations of PCBs, DRO+RRO, lead, and mercury, assuming a nominal 2-foot-deep sediment removal, are listed in Table 7.5 below. Sediment removal depths are illustrated on Figures 7-2a to 7-2d and include the following:

- 2-foot of soil removal above elevation +12-feet MLLW. To accommodate riparian planting.
- 2-foot sediment removal below elevation +12-feet MLLW.

Table 7.5 – EB-1 Sediment Concentration Statistics – 2-Foot-Thick Sediment Removal

Constituent	Number of Samples	Units	UCL95%/ (% Decline-a)	Highest Conc. (% Decline-a)	Location of Highest Detected Concentration
Total PCBs	116	ug/kg	15,443(88.5)	171,400(89.3)	HSA4 (2-3’)
DRO + RRO	90	mg/kg	11,308(35.1)	142,400(0)	HSA4 (2-3’)
Lead	104	mg/kg	1,632(49.8)	14,900(55.8)	HSA4 (2-3’)
Mercury	98	mg/kg	4.9(55.9)	52(44.7)	HSA4 (2-3’)

(a) – Compared to existing condition

Removal of the top two feet of sediment would result in substantial declines in the bulk (UCL95%) concentration of embayment sediment. Declines are estimated to be between approximately 35 and 89 percent of the existing condition concentrations. However, concentrations of PCBs, lead, and mercury would still exceed ENR-ULs in portions of the embayment as illustrated on Figures 7-2a to 7-2d. The highest concentrations would be present in the upper central portion of the embayment. The highest concentrations of DRO+RRO would be present in the similar area as for PCBs, lead, and mercury.

For cost estimating purposes (discussed below), it was assumed that a 2-foot-thick cap be placed after sediment removal. The cap would consist of a lower one-foot-thick layer of sand and gravel augmented with 0.5% organic carbon and one-foot of a coarse sand and gravel. The relatively coarse material would provide clam habitat. A 3-inch rocked channel would be constructed on top of the cap to direct flow and minimize erosion from the outfalls during lower tides.

7.4.4 EB-2 - 2 TO 3-FOOT SEDIMENT REMOVAL

UCL95% and highest remaining concentrations of PCBs, DRO+RRO, lead, and mercury assuming a nominal 2-foot to 3-foot-thick sediment removal are listed in Table 7.6 below. Sediment removal depths are illustrated on Figures 7-3a to 7-3b and include the following.

- 2-foot of soil removal above elevation +12-feet MLLW. To accommodate riparian planting.
- 2-foot sediment removal near mouth of embayment below +12-feet MLLW
- 3-foot sediment removal (elsewhere) below elevation +12-feet MLLW.

Table 7.6 – EB-2 Sediment Concentration Statistics – 2- to 3-Feet Thick Sediment Removal

Constituent	Number of Samples	Units	UCL95%/ (% Decline-a)	Highest Conc. (% Decline-a)	Location of Highest Detected Concentration
Total PCBs	116	ug/kg	6,676(95)	61,800(96.1)	HS7 (3'-4')
DRO + RRO	90	mg/kg	5,165(70.3)	46,200(67.6)	HSA4 (3'-4')
Lead	104	mg/kg	760(76.6)	8,440(75.0)	HSA2 (3'-4')
Mercury	98	mg/kg	2.2(80.1)	31(67.0)	HS7 (3'-4')

(a) – Compared to existing condition

Removal of the top two to three feet of sediment would result in substantial declines in the bulk (UCL95%) concentration of embayment sediment. Declines are estimated to be between approximately 70 and 95 percent of the existing condition concentrations. However, concentrations of PCBs, lead, and mercury would still exceed ENR-ULs in portions of the embayment as illustrated on Figures 7-3a to 7-3d. The highest concentrations would continue to be present in the upper central portion of the embayment. The highest concentrations of DRO+RRO would be present in the similar area as for PCBs, lead, and mercury.

For cost estimating purposes (discussed below), it was assumed that a two- to three-foot-thick cap would be placed after sediment removal. The two-foot cap would consist of a one-foot layer of sand and gravel augmented with 0.5% organic carbon, covered by one-foot of a coarse sand and gravel (clam habitat). The three-foot thick cap would consist of one-foot of sand augmented with 0.5% organic carbon covered by 2-feet (61 cm) of a coarse sand and gravel to provide clam habitat. A 3-inch rocked channel would be constructed on top of the cap to direct flow and minimize erosion from the outfalls during lower tides.

7.4.5 EB-3 - 2 TO 5-FOOT SEDIMENT REMOVAL

UCL95% and highest remaining concentrations of PCBs, DRO+RRO, lead, and mercury assuming a nominal 2-foot to 5-foot-thick sediment removal are listed in Table 7.7 below. Sediment removal depths are illustrated on Figures 7-4a to 7-4d and include the following:

- 2-foot of soil removal above elevation +12-feet MLLW. To accommodate riparian planting.
- 2- to 4-foot sediment removal near mouth of embayment below +12-feet MLLW (east of dam)
- 4-foot sediment removal below elevation +12-feet MLLW in central portion of embayment west of dam.
- 3- to 5-foot sediment removal below elevation +12-feet MLLW near head of embayment.

Table 7.7 – EB-3 Sediment Concentration Statistics – 2- to 5-Feet Thick Sediment Removal

Constituent	Number of Samples	Units	UCL95%/ (% Decline-a)	Highest Conc. (% Decline-a)	Location of Highest Detected Concentration
Total PCBs	116	ug/kg	912(99.3)	12,740(99.2)	HSA1 (4.5'-5')
DRO + RRO	90	mg/kg	1,071(93.8)	16,300(88.6)	Core G (5.1')
Lead	104	mg/kg	256(92.1)	4,050(88.0)	HSA-2 (4'-5')
Mercury	98	mg/kg	0.13(98.8)	0.63(99.3)	Core L (3.5')

(a) – Compared to existing condition

Removal of the top two to five feet of sediment would result in substantial declines in the bulk (UCL95%) concentration of embayment sediment. Declines are estimated to be between approximately 92 and 99 percent of the existing condition concentrations. Concentrations of PCBs, lead, and mercury would still exceed ENR-ULs in portions of the embayment as illustrated on Figures 7-4a to 7-4d. The highest concentrations would continue to be present in the upper central portion of the embayment. The highest concentrations of DRO+RRO would be present in the similar area as for PCBs, lead, and mercury.

For cost estimating purposes (discussed below), it was assumed that a two- to five-foot thick cap would be placed below +12 feet MLLW after sediment removal as follows:

- The two-foot cap (near mouth) would consist of a two-foot-thick (61cm) layer of coarse sand and gravel material to provide clam habitat. The bottom one foot would be augmented with 0.5% organic carbon.

- The three-foot thick caps (near mouth and in head) would consist of one-foot of sand augmented with 0.5% organic carbon covered by two-feet (61cm) of a coarse sand and gravel to provide clam habitat.

- The four-foot-thick cap would consist of one-foot of sand augmented with 0.5% carbon, covered with one-foot of sand, and two-feet (61cm) of a coarse sand and gravel to provide clam habitat.

- The five-foot thick cap would consist of one-foot of sand augmented with 0.5% carbon, covered with two-feet of sand, and two-feet (61cm) of a coarse sand and gravel to provide clam habitat.

- A 3-inch rocked channel would be constructed on top of the cap to direct flow and minimize erosion from the outfalls during lower tides.

7.5 EMBAYMENT COST ESTIMATES

Costs to implement each of the three embayment alternatives were estimated based on conversations with contractors, material suppliers, and DOFs experience on other similar projects. Estimating remedial costs in the current economic environment is challenging because of inflation, price of fuel, supply chain issues, and the bidding environment once contractor selection begins. Costs will vary from those discussed herein based on the final design, along with economic and bidding environments.

7.5.1 COST TO IMPLEMENT 2-FOOT SEDIMENT REMOVAL

The capital cost to complete the 2-foot sediment removal alternative is summarized in attached Table A7.7. The estimated cost is approximately $11,200,000 in general accordance with the following breakdown.

- Capital Cost – Construction (inc. 10.1% sales tax) - $7,800,000
- Design/Oversight (10% of Capital Costs) $ 780,000
- Maintenance/Monitoring (5% of Capital Costs) $ 390,000
- Subtotal $8,970,000
- Contingency (25%) $2,240,000
- Estimated Embayment Total $11,210,000

7.5.2 COST TO IMPLEMENT 2- TO 3-FOOT SEDIMENT REMOVAL

The capital cost to complete the 2- to 3-foot sediment removal alternative is summarized in attached Table A7.8. The estimated cost is approximately $12,100,000 in general accordance with the following breakdown.

- Capital Cost – Construction (inc. 10.1% sales tax) - $8,400,000
- Design/Oversight (10% of Capital Costs) $ 840,000
- Maintenance/Monitoring (5% of Capital Costs) $ 420,000
- Subtotal $9,660,000
- Contingency (25%) $2,415,000
- Estimated Embayment Total $12,075,000

7.5.3 COST TO IMPLEMENT 2- TO 5-FOOT SEDIMENT REMOVAL

The capital cost to complete the 2- to 5-foot sediment removal alternative is summarized in attached Table A7.9. The estimated cost is approximately $12,650,000 in general accordance with the following breakdown.

- Capital Cost – Construction (inc. 10.1% sales tax) - $8,800,000
- Design/Oversight (10% of Capital Costs) $ 880,000
- Maintenance/Monitoring (5% of Capital Costs) $ 440,000

- Subtotal $10,120,000
- Contingency (25%) $2,530,000
- Estimated Embayment Total $12,650,000

7.6 GROUNDWATER IMPACTS – MODEL RESULTS

A numerical model was developed by Keta Waters to assess impacts to groundwater flow into the embayment and LDW (Keta Waters 2021;2022 – Appendix A) under existing conditions and under the proposed embayment conceptual designs. Under existing conditions, approximately 7% to 8% (estimated at approximately 2,250 gallons per day[gpd] or 1.6 gallons per minute [gpm]) of the total inflow to the model area (approximately 31,400 gpd or 22 gpm) flows to the embayment. Most of the flow (approximately 92% or 2,080 gpd) to the embayment occurs in the upper sand zone (model layers 1 & 2) with the balance (approximately 7.5% or 170 gpd) in the upper portion of the lower sand zone (model layer 3).

Most of the estimated flow (+90%) occurs from the south shoreline at an approximate rate of 3.2 gpd per linear foot of shoreline (or 0.002 gpm per linear foot of shoreline). Installation of the north sheet pile wall results in similar flows to the embayment, however, flow to the embayment from the Douglas property is diverted to the LDW.

7.7 PRELIMINARY CAPPING DESIGN

Using the results of the numerical modelling and the PCB fate and transport analyses completed by DMD Inc., a preliminary cap design was evaluated by Keta Waters (2022b) using the Cap Sim transport model (Shen et al. 2018). This model is based on EPA and U.S. Army Corps of Engineers guidance (Palermo 1998) and was specifically designed for purposes of cap design.

For modelling purposes, it was assumed that PCBs are the primary COC and that the cap would be placed above a PCB concentration of 44 mg/kg. This concentration was for a subsurface sediment sample from Core B (mid-point sample depth 4.4 feet). Using the "*Fixed parameter three-phase partitioning model*" [WAC 173-340-747(4)], an equilibrium total PCB concentration of 0.98 ug/l was calculated as the starting porewater concentration in the model. Additional discussion of the PCB concentrations and partitioning co-efficients used in the modelling are presented in attachments to the KetaWaters (2022b) report (DOF 2021; DMD 2020).

The cap system that was modelled consisted of three primary zones: 1) sediment cap (two-feet thick), 2) sequester zone of cap material amended with sorptive additives (organic carbon) (one-foot thick), and 3) underlying sediment. The CapSim model was used to simulate the simultaneous transport of three Aroclors (1248, 1254, 1260) into the cap from the underlying sediment. Transport processes simulated by the model included 1) advection and dispersion of flow through the cap, 2) molecular diffusion, and 3) desorption/sorption through the cap. Three levels of sorptive amendments were simulated including 0.5%, 1.0%, and 1.5% fraction organic carbon (foc).

The CapSim model uses specific discharge to simulate flow through the cap[xvii]. The model run to simulate post-remedy conditions indicated an estimated specific discharge through sediment into the embayment to be approximately 43 cm/year. For each foc amendment, specific discharges of 20 and 200 cm/year were assumed to provide a range of assumed flows through the cap. Dissolved and sorbed PCB concentrations after 100 years were estimated at the top of the sequester zone. The results are summarized below in Tables 7.8 and 7.9.

Table 7.8 - Dissolved/Sorbed PCB Conc. – Specific Discharge 20 cm/yr.

Sequester foc (%)	Specific Discharge (cm/yr)	Dissolved total PCB (ug/l)	Sorbed PCB (ug/kg)
0.5	20	3.1E-21	1.4E-17
1.0	20	4.7E-27	4.0E-23
1.5	20	1.5E-30	1.9E-26

Table 7.9 - Dissolved/Sorbed PCB Conc. – Specific Discharge 200 cm/yr.

Sequester foc (%)	Specific Discharge (cm/yr)	Dissolved total PCB (ug/l)	Sorbed PCB (ug/kg)
0.5	200	1.8E-08	7.9E-05
1.0	200	2.6E-13	2.3E-09
1.5	200	1.8E-16	2.4E-12

The cap modelling indicates that total PCB concentrations in both sediment and groundwater (pore water) would be below cleanup levels with a 0.5% foc in a one-foot thick sequester zone. Assuming a specific discharge of 200 cm/year, the predicted total PCB concentration in sediment is 7.9E-05 ug/kg (0.000079 ug/kg) well below the LDW sediment cleanup level of 2 ug/kg. Similarly, the predicted total dissolved PCB concentration of 1.8E-08 ug/l (0.000000018 ug/l) is below the total PCB cleanup level of 0.0001 ug/l.

[xvii] Specific discharge is defined as flow per unit area. In the context of the CapSim model, the specific discharge is the flow through the cap divided by the area of the cap.

8.0 UPLAND TECHNOLOGY SCREENING

Remediation of the upland south-shoreline along the embayment needs to be integrated with the embayment remedy. It is assumed that the south shoreline remediation will occur at the same time as the embayment remediation, possibly as an interim action. Possible remedial technologies discussed below are generally applicable to all the upland areas, including the embayment south shoreline. Integration of the south shoreline remedy with the embayment remedy is further discussed in Section 9.0 below.

8.1 TECHNOLOGY IDENTIFICATION AND APPLICABILITY

The identified technologies potentially applicable to the upland site conditions are listed in attached Table A8.1 and supports the following discussion. Because of the different conditions within portions of the site, the potential application of identified technologies to specific areas is discussed. The technologies presented below, and alternatives discussed in Section 9 target the "*FS Focus Area*" as shown on Figure 8-1. The FS focus area was further divided into two areas termed the "*Peripheral Area*" (PA) that includes the ICS shoreline and filled in drainage ditch and the "*East* [Upstairs] *Drum Plant*" (ED) area.

The technologies, objectives, and application to specific media and RAOs are listed in attached Table A8.1. Technologies carried forward for inclusion into proposed remedial alternatives are summarized in Table A8.2. While a supplemental FS will be prepared for the Douglas property, it is included in Table A8.2 because installation of a sheet pile wall will likely be necessary along the north shoreline of the embayment to maintain slope stability. Each of the technologies is described below.

8.2 EXCAVATION WITH OFF-SITE DISPOSAL

Description. Excavation could be used to permanently remove from the site shallow highly impacted soils (hot spots) containing high concentrations of COCs. Removing highly contaminated soil and soil containing mobile NAPL, would reduce risks associated with soil contact and leaching into groundwater. Soils that do not designate as dangerous (DW) or Toxic Substances Control Act (TSCA) waste would be disposed off-site in a Subtitle D landfill. Soils designated as DW (based the TCLP test) or those regulated by TSCA would be disposed off-site at facilities permitted to receive these wastes. TSCA wastes would include in-situ soils with total PCB concentrations equal to or greater than 50 mg/kg.

Applicability. Soils containing PCBs, petroleum hydrocarbons (GRO/DRO+RRO), lead, and VOCs would be removed from the site. The highest applicability would include source soils and LNAPL in the SA-MW1 area and former settling lagoon sediments in the filled drainage ditch.

Advantages

- Could be implemented with conventional earthmoving/excavation equipment.

- Hot-spot and other soil removals along the embayment shoreline could be coordinated with work to remove impacted sediment from the embayment.

- Off-site disposal would permanently reduce the mass of COCs in site soil reducing soil contact and leaching to groundwater risks. Excavation in the SA-MW1 area would remove mobile NAPL from the embayment shoreline and eliminate the potential for NAPL migration into the embayment.

- Backfill soils placed below the seasonally high-water table could be augmented with organic carbon to further sequester residual organic-COCs potentially migrating in groundwater.

Disadvantages

- Excavation will likely require shoring, in places, to protect adjacent structures and minimize the volume of excavated soil for disposal.

- Some additional TCLP testing would be required for disposal purposes, primarily of former lagoon sediments.

- Excavation of soil with total PCB concentrations equal to or above 50 mg/kg will need to meet TSCA disposal requirements.

- Demolition of several structures along the embayment shoreline will be required.

Status. Carried forward for alternative development to meet RAOs 1 to 5.

8.3 ON-SITE TREATMENT TO REMOVE DW DESIGNATION AND OFF-SITE DISPOSAL

On-site in-situ treatment could potentially remove the characteristic DW designation (if testing indicates DW is present, based on TCLP testing). Soils that fail the TCLP test for metals could be excavated, treated with chemicals to reduce TCLP leachability, and be disposed off-site. Mixing soils with a calcium silicate-based additive (such as Blastox 215) has been shown to reduce the leachability of lead and other metals and would be combined with 8.2 above.

Applicability. In-situ treatment would be done on soils failing the TCLP test for metals; for the ICS/NWC property primarily lead. High lead concentrations have been detected in the SA-MW1 area and in former settling lagoon sediments.

Advantages

- Could be implemented with conventional equipment that is readily available.

- Reduce cost of off-site disposal (if DW is present).

Disadvantages

- The volume of soil that is potentially DW is likely not large enough to make this technology cost-effective. To date, no soil or sediment has designated as characteristic waste based on the TCLP.

- Bench-scale pilot testing would be required to prove the effectiveness of treatment.

Status. Not carried forward for alternative development because the volume of soil that potentially designates as DW is likely not large enough to make this technology cost-effective. TCLP testing at the site has not identified DW at the site.

8.4 EXCAVATION W/ ON-SITE EX-SITU SOLIDIFICATION/ STABILIZATION AND PLACEMENT

Impacted soil from below and above the water table could be excavated and physically solidified/stabilized in a pug-mill or other mixer and be placed and capped on-site. The solidified/stabilized material would likely be placed above the water table along the former drainage ditch alignment and be capped with low permeability paving. The likely stabilization agent would be cement to physically encapsulate the contaminated material. Other additives may be required to chemically reduce leachability (such as described in Section 8.3).

Applicability. Soils containing PCBs, petroleum hydrocarbons (GRO/DRO+RRO), lead, and VOCs would be excavated and stabilized. The highest applicability would include source soils and LNAPL in the SA-MW1 area and former settling lagoon sediments in the filled drainage ditch.

Advantages

- Could be implemented with conventional equipment that is readily available.

- Impacted soils would be removed from below the water table which reduces the potential for leaching into groundwater.

Disadvantages

- Monitoring and maintenance of the solidified/stabilized waste cells and cap would need to occur over the long term.

- Could not be used for soil containing PCBs above 50 ppm because once soil is disturbed, it would become a TSCA waste that requires disposal in a permitted facility.

- Solidification/stabilization of oily soils (primarily from the SA-MW1 area) can be difficult, so bench-scale and pilot testing would be required to develop a mix design.

Status. Not carried forward for alternative development as extensive bench and pilot scale testing would be required to develop a mix design. Could not be used for soils with PCBs above 50 mg/kg. The waste cells and cap would need to be monitored and maintained over the long term.

8.5 IN-SITU SOLIDIFICATION/STABILIZATION AND SUBSURFACE BARRIER

In-situ solidification/stabilization could be used for shallower soil or more likely for deeper hot-spot soil. Solidification/stabilization agents such as Portland cement with additives would be used to reduce permeability/leachability of impacted soils. Augers would be used to accomplish the mixing, which would occur in an overlapping pattern to depths of up to 35 to 40 feet.

This technology could also be used to install a barrier wall. Rebar or other reinforcement materials would be incorporated into the solidified material depending on structural support considerations. Depending on the required structural properties of the wall and degree of mixing versus removal of in-situ soils, the solidified wall could approach or be like a conventional Secant Pile wall.

Applicability. Soils containing PCBs, petroleum hydrocarbons (GRO/DRO+RRO), lead, and VOCs would be stabilized to varying degrees. The practical applicability would be for deeper source soils that might be impacting groundwater at the mouth of the former drainage ditch in the vicinity of SA-MW2. The primary goal would be to reduce the hydraulic conductivity in the source soils, which would in turn reduce leachability and potential for migration to surface water.

This technology could also be used to install a barrier wall to lengthen groundwater flow paths prior to discharge to surface water. This would promote sequestration of hydrophobic constituents such as PCBs and cPAHs by adsorption onto organic carbon and degradation of VOCs such as benzene and vinyl chloride.

Advantages

- Could be implemented with conventional equipment that is readily available.
- Shallow soil mixing (less than 15 feet deep) solidification/stabilization would reduce exposures associated with soil contact and leachability.
- Deeper soil mixing (greater than 15 feet deep) would reduce the potential for leaching into groundwater.

Disadvantages

- Materials used to mix in-situ with soil would need to be designed to solidify under saline groundwater conditions. Bench scale and pilot testing would be needed to develop a mix design.

- For use to install a barrier wall, total waterproofing is difficult to obtain in joints in deep solidification type walls, particularly in heterogeneous soil conditions where obstructions are likely present (e.g., old piles).

- Site is located within zone of expected liquefaction-induced slope failure during a major earthquake event and the wall would need to be designed accordingly.

- Secant type walls are more costly as compared to conventional sheet pile walls.

Status. Not carried forward for alternative development. Most hot-spot soils are shallow and could be addressed by other technologies (e.g., excavation). Geochemical sampling and evaluations indicate that PCBs are not leaching from soil to a significant degree, and extensive bench and pilot scale testing would be required to develop a mix design.

8.6 SUBSURFACE BARRIER - SHEET PILE WALL (CONTAINMENT)

A conventional sheet pile wall will likely be necessary to implement the sediment remedy by stabilizing the north embayment block wall and slopes to allow removal of impacted sediments. Such a wall could also be designed to lengthen/block groundwater flow paths to the embayment and LDW.

Applicability. Will be necessary to structurally support the north embayment shoreline. This technology could also be used to install a barrier wall to direct or lengthen groundwater flow paths prior to discharge to surface water or to physically contain hot spot contamination. This would promote sequestration of hydrophobic constituents such as PCBs and cPAHs by adsorption onto organic carbon and degradation of VOCs such as benzene and vinyl chloride.

Advantages

- Would prevent failure of block wall and north shoreline during sediment removal.

- Could be implemented with conventional equipment and materials that are readily available.

- No bench testing would be needed to install the wall.

- Would prevent shallow groundwater seeps into the embayment.

- Could be used to contain NAPL in the SA-MW1 area.

Disadvantages

- Buried obstructions along the wall alignment would need to be addressed prior to installation.

- Sheet pile wall steel would be subject to corrosion over time which might cause leakage, so the wall, if permanently installed, would need to be designed accordingly.

- Sheet pile wall is located within zone of expected liquefaction-induced slope failure during a major earthquake event and would need to be designed accordingly.

Status. This technology is carried forward for alternative development to meet RAOs 1 and 4.

8.7 MAINTAIN AND EXTEND EXISTING PAVING OR BARRIER (CONTAINMENT)

Existing paving and storm water collection/discharge to the King County Wastewater Treatment Division sanitary sewer prevents uncontrolled contact with underlying soils by humans and wildlife beneath most of the site. Precipitation recharge is prevented from contacting underlying soils above the water table reducing the potential for leaching into groundwater. Paving would be replaced and be extended into the remaining unpaved areas to reduce soil contact risks to humans and wildlife. Placement of quarry spalls could be used to reduce soil contact risks in lieu of paving. This alternative would be implemented along with institutional controls (8.17 below).

Applicability. Maintaining the existing paving will be part of any reasonable alternative implemented at the site, as will institutional controls. The paving prevents uncontrolled access to underlying soils containing human soil contact COCs (primarily PCBs, petroleum hydrocarbons, and lead) and contact with wildlife COCs (see Table 3.2 above). Extending pavement or other physical barrier will reduce wildlife contact along the unpaved portion of the former ditch alignment (see Figure 1-7). Reducing local recharge reduces the potential of COC leaching to groundwater.

Advantages

- Could be implemented with conventional equipment and materials that are readily available.

- No significant changes to existing facility operations would be required.

Disadvantages

- Some increase in storm water volumes would occur if paving were extended. The increase would be small based on the relative area to be paved.

- Shoreline permitting issues may limit the possibility of extending the pavement.

Status. This technology is carried forward for alternative development to meet RAOs 1 to 4. Placement of a quarry spalls barrier could be used in lieu of extending paving to reduce soil contact risks.

8.8 HYDRAULIC CONTAINMENT

This technology includes installation of extraction wells along the embayment shoreline. Extracted contaminated groundwater would be treated by an on-site treatment plant. Treated water would be strategically re-infiltrated into the subsurface or be discharged to the King County sanitary sewer under permit. Wastes from the treatment plant would be disposed off-site at an appropriate permitted facility.

Applicability. Would prevent GW-COCs (PCBs, PCP, benzene, and vinyl chloride) from migrating to surface water.

Advantages

- Hydraulic containment is a well-known remedial technology that has been implemented on numerous sites.
- Would reduce the amount of impacted groundwater flowing to sediment and surface water.

Disadvantages

- Hydraulic containment will not reduce contamination at the site to a significant degree. Rather, it is a containment technology that would be used to minimize the migration of COCs to surface water.
- Numerous wells would need to be installed along the embayment shoreline on relatively close spacings.
- Pumpage and treatment of saline water (corrosive environment) would reduce the life of well screens, pumps, and equipment used in the treatment plant.
- Treatment of groundwater and management of the overall system will require long-term continual operation and maintenance.
- Disposal of treated water to the sanitary sewer may not be available on a long-term basis.

Status. Hydraulic containment is not carried forward for alternative development because of the numerous disadvantages noted above including long-term operation and maintenance of a pumping/treatment system.

8.9 COLLECT MOBILE LNAPL FROM SA-MW1 AREA

A shallow recovery well or shallow collection trench would be installed in the SA-MW1 area to recover mobile LNAPL that contains petroleum hydrocarbons, PCBs, several SVOCs and VOCs.

LNAPL would be removed from the well using a skimmer or dual phase extraction. Any recovered groundwater would need to be treated and disposed in an appropriate manner. Recovered NAPL would be disposed off-site as a TSCA waste.

Applicability. This technology is only applicable to where mobile LNAPL is present in the SA-MW1 area. It could prevent mobile LNAPL from migrating to the embayment, but high concentrations of COCs would remain in residual LNAPL (in soil) with the potential to leach to groundwater.

Advantages

- Mobile NAPL would be removed from the subsurface to reduce the potential for leakage into the embayment.

- Groundwater pumpage (if conducted) would prevent contaminated water migration into the embayment from this area and improve the recovery of LNAPL.

Disadvantages

- Residual NAPL containing high concentrations of COCs will remain in soil and continue to potentially impact groundwater.

Status. Mobile LNAPL recovery is carried forward for alternative development as it could be used with physical containment to reduce LNAPL migration to the embayment.

8.10 ENHANCE EMBAYMENT SEDIMENT CAP AND UPLAND BACKFILL

Some groundwater from the adjacent uplands flows into the embayment. It is not practicable to remove all impacted soil in contact with groundwater beneath the uplands, so the potential exists for GW-COCs (primarily PCBs and VOCs) to migrate into the embayment with groundwater. The selected embayment remedy consists of removing impacted sediments and placing a sand cap to isolate remaining residues. The lower portion of the cap could be augmented with organic carbon to prevent migration via groundwater flow of COCs into the cap above the point of compliance (45 cm). Groundwater modeling was conducted to, in part, provide input for design of the sand cap (see Section 7.6). It also may be appropriate to augment upland backfill that is placed below the water table.

Applicability. This technology is applicable to the sediment and upland soil remedy to sequester COCs migrating in groundwater, primarily PCBs. It is a well-known technology, and its use is consistent with the sediment remedy outlined in the EPA 2014 ROD.

Advantages.

- The technology is well known, and equipment/materials are readily available.

- It can easily be incorporated into the embayment remedy, consistent with the LDW ROD.
- There are no treatment residues that need to be managed and disposed.
- The technology does not require maintenance of pumps or other mechanical equipment.
- It has successfully been used in the Puget Sound region (Thea Foss Waterway) to prevent migration of contaminants into sediment/surface water.

Disadvantages.

- None if properly applied.

Status. This technology will be incorporated into the embayment remedy, as necessary, as discussed in Section 7 above and in the upland excavation with off-site disposal (Section 8.2).

8.11 IN-SITU TREATMENT - CHEMICAL INJECTIONS

In-situ treatment would consist of in-situ chemical injections in the identified VOC area on the east side of the reconditioning building (ED remedial area). Concentrations of benzene and vinyl chloride are higher than CULs but do not appear to be migrating to surface water above CULs. Tetrachloroethene (PCE), trichloroethene (TCE), and cis-1,2-dichloroethene (cis-1,2-DCE) appear to be degrading to vinyl chloride (VC) by reductive dechlorination. There are three general approaches to in-situ treatment that were evaluated in this FS as summarized below.

- **In-Situ Chemical Oxidation (ISCO)**. Chemical injections could be used to oxidize (directly destroy VOCs). ISCO would consist of injection of oxidative chemicals (Fenton's reagent, permanganate, persulfate) in source areas.
- **In-situ Chemical Reduction (ISCR)** could promote the biodegradation of chlorinated VOCs (PCE, TCE and cis-1,2-DCE) in groundwater by the injection of edible oils or other substances to enhance reductive dechlorination. While the parent solvents PCE and TCE would be reduced, the process may create vinyl chloride.
- **In-Situ Enhanced Aerobic Biodegradation (ISB)**. Degradation of benzene and other GRO constituents and vinyl chloride could be enhanced by the introduction of oxygenated water or commercially available products (e.g., Regenesis oxygen release compound – ORC) to promote aerobic conditions and microbial degradation in and downgradient of source areas.

Applicability. As noted below, the applicability of a particular chemical injection depends on the target GW-COCs. While in-situ oxidation is applicable to most of the target COCs, chemicals to promote reductive dechlorination of PCE and TCE do not promote aerobic microbial degradation of benzene and other GRO constituents or vinyl chloride. In-situ oxidation or aerobic microbial degradation may be most applicable to the source area in the vicinity of MW-8 where the highest benzene concentrations were detected (Figures 4-10b and 4-11). ISCR would have limited effectiveness given the generally limited extent of concentrations of PCE and TCE in soil and groundwater.

Advantages.

- Chemicals and equipment to complete the injections are readily available.
- Monitoring can be used to fine tune the approach if multiple treatments are required (adaptive management).
- There are no treatment residues that need to be managed and disposed.
- The technology does not require maintenance of pumps and other mechanical equipment.

Disadvantages.

- Treatments for discrete areas of the site need to be tailored to the conditions within each area and the target chemicals. While ISCO can destroy the target VOCs, its use would reduce the bacterial populations that naturally degrade VOCs. Furthermore, enhancing conditions for reductive dechlorination would reduce the ability of the system to degrade benzene and VC, and vice a versa.
- Multiple injections over an extended period may be required to meet CULs.
- Some bench scale pilot testing may be required to assess geochemical conditions and chemical injection strengths in target areas.

Status. This technology (ISCO and ISB) is carried forward for alternative development to meet RAOs 1 and 4.

8.12 IN-SITU TREATMENT – PERMEABLE TREATMENT MEDIUM

Placement/injection of a permeable treatment medium would include organic carbon (such as peat) or granulated activated carbon (GAC) to enhance sequestration of COCs before discharge to sediment/surface water. Use of such materials could be done in several ways including incorporating the medium into a barrier wall system that would direct flow to the treatment medium (funnel/gate approach) or could be used at the ends of barrier walls to treat/polish groundwater flowing around the ends of the walls. Injectable liquid activated carbon (e.g., Regenesis PlumeStop) is available that could be used as part of a treatment wall system or be used as a contingency measure.

Applicability. The permeable treatment medium technology would most likely be used at points where groundwater discharges into surface water. Locations could include along the shoreline (incorporate into hot spot backfill along the embayment shoreline) or incorporated into a sediment cap after sources have been controlled to a significant degree. The primary purpose would be to restrict the migration of hydrophobic constituents, such as PCBs.

Advantages

- Application of the technology is well known.
- The technology is commercially available.
- The reactive materials can be installed with conventional equipment.
- The technology does not require maintenance of pumps and other mechanical equipment.

Disadvantages

- Bench scale testing may be required.
- The reactive materials may need to be supplemented/replaced in the future.

Status. This technology is carried forward for alternative development to meet RAOs 1 and 4.

8.13 AIR-SPARGING

Air sparging (AS) consists of injecting air into the subsurface to either strip VOCs from groundwater or increase dissolved oxygen concentrations in groundwater to promote aerobic degradation. A series of sparging wells would be installed below the water table and a compressor would be used to inject air. Air-sparging could be combined with soil vapor extraction (SVE).

Applicability. Air sparging would be most applicable to treat groundwater containing VOCs (primarily benzene) in the vicinity of DOF-MW8 (Figures 4-10b, and 4-11) . It could be used in conjunction with SVE to strip and collect VOCs, where the fine-grained aquitard is not present. Injecting air containing oxygen into groundwater would also promote aerobic degradation of benzene and vinyl chloride.

Advantages

- Equipment is available and straight forward to install and operate.

- Does not require the handling and injection of chemicals.
- Does not generate a large volume of material that needs to be managed and disposed.

Disadvantages

- Most applicable to unconfined aquifer conditions such as those beneath the eastern portion of the site. Sparging below confining layers would result in channeling and the displacement of water by air beneath confining layers.
- While the system is relatively simple, it does require periodic operation and maintenance work.
- Installation of a venting system would be required if sparge wells are installed below pavement.

Status. This technology is carried forward for alternative development to meet RAO 1 and 4.

8.14 SOIL VAPOR EXTRACTION - SVE

SVE consists of the extraction of soil vapor from horizontal or vertical wells under an applied vacuum. It is used to remove soil vapor containing VOCs from soil above the water table. On the ICS-NWC property, SVE would be accomplished by installing slotted piping in horizontal trenches below paving. A vacuum would be applied, and vapors would be treated with vapor-phase carbon. It could be combined with air-sparging.

Applicability. SVE would be most applicable to collect soil vapor VOCs (primarily benzene) in the vicinity of DOF-MW8 (Figures 4-10b, and 4-11) if an AS system is installed. It would be used in conjunction with AS.

Advantages

- Equipment is available and straight forward to install and operate.
- Would not produce a large quantity of liquids that require treatment and disposal.

Disadvantages

- SVE alone is not capable of remediating groundwater and soil below the water table.

- Treatment of the discharge vapor would likely be necessary. Condensates may require treatment with off-site disposal. Testing would need to be completed to assess whether vapors could be directly discharged to the atmosphere.

- Some small amounts of condensate water would need collection, testing and disposal.

Status. This technology is carried forward for alternative development in combination with air-sparging to meet RAOs 1 and 4.

8.15 UPGRADE 2ND AVE. STORM WATER CONVEYANCE

The 2nd Ave. storm water conveyance pipeline trends along the eastern site boundary. Most of the pipeline lies below the high tide water table. Testing indicates that the buried pipeline is sound with little evidence of groundwater infiltration. However, there is the possibility that concrete joints could separate in the future and allow impacted groundwater to flow into the pipe and be discharged directly to the embayment.

It does not appear practical to reroute the pipeline as it would entail requiring easements and other permits to route the pipeline along city rights-of-way and perhaps private property. The future potential of groundwater infiltration could be reduced by slip-fitting the pipeline with a pipeline liner or replacing the pipeline with a rigid pipe. A liner would be of smaller diameter and a hydraulic analysis would need to be completed to assess feasibility. A tide gate could also be installed at the outfall.

Applicability. To the 2nd Ave. storm water conveyance to prevent the potential of contaminated groundwater from migrating into the conveyance and, in turn, to the embayment.

Advantages.
- Reduce the potential for future groundwater infiltration into the 2nd Ave. storm water conveyance.

Disadvantages.
- None if feasible.

Status. This technology will be addressed as part of remedial design. Its use does not affect selection of the overall site remedy.

8.16 MONITORED NATURAL ATTENUATION – MNA

MNA is applicable to groundwater where VOC (future) releases have been eliminated, the VOC contaminant plume is stable or decreasing in size, and constituent concentrations are declining (attenuating) with groundwater migration. MNA is also favored where data indicate VOC constituents are degrading and concentrations are below CULs at the anticipated conditional point of compliance for groundwater (assumed along the embayment shoreline or east property line).

Monitoring data indicate that VOCs (benzene and vinyl chloride) are not discharging in groundwater above CULs to sediment/surface water. VOCs associated with NAPL in the SA-MW1 area will be addressed with the LNAPL.

Applicability. MNA is applicable to the site in general and would be part of any future monitoring program, especially in the ED area east of the main building. Data indicate that releases have been eliminated, the groundwater plume is stable, and benzene and vinyl chloride are attenuating with migration as these compounds have not been detected in groundwater downgradient of the east property line. Along the embayment shoreline, MNA would be promoted by allowing oxygenated estuarine water to infiltrate into shoreline soils during higher tides that would, in our experience, promote degradation of benzene and vinyl chloride, prior to discharge to the embayment.

Advantages

- Relies on natural processes to remediate groundwater contamination.
- Does not require substantial operation and maintenance of an active remedial system.
- Does not produce residue materials that need to be managed and disposed.
- Can be used in conjunction with in-situ treatments.

Disadvantages

- Monitoring is necessary to ensure attenuation is occurring and that the plume is stable or decreasing in size.

Status. This technology is carried forward for alternative development to meet RAOs 1 and 4.

8.17 INSTITUTIONAL CONTROLS

Institutional controls involve recording environmental covenants to control exposures and inform future site users/owners of restrictions that might limit future land use, impact redevelopment design, and protect site workers. For example, use of soil contact industrial CULs requires that an environmental covenant be recorded to ensure the site remains in industrial use. Institutional controls will be part of the remedy for the ICS-NWC site.

Status. This component is carried forward for alternative development to meet RAOs 1 to 4.

8.18 PERFORMANCE MONITORING

Performance (compliance) monitoring includes sampling of groundwater, soil, and sediment to assess the performance of implemented remedial actions to meet CULs at the points of compliance. Operation and maintenance (e.g., inspection of soil/sediment caps) are typically part of performance monitoring plans. The results of monitoring will also provide the basis for evaluating the efficacy of the implemented remedial actions and the need for additional actions as part of adaptive management.

Status. This component is carried forward for alternative development to meet RAOs 1 to 4.

9.0 UPLAND REMEDIAL ALTERNATIVES

Upland remedial alternatives were developed using the remedial technologies discussed above and listed in Table A8.2 and carried forward. As noted at the beginning of this FS, the upland alternatives assume that they are integrated with the intertidal embayment remedy. Alternatives were developed for the FS focus area (Figure 8-1) that was further subdivided into two areas termed the peripheral (PA) and east drum plant (ED) areas. Within these identified areas, one or more media exceed CULs and soils are potential source areas for leaching to groundwater.

In upland alternatives 1 to 4 discussed below, it was assumed that Monitored Natural Attenuation (MNA) would be the selected alternative for the ED area discussed in Section 9.6 below. Section 9.6 discusses and evaluates MNA and two other alternatives for the ED area.

9.1 UPLAND CLEANUP LEVELS ANALYSIS

CUL analyses were completed to assess the effectiveness, in part, of each of the upland remedial alternatives described below. This was done by estimating soil concentration reductions for the primary soil COCs from existing conditions and comparing the results with proposed CULs using the MTCA performance criteria in WAC 173-340-745(8). The primary soil COCs are those constituents consistently detected including PCBs, DRO+RRO, lead, and mercury.

CULs are applied using the MTCA performance criteria listed below.

- The upper 95% confidence limit of the mean concentration (UCL95%) should be below the CUL,
- No more than 10% of the samples can exceed the CUL, and
- No single sample can exceed two times the CUL.

The UCL95% was calculated using the statistical program ProCUL v. 4.0. This program assesses data distributions and calculates the UCL95% using normal and lognormal data distributions. The program can also calculate the UCL95% for data sets where no distribution is evident using non-parametric statistical procedures (such as the Chebyshev method).

Soil data was obtained from Appendix H (1986 to 2015) of the RI and the supplemental hot-spot sampling completed in January 2021 (Appendix D). In formatting the soil data sets for analysis, the following samples were eliminated: duplicates, non-detects with no reporting level, samples below a depth of approximately twenty feet (mostly non-detects), and off-site samples (MW-F). Non-detect samples with a reporting limit were set at the reporting limit. When assessing the impacts of soil excavation/backfilling with off-site disposal, imported backfill soils were set at the following concentration levels: PCBs – 2 ug/kg; lead – 1.8 mg/kg; DRO+RRO – 13 mg/kg (typical reporting level); and mercury – 0.05 mg/kg (typical reporting level). Attached Table A9.1a summarizes the statistical results for existing conditions.

A summary of possible CULs is listed in attached Table A5.1. Proposed CULs used to assess upland remedial alternatives are listed and discussed below.

- **Total Aroclor PCBs**: Upland CUL – 10 mg/kg. Based on Method A CUL for an industrial land use (WAC 173-340-900-Table 745-1). The CUL is based on applicable Federal Law (40 C.F.R. 761.61) and assumes a cap will be placed and maintained. Groundwater monitoring data and DMD analyses indicate that PCBs are highly hydrophobic with very high soil/water partitioning coefficients and do not readily migrate in groundwater.

- **DRO+RRO:** Upland CUL – 2,000 mg/kg. Based on Method A CUL to prevent the accumulation of free product on groundwater (WAC 173-340-900-Tables 740-1 and 745-1). While DRO+RRO soil concentrations have been detected at several locations on the site, free (separate phase product) has only been detected in the SA-MW1 area (see Figure 4-6). A higher CUL could likely be justified based on empirical evidence and with development of a Method B soil contact CUL for most of the site. However, for purposes of this FS, a CUL of 2,000 mg/kg was assumed. DRO+RRO is identified as a groundwater COC for future monitoring purposes (i.e., to include in future monitoring to confirm that DRO+RRO poses minimal risk to surface water).

- **Lead:** Upland CUL – 1,000 mg/kg. Based on direct contact Method A CUL for an industrial land use site (WAC 173-340-900-Table 745-1). Lead is not a groundwater COC.

- **Mercury**: Upland CUL – 2 mg/kg. Mercury was only detected in one groundwater sample above the surface water CUL of 0.025 ug/l (see Table A3.2) and is identified as a groundwater COC for future monitoring purposes (i.e., to include in future monitoring to confirm that mercury poses minimal risk to surface water). A soil contact CUL is not available for mercury so the Method A CUL (WAC 173-340-900-Table 740-1 and 745-1) was used in this analysis. This value is also assumed to be protective of the direct contact exposure pathway.

9.2 UPLAND ALTERNATIVE NO. 1 (UP-1) – UPLAND CONTAINMENT, MOBILE NAPL RECOVERY, AND MNA

Description. Alternative No. 1 consists of the following major components as illustrated on Figures 9-1a and 9-1b. The capital components could be constructed over a period of several months. NAPL recovery and MNA would occur over a period of several years.

- Install a structural sheet pile wall along the south shoreline (along the approximate +12 feet MLLW contour). The wall would be installed to a depth of approximately 42-feet. The wall would be catholically protected or coated to minimize corrosion and would prevent the seepage of groundwater and NAPL directly into the embayment. Groundwater flow paths would be lengthened allowing for natural attenuation.

- Install a sheet pile wall around SA-MW1 area to contain, prevent mobile NAPL from migrating into embayment, and assist in NAPL recovery. The wall would be installed to a depth of ten feet and be catholically protected or coated to minimize corrosion.

- Remove mobile NAPL from contained SA-MW1 area as practical. NAPL would be removed by a recovery well installed within the SA-MW1 contained area.

- Maintain existing pavement and pave existing unpaved areas along the east property boundary and along a portion of the embayment shoreline. The pavement would prevent worker and wildlife contact with underlying contaminated soils along with preventing leaching of contaminated soil above the water table.

- Continue to collect and treat (as necessary) stormwater under permit as part of normal site operation.

- Implement Monitored Natural Attenuation (MNA) – For contaminants associated with the ED area (primarily benzene and PCP). Such monitoring would include wells DOF-MW7 and DOF-MW8, two new wells, and be integrated into the performance monitoring system.

- Complete performance groundwater monitoring along the east property line (using existing wells MW-Lu/LL, MW-Gu/GL, MW-Fu/FL and HC-B2[R]) and at the ends of the sheet pile wall using (existing wells MW-Du, MW-Dp, SA-MW3 and MW-IL). Monitoring parameters would include gasoline-range organics (GRO), BTEX, diesel/residual oil range organics (DRO & RRO), pentachlorophenol (PCP), chlorinated solvents (PCE, TCE and vinyl chloride), and Aroclor PCBs.

- Implement institutional controls to:
    a. Prohibit the use of groundwater beneath the site for drinking water purposes, and

    b. Maintain pavement and industrial site use.

Integration with Embayment Remedy. Once the south shore barrier wall is installed, the upland and embayment remedies could be completed independently of each other. The barrier wall would provide stability for the south shore slope.

Estimated Reduction in Upland COC Soil Concentrations and Comparison to CULs. Estimated UCL95% and highest concentrations for existing/UP-1 conditions are summarized in attached Table A9.1a. No reduction in soil concentrations would be achieved as no contaminated soil is being removed from the site. Mobile NAPL would be removed from the SA-MW1 area reducing the potential for migration into the embayment.

Existing concentrations of PCBs, lead, DRO+RRO, and mercury exceed one or more of the three MTCA performance criteria as summarized in attached Table A9.1a. PCBs and DRO+RRO exceed all three criteria. The UCL95% concentration and percent (%) exceeding the assumed CULs are met for lead and mercury. However, twelve (mercury) to fourteen (lead) samples exceed the 2x criterion.

Material Quantities. The following quantities were estimated for cost estimating purposes:

- Sheet pile wall length – 550 feet
- Sheet pile wall area – 23,100 square feet
- Additional containment wall - 150 linear feet
- Additional containment wall area – 1,500 square feet
- Excavation volume – 0 cubic yards
- Subtitle C Disposal (solidified NAPL) – 5 cubic yards
- Subtitle D Disposal (soil) – 0 cubic yards
- Imported backfill – 0 cubic yards (0 tons)
- Riparian planting - 690 square feet
- New paving – 18,900 square feet (2,100 square yards)

Estimated Cost (see Table A9.1b) - $3,890,000 (includes 20% contingency)

9.3 UPLAND ALTERNATIVE NO. 2 (UP-2) – UPLAND CONTAINMENT, REMOVE SA-MW1 NAPL, AND REMOVE SOIL IN UNPAVED SHORELINE AREA

Description. Alternative No. 2 consists of the following major components as illustrated on Figures 9-2a and 9-2b. The capital components could be constructed and NAPL removal accomplished over a period of several months. MNA would occur over a period of several years.

- Install sheet pile wall along the south shoreline (along the approximate +12 feet MLLW contour) to a depth of approximately 42 feet. The wall would be catholically protected or coated to minimize corrosion and would prevent the seepage of groundwater directly into the embayment. Groundwater flow paths would be lengthened allowing for natural attenuation.

- Excavate and dispose off-site soil containing NAPL and high concentrations of several COCs including PCBs and petroleum hydrocarbons local too well SA-MW1. Excavation would be completed to depths of between four- and eight-feet using trench-boxes. Some of the excavated material would have PCB concentrations equal to or greater than 50 ppm and would need to be disposed at a TSCA facility (Subtitle C) with EPA oversight and approval. For cost estimating purposes, it was assumed that 50% of the material would be disposed at a Subtitle C facility while the balance would be disposed at a Subtitle D facility.

- Backfill the excavation with imported uncontaminated sand/gravel fill. Repave area to edge of existing paving, slope remaining area to top of sheet pile wall, and plant riparian vegetation (between elevations of +12 to approximately +15 feet MLLW).

- Excavate and dispose off-site soil from the unpaved shoreline east of the SA-MW1 area. Excavation would be completed to a depth of three feet and would be disposed at a Subtitle D landfill. Backfill the excavation with imported uncontaminated sand/gravel fill. Repave area to edge of existing paving, slope remaining area to top of sheet pile wall, and plant riparian vegetation (between elevations of +12 to approximately +15 feet MLLW).

- Maintain existing pavement and pave existing unpaved areas along the east property boundary. The pavement would prevent worker and wildlife contact with underlying contaminated soils along with preventing leaching of contaminated soil above the water table.

- Continue to collect and treat (as necessary) stormwater under permit as part of normal site operation.

- Implement Monitored Natural Attenuation (MNA) – For contaminants associated with the ED area (primarily benzene and PCP). Such monitoring would include wells DOF-MW7 and DOF-MW8, two new wells, and be integrated into the performance monitoring system.

- Complete groundwater monitoring along the east property line (using existing wells MW-Lu/LL, MW-Gu/GL, MW-Fu/FL and HC-B2[R]) and the ends of the sheet pile wall using (existing wells MW-Du, MW-Dp, SA-MW3 and MW-IL). Monitoring parameters would include Gasoline-range organics (GRO), BTEX, diesel/residual oil range organics (DRO & RRO), pentachlorophenol (PCP), chlorinated solvents (PCE, TCE and vinyl chloride), and Aroclor PCBs.

- Implement institutional controls to:
    a. Prohibit the use of groundwater beneath the site for drinking water purposes, and

    b. Maintain pavement and industrial site use.

Integration with Embayment Remedy. Once the south shore barrier wall is installed, the upland and embayment remedies could be completed independently of each other. The barrier wall would provide stability for the south shore slope.

Estimated Reduction in Upland COC Soil Concentrations and Comparison to CULs. Reductions in COC concentrations are summarized in attached Table A9.2a. The UCL95% concentration for PCBs shows the greatest concentration reduction (71.6%) followed by mercury (37.5%), lead (21.3%), and DRO+RRO (18.9%).

Concentrations of PCBs, lead, DRO+RRO, and mercury would exceed one or more of the three MTCA performance criteria as summarized in attached Table A9.2a. PCBs and DRO+RRO would exceed all three criteria. The UCL95% concentration and percent exceeding the assumed CULs would be met for lead and mercury. Ten samples would still exceed the 2x criterion for lead and mercury.

Material Quantities. The following quantities were estimated for cost estimating purposes:

- Sheet pile wall length – 550 feet
- Sheet pile wall area – 23,100 square feet
- Excavation volume – 890 cubic yards
- Subtitle C Disposal – 300 cubic yards
- Subtitle D Disposal – 590 cubic yards
- Imported backfill – 890 cubic yards (1335 tons)
- Paving – 13,500 square feet (1500 square yards)
- Riparian planting – 3,760 square feet

Estimated Cost (see Table A9.2b) **-** $4,213,000 (includes 20% contingency)

9.4 UPLAND ALTERNATIVE NO. 3 - UPLAND CONTAINMENT, SA-MW1 NAPL AND (FORMER) WORKING SURFACE SOIL REMOVAL

Description. Alternative No. 3 consists of the following major components as illustrated on Figures 9-3a and 9-3b. The capital components could be constructed, and NAPL/soil removal accomplished over a period of several months. MNA would occur over a period of several years.

- Remove and dispose off-site soil containing NAPL and high concentrations of several COCs including PCBs and petroleum hydrocarbons located in the vicinity of well SA-MW1 and former working surface soil as shown on Figure 9-3a. The SA-MW1 area would be excavated to approximate depths of between four- and eight-feet using a trench box while the remainder of the working surface area would be excavated to a depth of two- to eight-feet. Some of the excavated material would have PCB concentrations equal to or greater than 50 ppm and would need to be disposed at a TSCA Subtitle C facility with EPA oversight and approval. The remainder of excavated material would be disposed at a Subtitle D facility.

- Backfill the excavated area with imported uncontaminated sand/gravel fill.

- In lieu of the south shore sheet pile wall, the upland slope adjacent to the embayment would be cut back to a 3:1 slope (3-foot horizonal to 1-foot vertical) to maintain stability. A two- to three-foot thick cap would be placed over the cut slope and be integrated with the embayment sediment cap and be planted with riparian vegetation.

- Existing pavement would be replaced (to the top of new slope) or be maintained. New paving would be placed over the unpaved areas along the east property boundary. The pavement would prevent worker and wildlife contact with underlying contaminated soils along with preventing leaching of contaminated soil above the water table.

- Continue to collect and treat (as necessary) stormwater under permit as part of site operations.

- Monitored Natural Attenuation (MNA) – For contaminants associated with the ED area (primarily benzene and PCP). Such monitoring would include wells DOF-MW7 and DOF-MW8, two new wells, and be integrated into the performance monitoring system.

- Complete groundwater monitoring along the east property line (using existing wells MW-Lu/LL, MW-Gu/GL, MW-Fu/FL and HC-B2[R]) and the ends of the sheet pile wall using (existing wells MW-Du, MW-Dp, SA-MW3 and MW-IL). Monitoring parameters would include gasoline-range organics (GRO), BTEX, diesel/residual oil range organics (DRO & RRO), pentachlorophenol (PCP), chlorinated solvents (PCE, TCE and vinyl chloride), and Aroclor PCBs.

- Implement institutional controls to:
    a. Prohibit the use of groundwater beneath the site for drinking water purposes, and

    b. Maintain pavement and industrial site use.

Integration with Embayment Remedy. The south shoreline remedy would need to be engineered and integrated with the embayment remedy to maintain stable slopes along the embayment and provide for adequate cover. The details of the integration would be developed during design once a remedy is selected.

Estimated Reduction in Upland COC Soil Concentrations and Comparison with CULs. Reductions in COC concentrations are summarized in attached Table A9.3a. The UCL95% concentration for PCBs shows the greatest concentration reduction (80.8%) followed by lead (57.3%), DRO+RRO (53.8%) and mercury (37.5%).

DRO+RRO would still exceed the three criteria. PCBs, lead, and mercury would meet two of the MTCA criteria, the UCL95% concentrations would be less than the CUL and the percentage of samples exceeding the CUL would be less than 10%. Some sample concentrations would still exceed two times the CUL (PCBs – twelve samples; lead - six samples; mercury - ten samples).

Material Quantities. The following quantities were estimated for cost estimating purposes:

- Sheet pile wall length – Not applicable
- Sheet pile wall area – Not applicable
- Excavation volume – 3,100 cubic yards (4,650 tons)
- Subtitle C Disposal – 2,450 cubic yards (3,675 tons)
- Subtitle D Disposal – 650 cubic yards (975 tons)
- Imported backfill – 3,000 cubic yards (4,500 tons)
- Paving – 14,000 square feet (1,555 square yards)
- Riparian planting – 12,000 square feet

Estimated Cost (see Table A9.3b) **-** $2,344,000 (includes 20% contingency)

9.5 ALTERNATIVE NO. 4 (UP-4) - UPLAND CONTAINMENT, SA-MW1 NAPL AND (FORMER) WORKING SURFACE SOIL, AND LAGOON SEDIMENT REMOVAL

Description. Alternative No. 4 consists of remediating former settling lagoon sediments (Figure 9.4a). The capital components could be constructed, and NAPL/soil removal accomplished over a period of several months. MNA would occur over a period of several years. The alternative could be combined with any of the shoreline alternatives or be completed independently of the embayment and south shoreline cleanups (for example cleanup could occur on a different timeline). For purposes of this FS to calculate concentration reductions, it was assumed that Alternative 4 would be combined with Alternative 3 remedial components. Bottom sediment from the former settling lagoon would be removed that would require excavation to estimated depths of eight- and eleven-feet as illustrated on Section F-F' (Figure 9.4c) as follows. The trend of Section F-F' is shown on Figure 4-1a.

- Paving would be removed, as necessary.

- The top three feet of soil (approximately 800 CY) would be removed and placed in a stockpile.

- Deeper soil would be removed to depths of eight- to eleven-feet below ground level using a trench box. Soil with PCB concentrations equal to or greater than 50 ppm would be disposed at a Subtitle C landfill while remaining soil would be disposed at a Subtitle D landfill.

- Clean imported sand and gravel fill would be used to fill the excavation to approximately three feet below existing grade. The stockpiled soil would be placed to bring the excavation to grade.

- The area would be paved, and stormwater would be collected and discharged as part of the facility operation under permit.

- Institutional controls and monitoring would be implemented as described in Alternative No. 3.

Estimated Reduction in Upland COC Soil Concentrations and Comparison with CULs. Reductions in COC concentrations are summarized in attached Table A9.4a. The UCL95% concentration for PCBs shows the greatest concentration reduction (96.5%), followed by lead (83%), DRO+RRO (74%) and mercury (71%).

Concentrations of PCBs would meet all three MTCA criteria assuming a CUL of 10 mg/kg total PCBs. Lead, DRO+RRO, and mercury would meet two of the MTCA criteria, the UCL95% concentrations would be less than the CUL and the percentage of samples exceeding the CUL would be less than 10%. While the number of samples exceeding two-times CULs criterion was significantly reduced, some of the samples would still exceed the criterion (lead – one sample; DRO+RRO – nineteen samples; mercury – three samples).

Material Quantities. The following quantities were estimated for cost estimating purposes:

- Sheet pile wall length – Not applicable
- Sheet pile wall area – Not applicable
- Excavation volume – 2,600 cubic yards
- Stockpile and backfill – 800 CY
- Subtitle C Disposal – 900 cubic yards
- Subtitle D Disposal – 900 cubic yards
- Imported backfill – 1,800 cubic yards (2,700 tons)
- Paving –7,300 square feet (810 square yards)
- Riparian planting – none directly associated with Alternative 4

Estimated Cost (see attached Table A9.4b) - $1,155,000

9.6 ICS/NWC EAST OF DRUM RECONDITIONING PLANT (ED AREA)

The area immediately east of the drum reconditioning plant in the vicinity of the drum furnace appears to be a source area for benzene based on concentrations detected in groundwater samples from well DOF-MW8 (Figures 9.5a,b,c). Low concentrations of vinyl chloride have also been detected at this location (Figures 4-12b,c). Groundwater beneath this area (on average) flows in a generally easterly direction towards the east ICS/NWC property line. Natural attenuation appears to be occurring as benzene and vinyl chloride have not been detected above CULs in wells and push-probes along the east property line.

Three alternatives were developed and evaluated for the ED remedial area with the goal of protecting surface water via groundwater discharge from this area. Cleanup of soil in the former settling lagoon (Alternative 4 above) would also assist in meeting this objective as analysis of buried lagoon sediment detected the presence of benzene (e.g., a sample from push-probe LP-3 had a benzene concentration of 1,600 ug/kg – Figure 9-4c). The source area appears to be in the immediate vicinity of probe P12 and DOF-MW8. The primary objective of the ED remedies is to address benzene concentrations in groundwater to ensure protection of surface water.

9.6.1 – ED-1 - MNA

Description. Groundwater monitoring specific to this area would be completed at existing wells DOF-MW8, HC-B2R and MW-Gu, and in two new wells; one located between DOF-MW8 and the former drainage ditch and a second along the east property line in the general area between probes P20 and P23 (Figure 9.5b). The new wells would be screened in a similar manner as DOF-MW8 (Figure 9.5c). Samples would be analyzed for benzene, toluene, ethylbenzene and xylenes and halogenated hydrocarbons (PCE, TCE, cis-1,2-DCE and VC). The cost of groundwater monitoring is embedded in the other upland remedial alternatives. MNA and monitoring would occur over a period of several years.

Estimated Cost: $15,000 (to install two new wells).

9.6.2 – ED-2 - AIR-SPARGING/SOIL VAPOR EXTRACTION (SVE) AND MNA

Description

Install a system of air-sparging (AS) wells below the water table and a soil vapor extraction (SVE) system to collect benzene and other VOCs stripped from groundwater in the apparent source area (Figure 9-5a,b,c). Twelve sparge wells on approximately 15-foot centers would be installed at accessible locations adjacent to the drum furnace and be connected to an air compressor. SVE piping would be installed in two 100-foot-long north-south horizontal trenches along the drum furnace and drum cooling structure which would be connected to a blower. Air and vapor collection pipes would lie beneath paving. Extracted vapors would be treated with vapor phase carbon. The objective of AS/SVE is to permanently remove VOCs from soil and groundwater to reduce benzene concentrations in the source area. Air-sparging and SVE systems typically run for a period of 18 to 24 months. MNA and monitoring would occur over a period of several years after the air-sparing/SVE system is shut down.

- The advantages of this approach are that the system can be installed using conventional equipment, would strip/collect VOCs from soil and groundwater, and would also increase groundwater oxygen concentrations to promote natural degradation of benzene and vinyl chloride. The disadvantages of the system are that subsurface airflow often occurs through preferred pathways, requires operation/maintenance, and produces a waste that requires disposal. On this site, access would also be a challenge because of the drum furnace and other structures.
- Address remaining VOC residues in groundwater using MNA to reduce risks to sediment/surface water.

- Integrate long-term monitoring with the site-wide monitoring program. Prepare an inspection/maintenance plan specific to the AS/SVE system. For cost estimating purposes, it was assumed the system would operate for three years.

- Implement institutional controls to prevent drinking water use.

Estimated Cost: $311,000 (Table A9.5).

9.6.3 – ED-3 - IN-SITU TREATMENT AND MNA

Description

In-situ (chemical injection) treatment of soil and groundwater in the ED source area. Such treatments would occur over a period of six months while MNA and monitoring would occur over a period of several years after the in-situ treatments were completed.

- Two approaches were evaluated:

    - **In-Situ Chemical Oxidation (ISCO)**. A solution of sodium persulfate or equivalent would be injected into the source area to chemically destroy benzene and other organic soil/groundwater contaminants. The advantages of this approach are that both aromatic (BTEX) and halogenated (PCE, TCE) organic compounds are destroyed, the destruction is immediate, no waste materials are produced that require disposal, and there is no long-term operation/maintenance required. The primary challenge with this approach is delivery to the entire contaminated zone and multiple injections may be required. ISCO will also destroy microbial populations that appear to be naturally degrading VOCs. Additional characterization and pilot testing would be necessary to define the source area and design the chemical injection program. For cost estimating purposes, two rounds of injections were assumed to occur at eighteen grid locations on fifteen-foot centers.

    - **In-Situ Enhanced Aerobic Biodegradation (ISB)**. A solution of oxygen release compound (ORC) or equivalent would be injected into the general source area to add oxygen to promote aerobic biodegradation of benzene and vinyl chloride. The advantages of this approach are that degradation of aromatic (BTEX) compounds and vinyl chloride is promoted, no waste materials are produced that require disposal, and there is no long-term operation/maintenance required. The primary disadvantage of this approach is that it is a passive method that relies on groundwater flow to distribute the oxygen containing solution through the groundwater zone to be treated. The primary challenge is delivery to the entire contaminated zone and multiple injections may be required. For cost estimating purposes, two rounds of injections were assumed to occur at ten grid locations on twenty-foot centers. Given the relatively small size of the source area, pilot testing was not included in the cost estimate.

- Address remaining VOC residues in groundwater using MNA to ensure protection of sediment/surface water.

- Integrate long-term monitoring with the site-wide monitoring program.

- Implement institutional controls to prevent drinking water use.

Estimated Cost: ISCO - $245,000 (Table A9.5)

Estimated Cost: ISB - $125,000 (Table A9.5)

10.0 EVALUATION OF ALTERNATIVES

To select a preferred cleanup action, the alternatives were evaluated using the criteria in WAC 173-340-360 including *"Threshold requirements"* [WAC 173-340-360(2)(a)] and "*Other requirements*" [WAC 173-340-360(2)(b)]. Alternatives being considered to cleanup a site need to meet the following threshold requirements:

- Protect human health and environment,
- Comply with cleanup standards,
- Comply with applicable state and federal laws, and
- Provide for compliance monitoring.

Assuming threshold requirements are met, other requirements come into play including the following:

- Use permanent solutions to the maximum extent practicable,
- Provide for a reasonable restoration time frame, and
- Consider public concerns

To determine whether an alternative uses permanent solutions to the maximum extent practicable, a "*Disproportionate cost analysis*" [WAC 173-340-360(3)(e)] is performed. This analysis ranks alternatives being considered using the following criteria and compares this ranking to estimated costs.

- Protectiveness,
- Permanence,
- Cost,
- Effectiveness over the long run,
- Management of short-term risks,
- Technical and administrative implementability, and
- Consideration of public concerns.

Each alternative was ranked using a relative scale of low (1), medium (2), and high (3) as to how each alternative meets each of the factors. The rankings were based on best professional judgement, for the most part, as quantitative methods are generally not available. The incremental benefit vs incremental cost (disproportionate cost analysis or DCA) was assessed by calculating a benefit/cost ratio by dividing a total benefit score by the estimated cost in millions of dollars. The higher the ratio, the greater the benefit vs estimated cost.

The Reasonable Restoration Time Frame (RRTF) is judged by the factors described in WAC 173-340-360(4)(b) and include the following:

- Potential risks to human health and the environment,
- Practicability of achieving a shorter restoration time frame,
- Current and future use of site and surrounding areas and associated resources,
- Availability of alternative water supplies,

- Likely effectiveness and reliability of institutional controls,
- Ability to control and monitor migration of hazardous substances from the site,
- Toxicity of hazardous substances at the site, and
- Natural processes that reduce concentrations of hazardous substances.

In the following sections, the alternatives are evaluated with respect to threshold requirements followed by a discussion of the DCA and RRTF. Based on these evaluations, a preferred remedial alternative is identified and discussed in Section 11.

10.1 EMBAYMENT ALTERNATIVES

10.1.1 THRESHOLD REQUIREMENTS

Protect Human Health and Environment. The three embayment alternatives (EB-1, EB-2, and EB-3) are protective of the human health and environment, as they meet CULs at the point of compliance (45 cm) by virtue of placing engineered caps (61 to 152 cm thick) and a sequestration layer containing organic carbon at the bottom of the cap (to prevent residual groundwater contaminants from moving into the caps). Alternatives EB-2 and EB-3 are incrementally more protective, as the alternatives permanently remove progressively more contaminated sediment, and progressively thicker caps would be placed.

Figure 10-1a (also see attached Tables A7.5 and A7.6), shows plots of the estimated UCL95% concentrations for existing conditions, EB-1, EB-2, and EB-3. The greatest concentration declines occur (35.1 to 88.5%) with removal of the top 2-feet of sediment (EB-1). With additional sediment removal, concentrations continue to decline for all constituents but at a lower rate for PCBs, lead, and mercury. Concentrations of DRO+RRO appear to decline more proportionally with the amount of sediment removed. Declines of between 70.3 and 95% were estimated for EB-2 and between 92.1 and 99.3% for EB-3.

Figure 10-1b (also see Tables 7.5and 7.6), shows plots of the highest remaining sample concentration for each alternative. As with the UCL95% concentrations, the greatest declines from existing conditions occur with removal of the top 2-feet of sediment (EB-1), except for DRO+RRO. With additional sediment removal, highest concentrations continue to decline for all constituents. Declines (from existing conditions) of between 67 and 96% were calculated for EB-2 and between 88 and 99% for EB-3.

Comply with Cleanup Standards. The EPA LDW ROD (2014) presents the conceptual remedy for the embayment (sediment removal with capping) along with CULs, ENR-ULs, and points of compliance for LDW sediment. The three embayment alternatives meet CULs at the point of compliance (45 cm) by virtue of placing engineered caps (61 to 152 cm thick) and a sequestration layer containing organic carbon at the bottom of the cap (to prevent residual groundwater contaminants from moving into the caps).

As illustrated on Figures 7-2a,b,c,d; 7-3a,b,c,c; and 7-4a,b,c,d, concentrations of PCBs, DRO+RRO, lead, and mercury would exceed ENR-ULs beneath portions of the cap in all alternatives, however, the area where the exceedances occur, and the magnitude of the exceedances decline from EB-1 to EB-3. In EB-1, exceedances occur beneath most of the embayment while in EB-3 the exceedances mostly occur beneath the central portion of the head of the embayment where the thickest cap (4 to 5 feet) would be placed.

Meet State/Federal Laws. The primary federal requirement (40 C.F.R. 761.61) is associated with cleanup of "*bulk PCB remediation waste*" such as sediment. Total Aroclor PCB concentrations beneath portions of the embayment are equal to or greater than 50 ppm. Sediment containing PCBs equal to or above 50 ppm would be segregated and disposed in a Subtitle C landfill with EPA approval [based on a risk-based cleanup under 40 C.F.R. 761.61(c)]. Alternatives EB-1 (up to 171 ppm) and EB-2 (up to 61.8 ppm) would cap sediment containing PCBs greater than 50 ppm. The highest remaining PCB concentration would be approximately 12.7 ppm if EB-3 is implemented.

Compliance Monitoring. A compliance monitoring program is part of each alternative and would include periodic visual inspections to ensure the integrity of the cap, and surface and subsurface sediment sampling to evaluate the performance of the engineered cap.

10.1.2 DISPROPORTIONATE COST ANALYSIS (DCA)

The relative rankings of the embayment alternatives described above are summarized in attached Table A10.1 (Table A10.1a) using the "*other*" evaluation factors listed above in Section 10.0.

Overall Protectiveness. As noted above for threshold requirements, the three embayment alternatives (EB-1, EB-2, and EB-3) are protective of the human health and environment as they meet CULs at the point of compliance (45 cm) by virtue of placing engineered caps (61 to 152 cm thick) and a sequestration layer containing organic carbon at the bottom of the cap (to prevent groundwater contaminants from moving into the caps). Alternatives EB-2 and EB-3 are incrementally more protective, as the alternatives permanently remove progressively more contaminated sediment, and progressively thicker caps would be placed. EB-3 reduces risks and improves environmental quality to the greatest degree. The three alternatives have a similar restoration time frame (several months) and pose similar on-site and off-site risks which are manageable.

Permanence. Alternative EB-3 is the most permanent of the alternatives as it removes the most contaminated material from the site. The permanence ranking for alternatives EB-2 and EB-1 declines as the amount of sediment removed declines. None of the alternatives would breach the lower permeability fine-grained silt layer that underlies the embayment. Preliminary cap modelling (assuming a starting PCB concentration of 44 mg/kg), a 1.0-foot-thick sequestration layer augmented with 0.5% organic carbon, and a 100-year period) indicate the alternative would be protective. The highest remaining sample PCB concentration for EB-1 and EB-2 are higher than the modelled value (171 and 61.8 mg/kg total PCBs, respectively) while the highest concentration for EB-3 (12.7 mg/kg) is well below the modelled value.

Long Term Effectiveness. EB-3 is judged to have the most long-term effectiveness as it permanently removes from the site the greatest volume of contaminated material and would include the placement of thicker caps. EB-2 ranks second and EB-1 ranks third in long term effectiveness, based on the amount of sediment removed and cap thicknesses. Each of the caps includes habitat creation for clams, although the sequestration layer would extend above the point of compliance for EB-1. The sequestration layer for EB-2 and EB-3 would be below the habitat layer. The clam habitat layer would consist of coarse sand and gravel and assist in minimizing erosion.

Short-Term Risks. Alternative EB-3 poses the highest short-term risk as remedial workers will manage the greatest amount of contaminated sediment and the greatest amount of contaminated material will be transported off-site. The short-term risks are similar for alternatives EB-1 and EB-2. The risks for all the alternatives are manageable.

Technical/Administrative Implementability. All the embayment alternatives are implementable. EB-1 is the most implementable while the implementability of EB-2 and EB-3 is similar. All three alternatives require coordination with remediation of the south embayment shoreline.

Consider Public Concerns. Public concerns generally revolve around the degree of environmental improvement vs. public inconvenience (generally traffic). For purposes of this FS, it was assumed that the degree of long-term environmental cleanup would have greater weight (i.e., generate more or less public concern) than short-term public inconvenience (i.e., more, or less public concern). Using these factors EB-3 would be of less concern (ranking for 3) than either alternatives EB-1 and EB-2.

Cost and Disproportionate Cost Analysis (DCA). The estimated cost of the alternatives is $11,210,000 for EB-1; $12,075,000 for EB-2; and $12,650,000 for EB-3. The incremental cost between EB-1/EB-2 is $865,000 or an increase of approximately 7.7% while the incremental cost between EB-1/EB-3 is approximately $1,440,000 or an increase of approximately 12.8%.

Table 10.1a presents the calculated benefit/cost ratios for the embayment alternatives. The ratios were as follows:

	Benefit/Cost Ratio
• EB-1	0.89
• EB-2	0.99
• EB-3	1.10

The DCA indicates that EB-3 provides the highest incremental benefit vs incremental cost as this alternative has the highest benefit/cost ratio.

10.1.3 REASONABLE RESTORATION TIME FRAME (RRTF)

Each of the RRTF factors to be considered in selecting a remedial alternative are discussed below (as applicable). Overall, EB-3 provides for a RRTF based on the following factors.

- **Potential risks to human health and the environment –** Overall risks decrease as more contaminated sediment is removed from the embayment, residual concentrations decline, and the cap thicknesses increase. EB-3 removes the most contaminated sediment as compared to EB-1 and EB-2.

- **Practicability of achieving a shorter restoration time frame –** Sediment removal with off-site disposal provides for an RRTF of several months with any of the alternatives. Restoration would occur when construction was completed. There are no known practical means to substantially shorten the RRTF.

- **Current and future use of site and surrounding areas and associated resources**. The future use of the site would likely be a side channel habitat area to the LDW. All the alternatives would provide for this embayment use.

- **Availability of alternative water supplies**. Not applicable.

- **Likely effectiveness and reliability of institutional controls**. Institutional controls will be required to prevent disturbance of the engineered caps. Such controls have been commonly used and have been effective.

- **Ability to control and monitor migration of hazardous substances from the site**. Contaminated sediment removal (source control) and placement of the engineered cap (including the sequestration layer of organic carbon) will control contaminant migration through the cap and has been effectively used in the Puget Sound area. Monitoring of potential migration through the cap to the point of compliance is practical and effective.

- **Toxicity of hazardous substances at the site**. PCBs are the primary hazardous substance at the site. While PCBs are persistent and toxic to living organisms, they have low solubility and are highly hydrophobic (PCBs strongly partition to materials with organic carbon). All three alternatives include an engineered cap with a sequestration layer augmented with organic carbon.

- **Natural processes that reduce concentrations of hazardous substances**. PCBs and most of the other COCs in sediment are not susceptible to natural degradation. To the extent that volatiles (such as BTEX) are present in residual sediment, natural degradation can be anticipated.

10.1.4 OVERALL RANKING EMBAYMENT ALTERNATIVES

Each of the embayment alternatives meets the threshold requirements. The DCA indicates the incremental benefits of alternative EB-3 outweigh the incremental costs as this alternative has the highest benefit/cost ratio. EB-3 also provides for a RRTF. Based on these considerations, alternative EB-3 is included in the overall preferred remedy (see Section 11.0).

10.2 PERIPHERAL (UPLAND) AREA ALTERNATIVES

10.2.1 THRESHOLD REQUIREMENTS

Protect Human Health and Environment. All four upland alternatives would be protective of upland receptors through a combination of mobile NAPL and contaminated soil containment/removal, capping, monitoring, and institutional controls. UP-1 (physical NAPL containment) is ranked lower than the other alternatives because mobile NAPL is physically contained but remains on-site, while the other alternatives would remove mobile NAPL from the site which would be more protective.

As more contaminated soil is removed from the site, UCL95% concentrations and the highest remaining concentrations decline as illustrated on Figures 10-2a and 10-2b. The potential for groundwater contamination declines with contaminated soil removal. The estimated UCL95% concentration is lower than the CULs for lead and mercury under the existing (pre-remedial) condition. With implementation of UP-3, the UCL95% concentration for total PCBs would decline by approximately 81% and fall below the CUL, while that for DRO+RRO would decline by approximately 74% and fall below the CUL with implementation of UP-3+UP-4.

Figure 10-2b, shows plots of the remaining highest sample concentration for each alternative. As soil is removed, the highest remaining concentrations decline for all constituents. Declines of between approximately 47 and 88% from existing conditions would occur for UP-3 and between 50 and 99% for UP-3+UP-4. The highest concentration of PCBs would fall below the 2X CUL criterion for UP-3+UP-4, while the highest concentrations of DRO+RRO (nineteen samples), lead (one sample), and mercury (three samples) would remain above the 2X CUL criterion (Table A9.4a).

Comply with Cleanup Standards (CULs). Alternatives UP-1 and UP-2 have the lowest ranking with respect to meeting CULs because PCBs and DRO+RRO in soil would not meet any of the performance criteria, while lead and mercury would exceed the 2x criterion (Tables A9.1a and A9.2a). Alternative UP-3 has a middle ranking as concentrations of PCBs, lead and mercury would meet two of the three performance criteria, although they would exceed the 2x criterion (Table A9.3a). DRO+RRO would still exceed the three performance criteria. Combined UP-3 and UP-4 are ranked highest because performance criteria would be met for PCBs and two of the three criteria would be met for DRO+RRO, lead, and mercury (Table A9.4a). The 2x criterion would be exceeded for DRO+RRO, lead, and mercury, but the number of exceedances would be lower compared to other alternatives.

Meet State/Federal Laws. The primary federal requirement (40 C.F.R. 761.61) is associated with cleanup of "*bulk PCB remediation waste*" such as soil. For low occupancy areas the federal cleanup level is 25 mg/kg. Concentrations between 25 mg/kg and 100 mg/kg can remain if the site is covered with a cap that is maintained. PCB concentrations greater than 100 mg/kg would remain if UP-1, UP-2, and UP-3 were implemented as summarized in attached Tables A9.1a, A9.2a, and A9.3a. For UP-1 and UP-2 greater than 100 mg/kg total PCBs would remain in mobile NAPL (SA-MW1 area), working surface soil (locations P1, P8) and in lagoon sediment, while for UP-3 PCB concentrations greater than 100 mg/kg would remain in buried lagoon sediment. Combined UP-3+UP4 alternatives would remove all PCB concentrations greater than 100 mg/kg. The highest remaining PCB concentration (17 mg/kg at PP-28 [10'-12']) would be below the federal cleanup level for low occupancy areas.

Compliance Monitoring. A compliance monitoring program is part of each upland alternative. During contaminated soil removal work, compliance soil samples would be collected and analyzed along the periphery of the excavation. After the cleanup is completed, periodic visual inspections to ensure the integrity of the cap (paving), and performance/compliance groundwater monitoring would be completed.

10.2.2 DISPROPORTIONATE COST ANALYSIS (DCA)

The relative rankings of the upland alternatives described above are summarized in attached Table A10.1 (Table A10.1b) using the "*other*" evaluation factors listed above in Section 10.0.

Overall Protectiveness. As noted above, all four upland alternatives would be protective of upland receptors through a combination of mobile NAPL and contaminated soil containment/removal, capping, monitoring, and institutional controls. UP-1 (physical NAPL containment) is ranked lower than the other alternatives because mobile NAPL is physically contained but remains on-site, while the other alternatives would remove mobile NAPL from the site which would be more protective. UP-3 +UP4 is most protective because contaminated material from the former settling lagoon would also be removed. Alternatives UP-3 and UP-3 +UP-4 are incrementally more protective, as the alternatives permanently remove progressively more contaminated material. UP-3 + UP-4 reduce risks and improve environmental quality to the greatest degree. UP-1 poses the highest on-site risk as NAPL remains on-site while UP-3 + UP-4 pose the lowest on-site risk. Off-site risks are manageable.

Permanence. UP-1 and UP-2 are the lowest ranked alternatives. UP-1 is ranked low with regard to permanence because the alternative primarily consists of physical containment, while UP-2 would remove mobile NAPL, most of the remaining soil exceeding CULs would remain and be capped on-site. UP-3 has a higher ranking than UP-1 or UP-2 because most of the former working surface soil would be removed, however, buried lagoon sediment would remain under a cap. Combined UP-3+UP-4 rank highest because these alternatives remove the most contaminated material from the upland area.

Long Term Effectiveness. Combined alternatives UP-3+UP-4 are judged to have the most long-term effectiveness as they permanently remove from the site the greatest volume of contaminated material. UP-1 has the lowest ranking as it relies solely on physical containment. UP-2 is ranked similarly to UP-1 because most of the contaminated soil remains on site. UP-3 is ranked medium effectiveness because buried settling lagoon sediment would remain on-site.

Short-Term Risk Management. The short-term risks of the four upland alternatives are manageable. Combined alternatives UP-3+UP-4 poses the highest short-term risk as remedial workers will manage the greatest amount of contaminated material and the settling basin cleanup would require a shored excavation. Short-term risks are similar for alternatives UP-2 and UP-3.

Technical/Administrative Implementability. All the upland alternatives are implementable. UP-1 and UP-2 include a south shoreline sheet pile wall that may be difficult to install because of buried features such as piling, training walls, concrete debris etc., UP-3 and UP-4 do not include the sheet pile wall and therefore are ranked higher than UP-1 and UP-2. UP-3 is ranked higher than UP-4 because of the depth of buried settling lagoon contaminated material removal.

Consider Public Concerns. Public concerns generally revolve around the degree of environmental improvement vs. public inconvenience (generally traffic). For purposes of this FS, it was assumed that the degree of long-term environmental cleanup would have greater weight (i.e., generate less public concern) than short-term public inconvenience. Using these factors UP-3 + UP-4 would be of less concern (ranking of 3) than either of the other alternatives. UP-1 would likely rank lowest because mobile NAPL would remain on-site.

Cost and Disproportionate Cost Analysis. The estimated cost of the alternatives is $3,890,000 for UP-1; $4,213,000 for UP-2; $2,344,000 for UP-3, and $1,155,000 for UP-4 as illustrated on Figure 10-3a. The incremental cost between UP-1/UP-2 is $323,000 or an increase of approximately 8.3% while the incremental cost between UP-2/UP-3 is approximately $1,869,000 or a decrease of approximately 44%. The incremental cost between UP-3 and UP-4 is $1,155,230 or an increase of approximately 49%.

Table 10.1b presents the calculated benefit/cost ratios for the embayment alternatives. The ratios were as follows:

	Benefit/Cost Ratio
• UP-1	2.05
• UP-2	2.38
• UP-3	5.65
• UP-3 + UP-4	4.29

The DCA indicates that UP-3 provides the highest incremental benefit vs incremental cost as this alternative has the highest benefit/cost ratio. While UP-3 + UP-4, has a lower ratio (4.29), this alternative has the highest total benefit score.

10.2.3 REASONABLE RESTORATION TIME FRAME (RRTF)

Each of the RRTF factors to be considered in selecting a remedial alternative are discussed below (as applicable). Overall, UP-3 + UP-4 provides for a RRTF based on the following factors.

- **Potential risks to human health and the environment –** Overall risks decrease as more contaminated soil is removed from the upland and residual concentrations decline. Alternatives UP-3 and UP-4 remove the most contaminated soil as compared to the other alternatives. These alternatives also include augmenting backfill below the water table with organic carbon to prevent residual contaminant migration to the embayment and include a cap (paving) with stormwater controls/treatment to further reduce precipitation recharge and potential leaching within site soils.

- **Practicability of achieving a shorter restoration time frame –** Soil removal with off-site disposal provides for an RRTF of several months with any of the alternatives. Restoration would occur when construction is completed. There are no known practical means to substantially shorten the RRTF.

- **Current and future use of site and surrounding areas and associated resources**. The future use of the site and surrounding area is industrial. The upland alternatives are compatible with such uses.

- **Availability of alternative water supplies**. Groundwater and surface water at the site are non-potable and the area is currently served by municipal water supplies.

- **Likely effectiveness and reliability of institutional controls**. Institutional controls will be required to prevent disturbance of the cap and maintain its integrity, and to prevent the use of groundwater for drinking water purposes. Such controls have been commonly used and have been effective.

- **Ability to control and monitor migration of hazardous substances from the site**. Contaminated soil removal (source control), augmenting backfills below the water table with organic carbon, placement of a cap with stormwater controls/treatment will control contaminant migration into the embayment from the upland area. Monitoring of potential migration through the cap to the point of compliance is practical and effective.

- **Toxicity of hazardous substances at the site**. PCBs are the primary hazardous substance at the site. While PCBs are persistent and toxic to living organisms, they have low solubility and are highly hydrophobic (PCBs strongly partition to materials with organic carbon). All three alternatives include a cap and augmenting backfill with organic carbon to sequester COCs prior to discharge to surface water and sediment. UP-3 + UP-4 remove the most hazardous substances from the site.

- **Natural processes that reduce concentrations of hazardous substances**. PCBs and most of the other COCs in sediment are not susceptible to natural degradation. However, groundwater monitoring and geochemical analyses indicate that PCBs are partitioning strongly to soil, especially along the eastern property line. To the extent that volatiles (such as BTEX) are present in residual soil and groundwater, natural degradation can be anticipated.

10.2.4 OVERALL RANKING UPLAND ALTERNATIVES

Alternatives UP-1, UP-2 and UP-3 would likely not meet federal cleanup requirements under 40CFR761.61 as PCB concentrations greater than 100 ppm would remain in some soil. Alternative UP-3 + UP-4 would meet all the threshold requirements. The DCA indicates the incremental benefits of alternative UP-3 outweigh the incremental costs of the other alternatives as this alternative has the highest benefit/cost ratio (Table 10.1b). Alternative UP-3 + UP-4 provides for a RRTF. Based on these considerations, alternative UP-3 + UP-4 is included in the overall preferred remedy (see Section 11.0).

10.3 – EAST DRUM PLANT (ED) ALTERNATIVES

10.3.1 THRESHOLD REQUIREMENTS

Protect Human Health and Environment . Benzene is the primary COC associated with the East Drum Plant with potential migration beyond the east property line. Existing data indicate that benzene is naturally attenuating with migration and that all the alternatives are protective of surface water/sediment via groundwater discharge and vapor migration into site buildings.

Comply with Cleanup Standards. Benzene concentrations exceed the surface water CUL within the interior of the site, but natural attenuation is reducing benzene concentrations below the CUL before migration to the east property line or to surface water. Groundwater beneath the site and in the embayment is non-potable.

Meet State/Federal Laws. The alternatives meet state and federal laws.

Compliance Monitoring. A compliance monitoring program is incorporated into each alternative to confirm that migration would not adversely affect sediment or surface water.

10.3.2 DISPROPORTIONATE COST ANALYSIS (DCA)

The relative rankings of the ED area alternatives described above are summarized in attached Table A10.1 (Table A10.1c) using the "*other*" evaluation factors listed above in Section 10.0.

Overall Protectiveness. As noted above, COC CULs associated with the ED area (primarily benzene) are met at the east property line. Available data indicate that benzene is naturally degrading with migration from the source area. Groundwater beneath the site had been determined to be non-potable and it does not appear that vapor migration into site buildings is an issue at this industrial site. Based on these considerations, each of the ED area alternatives is considered protective and equally weighted in the DCA.

Permanence. All the ED alternatives will permanently reduce contaminant concentrations in groundwater through degradation or destruction, with time. Each of the ED area alternatives is considered protective and equally weighted in the DCA.

Long Term Effectiveness. Over the long-term, the alternatives would be similar in effectiveness (i.e., in protecting surface water via groundwater migration) and are equally weighted in the DCA.

Short-Term Risks. Alternative ED3a poses the highest short-term risk as remedial workers will manage corrosive chemicals. The short-term risks are similar for the other alternatives.

Technical/Administrative Implementability. All the ED alternatives are implementable. ED1 is the most implementable while the implementability of ED3a and ED3b is similar. Alternative ED2 is the least implementable because of access issues caused by structures.

Consider Public Concerns. Public concerns generally revolve around the degree of environmental improvement vs. public inconvenience (generally traffic). However, in this case most of the issue is associated with on-site conditions. DOF would not anticipate much public concern assuming performance/compliance monitoring indicates that CULs are met at the site boundary. For purposes of the DCA, it was assumed equal rankings.

Cost and Disproportionate Cost Analysis. The estimated costs of the ED alternatives are $15,000 for ED; $311,000 for ED2; $245,000 for ED-3 (ISCO); and $270,000 for ED3 (IB). The costs are plotted on Figure 10.3b.

Table 10.1c presents the calculated benefit/cost ratios for the ED area alternatives. The ratios were as follows:

	Benefit/Cost Ratio
• ED-1	850
• ED-2	48
• ED-3a	60
• ED-4a	123

The DCA indicates that ED-1 provides the highest incremental benefit vs incremental cost as this alternative has the highest benefit/cost ratio. Under existing conditions, benzene from this area does not represent a significant risk to surface water via groundwater discharge. The cost of implementing more active alternatives range from eight to twenty times the cost of MNA (ED-1). Furthermore, groundwater monitoring will be part of all the upland alternatives which will be about the same cost whether or not more active remediation is completed in the ED area. Based on these considerations, the cost of completing active groundwater remediation in the ED area is disproportionate to the incremental environmental benefit.

10.3.3 REASONABLE RESTORATION TIME FRAME (RRTF)

Each of the RRTF factors to be considered in selecting a remedial alternative are discussed below (as applicable).

- **Potential risks to human health and the environment** – COCs associated with the ED area (primarily benzene) pose negligible risk to human health and the environment. Groundwater beneath the site is classified as non-potable and groundwater CULs are met at the east (downgradient) property line. There is also evidence that benzene is naturally degrading with migration from the ED source area, supporting the implementation of ED-1 (MNA). Benzene and other ED COCs (primarily VOCs) are present in buried settling lagoon material located downgradient of the ED source area. Implementation of upland alternative UP-3 + UP-4 would remove most of this material further reducing the potential for these COCs to migrate off-site.

  The ED source area appears to be located along the eastern edge of the main manufacturing building (Figures 4-10a and 4-11) with groundwater flow in an easterly direction. Benzene was not detected near the water table beneath the building and there are no structures to the east. Based on these considerations, vapor intrusion into the main manufacturing building does not pose an undue risk.

- **Practicability of achieving a shorter restoration time frame** – ED-1, MNA, would take several years to meet cleanup levels. ED-3a (ISCO) and ED-3b (ISB) could potentially reduce the restoration time frame by directly treating in situ the source area that could be accomplished over six to twelve months.

- **Current and future use of site and surrounding areas and associated resources**. The future use of the site and surrounding area is industrial. The ED alternatives are compatible with such uses.

- **Availability of alternative water supplies**. Groundwater and surface water at the site are non-potable and the area is currently served by municipal water supplies.

- **Likely effectiveness and reliability of institutional controls**. An institutional control will be required to prevent uncontrolled use of groundwater. Such controls have been commonly used and have been effective.

- **Ability to control and monitor migration of hazardous substances from the site**. Performance/compliance monitoring of ED COCs in groundwater will be part of any of the ED alternatives. Groundwater monitoring can be effectively accomplished to assess the overall performance of the upland and ED cleanup and to confirm that human health and environment are protective.

- **Toxicity of hazardous substances at the site**. The toxicity of the ED COCs via possible exposure pathways are well established and delineated for this site.

- **Natural processes that reduce concentrations of hazardous substances.** Benzene naturally degrades in most subsurface environments and available data indicate that such degradation is occurring at this site.

10.3.4 OVERALL RANKING – ED AREA ALTERNATIVES

Each of the ED alternatives meet the threshold requirements. In situ treatment of groundwater (ED-3a and ED-3b) could potentially reduce the RRTF, however the DCA indicates that the incremental benefit vs incremental cost of these alternatives is far lower than that of ED-1 (MNA). Therefore, ED-1 is included in the preferred remedy presented in Section 11.

11.0 – PREFERRED REMEDIAL ALTERNATIVE

11.1 – ICS/NWC PREFERRED REMEDY

The preferred ICS/NWC remedial remedy is a combination of several alternatives:

- **Embayment Alternative EB-3** to include the following primary components:
    - A structural sheet pile wall would be installed along the north embayment shoreline .
    - A temporary dam would be constructed at the embayment neck to allow sediment removal beneath most of the embayment to be done in the dry. Some dredging may be required on the waterway side of the dam.
    - Remove structures (along shoreline) and debris, and sediment to depths of between two and five feet. Dispose of debris and sediment off-site at either a Subtitle D or Subtitle C facility depending on in-situ PCB concentrations and EPA approvals.
    - Place an engineered cap (two to five feet thick) to similar pre-cleanup elevations. Mix the bottom foot of the cap with 0.5% organic carbon.
    - Record institutional controls and place signs to prevent significant disturbance of the cap by excavation/dredging.
    - Implement a monitoring program to ensure cap physical and chemical integrity.

- **Upland Alternatives No. UP-3, UP-4, and ED-1** to include the following primary components:
    - Remove mobile NAPL from SA-MW1 area with excavated soil.
    - Cut back the south shoreline adjacent to ICS operations to construct a stable sloped shoreline that will integrate into the embayment cleanup.
    - Remove contaminated soil along the south shoreline and former working surface soil to depths of between two and eight feet.
    - Remove buried settling lagoon contaminated material along eastern property line.
    - Backfill excavated areas with imported sand and gravel. Mix backfills below the water table with 0.5% organic carbon.
    - Dispose off-site excavated soil at either a Subtitle D or Subtitle C facility depending on in-situ PCB concentrations and EPA approvals.
    - Replace paving to the top of the cut slope and along the eastern site boundary. Place new pavement in the currently unpaved portion of the eastern site boundary.
    - Continue to collect and treat (as necessary) stormwater runoff as part of ICS operations.
    - Plant riparian vegetation along the south shoreline (downslope from the edge of paving).
    - Record institutional controls to maintain site paving and prevent the uncontrolled use of groundwater beneath the site.

- o Develop and implement a monitoring program to ensure the physical integrity of site paving that acts as a cover and a groundwater monitoring program as part of MNA.

11.2 THRESHOLD REQUIREMENTS

Protection of Human Health and Environment. The preferred alternative is most protective of potential receptors, as the alternative permanently removes from the site the greatest amount of contaminated material (i.e. removing source materials termed "*source control*", including mobile NAPL, TSCA waste [PCB >50 ppm]) and contaminated soil, and generally meets CULs at the points of compliance, except for locations that exceed the upland 2X performance criterion (attached Table A9.4a). Potential receptors via soil/sediment contact (upland site workers and wildlife, low tide visitors to the embayment) are protected by substantially reducing soil/sediment concentrations, placing, and maintaining engineered caps, and recording institutional controls.

In general terms, the potential for contaminants to migrate into sediment and surface water via NAPL and groundwater flow is affected by the concentration of contaminants in NAPL and soil in contact with groundwater, and the amount of local precipitation recharge infiltrating into soil above the water table. As noted in Section 4.1.2, available data indicate that the predominant source of contaminates to the embayment is NAPL which appears to be leaking into the embayment from the SA-MW1 area. The preferred remedy removes the mobile NAPL source from this area to halt the leakage. The potential for leaching of contaminants by groundwater is substantially reduced by removing source materials, which in turn, reduces soil concentrations by as much as an estimated 96.5% (PCB concentrations) as summarized in Table A9.4a. The upland engineered cap and stormwater system prevents precipitation recharge leaching residual contaminants from soil above the water table and institutional controls prevent the uncontrolled use of groundwater. Furthermore, backfill soil placed beneath the water table and the embayment engineered cap will be mixed with organic carbon to sequester any residual contaminants that leach into groundwater.

The ED area lies interior to the site and poses no significant risk to sediment or surface water. Available data indicate natural attenuation of VOCs (primarily benzene) is occurring with migration from this area. The overall cleanup includes sequestration and/or degradation of groundwater residues that may remain with the potential to migrate to surface water/sediment via groundwater.

Comply with Cleanup Standards. The preferred alternative results in directly (without containment or institutional controls) meeting two of the three MTCA cleanup performance criteria for PCBs, DRO+RRO, lead, and mercury. Only one sample exceeds the lead 2X criterion (PP18, 5'-7') and only two samples exceed the 2X criterion for mercury (PP-28, 10'-11'; and P-18, 14'-16'). A greater number of samples (19) exceed the DRO+RRO 2X criterion. The DRO+RRO 2X criterion is based on preventing the accumulation of free product on groundwater. Free product has not been detected at the nineteen locations. All the 2X criterion exceedances will be covered with backfill and paving, which will prevent uncontrolled exposure to potential receptors.

The proposed CUL for PCBs is 10 mg/kg and as indicated in Table A9.4a, implementation of the preferred remedy reduces the overall PCB concentration in soil to approximately 1.4 mg/kg based on the UCL95% statistical analysis. Geochemical analyses indicate that the preferred remedy is protective of embayment surface water and sediment via groundwater discharge, especially as the remedy includes removal of mobile NAPL and mixing backfill and the embayment engineered cap with organic carbon to sequester PCB residuals that potentially leach into groundwater. Based on discussions with Ecology, removal of NAPL and contaminated soil from the embayment shoreline area should be considered an "*interim action*" subject to performance and compliance monitoring (discussed below). The final cleanup action will be based on this monitoring[xviii].

Meet State/Federal Laws. The preferred alternatives meet state and federal laws. The primary requirement (40 C.F.R. 761.61) is associated with cleanup of "*bulk PCB remediation waste*" such as soil. For upland low occupancy area, the federal cleanup level is 25 mg/kg. The proposed alternatives result in remaining PCB concentrations below this value, and a cap/cover would be placed and maintained over soil containing PCB residues.

Compliance Monitoring. A compliance monitoring program is part of the preferred alternative. The monitoring program includes groundwater sampling and analysis to assess the performance of the preferred remedy. If monitoring indicates that groundwater CULs are not achieved at the points of compliance, the cause of the CUL exceedances will be evaluated, and based on this evaluation additional cleanup actions will be identified and implemented, as necessary.

11.3 DCA AND RRTF

Section 10 presents the DCA and evaluation of RRTF for the alternatives evaluated in this FS. These analyses indicate that the incremental benefits of the preferred remedy are commensurate with the incremental costs and that restoration will occur in a reasonable time frame (for the most part soon after remedial construction is complete).

[xviii] As a practical manner, "*final*" cleanup actions on most relatively complicated sites are in fact "*interim actions*" until performance/compliance monitoring data confirm CULs are met at the established points of compliance.

11.4 COST

The estimated cost to complete the preferred remedy is summarized in Table 11.1 below.

Table 11.1 Cost Estimate Summary

Area/Alternative	Base Cost Est.	Contingency	Contingency Amount	Cost w/ Contingency
Embayment (Alt. 3)	$10,120,000	25%	$2,530,000	$12,650,000
Upland				
Alt. No. 3 (shoreline)	$1,953,500	20%	$390,700	$2,344,000
Alt. No. 4 (settling lagoon)	$963,000	20%	$192,000	$1,155,000
Subtotal Upland	$2,916,500	-----		
Estimated Total	$13,036,500	-----	$3,112,700	$16,150,000

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TABLE A3.1 - Summary of COC Direct Contact Cleanup Levels

Constituent of Concern	Embayment		ICS Upland					Douglas Upland	
	Sediment Contact		Soil Contact		Contact GW	Contact Surface Water Fm ICS Upland		Contact Surface Water Fm. Douglas Upland	
Receptor	Aquatic Organisms (mg/kg)(a)	Human Visitors (mg/kg)(g)	Wildlife (mg/kg) (h)	Utility Workers (mg/kg)	Utility Workers	Aquatic Organisms (ug/l)(a)	Human Visitors (ug/l)(f)	Aquatic Organisms (ug/l)(a)	Human Visitors (ug/l)(f)
Arsenic	57	7 (i)	20	-----	-----	-----	-----	-----	-----
Total Chromium	260	120000 (as Cr+3)	135	-----	(j)	27 (as Cr+3)	100	-----	-----
Copper	-----	-----	-----	-----	(j)	3.1 (b)	640	-----	-----
Lead	450	250	220	1000 (e)	-----	-----	-----	-----	-----
Mercury	0.41	2	-----	2	(j)	0.025	2	-----	-----
Zinc	410	240000	570	-----	-----	-----	-----	-----	-----
GRO	-----	-----	-----	30	(j)	800	800	-----	-----
Benzene	-----	-----	-----	-----	(j)	1.6	5	1.6	5
Ethylbenzene	-----	-----	-----	-----	(j)	21	700	-----	-----
Toluene	-----	-----	-----	-----	(j)	100	640	-----	-----
Tetrachloroethene	-----	-----	-----	-----	(j)	2.9	5	-----	-----
Trichloroethene	-----	-----	-----	-----	(j)	0.7	4	-----	-----
cis-1,2-Dichloroethene	-----	-----	-----	-----	(j)	384000	16	-----	-----
vinyl chloride	-----	-----	-----	-----	(j)	0.18	0.29	-----	-----
DRO+RRO	2000	2000	15000	2000	(j)	500	500	500	500
1,3-Dichlorobenzene	-----	-----	-----	-----	(j)	2	na	-----	-----
1,4-Dichlorobenzene (k)	3.1/0.11	190	-----	-----	(j)	4.9	75	-----	-----
Benzyl alcohol	0.06	8000	-----	-----	-----	-----	-----	-----	-----
1,2-Dichlorobenzene (k)	2.3/0.04	7200	-----	-----	-----	-----	-----	-----	-----
2,4-Dimethyl phenol	0.03	1600	-----	-----	-----	-----	-----	-----	-----
1,2,4-Trichlorobenzene (k)	0.81/0.03	34	-----	-----	-----	-----	-----	-----	-----
Naphthalene	-----	-----	-----	-----	(j)	1.4	160	1.4	160
2-Methylnaphthalene (k)	38/0.67	320	-----	-----	(j)	14	32	-----	-----
Acenaphthene (k)	16/0.50	4800	-----	-----	-----	-----	-----	-----	-----
Fluorene (k)+A59	23/0.54	3200	-----	-----	-----	-----	-----	-----	-----
N-Nitrosodiphenylamine (k)	11/0.03	200	-----	-----	-----	-----	-----	-----	-----
Pentachlorophenol	0.36	2.5	11	-----	(j)	0.025 (c)	1	-----	-----
Anthracene (k)	220/0.96	24000	-----	-----	-----	-----	-----	-----	-----

TABLE A3.1 - Summary of COC Direct Contact Cleanup Levels

Constituent of Concern	Embayment		ICS Upland					Douglas Upland	
	Sediment Contact		Soil Contact		Contact GW	Contact Surface Water Fm ICS Upland		Contact Surface Water Fm. Douglas Upland	
Receptor	Aquatic Organisms (mg/kg)(a)	Human Visitors (mg/kg)(g)	Wildlife (mg/kg) (h)	Utility Workers (mg/kg)	Utility Workers	Aquatic Organisms (ug/l)(a)	Human Visitors (ug/l)(f)	Aquatic Organisms (ug/l)(a)	Human Visitors (ug/l)(f)
Bis(2-ethylhexyl)phthalate	-----	-----	-----	-----	(j)	0.20 (c)	6	-----	-----
Butylbenzylphthalate	0.06	530	-----	-----	-----	-----	-----	-----	-----
Benzo(a)anthracene	-----	-----	-----	-----	-----	-----	-----	0.01 (c)	see cPAH TEQ
Chrysene	-----	-----	-----	-----	-----	-----	-----	0.01 (c)	
Benzo(a)pyrene	-----	-----	-----	-----	-----	-----	-----	0.01 (c)	
Indeno(1,2,3-cd)pyrene	-----	-----	-----	-----	-----	-----	-----	0.01 (c)	
Dieldrin	-----	-----	0.17	-----	(j)	0.0013 (c)	0.0055	-----	-----
cPAH (TEQ)	-----	0.09(a)	-----	-----	-----	0.01 (c)	0.02	0.01 (c)	0.02
4,4-DDE +-DDD+-DDT	-----	-----	1	-----	-----	-----	-----	-----	-----
4,4-DDE	-----	-----	-----	-----	(j)	0.0013 (c)	0.26	-----	-----
4,4'-DDD	-----	-----	-----	-----	(j)	0.0013 (c)	0.36	-----	-----
4,4'-DDT	-----	-----	-----	-----	(j)	0.0013 (c)	0.26	-----	-----
trans-chlordane	-----	-----	-----	-----	(j)	0.0001	0.25	-----	-----
cis-chlordane	-----	-----	-----	-----	(j)	0.0001	0.25	-----	-----
Total Aroclor PCBs (dw)	0.13	0.5	2	10(d)	(j)	0.01 (c)	0.44	0.01 (c)	0.44
Total Congener PCBs (dw)	0.13	0.5	-----	-----	-----	0.0001 (c)	0.44	0.0001 (c)	0.44
2,3,7,8 TCDD (ng TEQ/kg-dw)	2	13	-----	-----	-----	-----	-----	-----	-----

Notes:

(a) - Sediment and surface water (SW) CULs updated using the LDW Wookbook (May 2021).

(b) - As dissolved fraction. (c) - Based on PQL

(d) - Assumes environmental cap is placed and maintained. (e) - Assumes industrial landuse w/o environmental cap

(f) - Groundwater (GW) discharge to marine surface water. CULs to protect drinking water - DW (LDW Wookbook May 2021). Unadjusted for incidental ingestion (significantly reduced possible exposure). CULs for aquatic organisms are protective of recreational human visitors.

(g) - From CLARC (Feb. 2021) - Method B CULs if available; Method A if Method B not available. Unadjusted for incidental ingestion (significantly reduced exposure. CULs for aquatic organisms are protective of recreational human visitors except for cPAH-TEQ.

(h) - Applies to unpaved portion of ICS upland property.

(i) - Based on background.

(j) - CULs not available. Highest concentrations below DW CULs or acceptable risk levels (see Tbl. A3.3).

(k) - Sediment aquatic organism CUL - Organic carbon normalized/dry weight (AET if TOC <0.5% or >3.5%).

----- - Not a COC for indicated media or not available

Table A3.2 - FS Groundwater COC Associations by Area - ICS/NWC Property

Constituent	GW-CUL (ug/l)	DW/ LDW PCUL	Comment
GW-COC Along Embayment Shoreline and East Property Line (Peripheral Remedial Area)			
Total PCBs	0.01		Total PCB is the most frequently detected GW-COC. Highest concentrations are associated with LNAPL (2.5 to 6.9 ug/l). Other samples from monitoring wells ranged between 0.03 to 1.5 ug/l. Suspended solids impacting groundwater PCB results.
LNAPL Associated Constituents (SA-MW1 Area)			
LNAPL	Present	-----	Present along the middle portion of the embayment shoreline in SA-MW1 Area. Primary current source of GRO/DRO/RRO and PCBs to embayment.
GRO	800	800	Associated with LNAPL in SA-MW1 area (1400 to 2800 ug/l) and P15 (1800 ug/l)
DRO+ RRO	500	500	Primarily associated with LNAPL in SA-MW1 area (770 to 2000 ug/l).
Benzene	1.6	5	Associated with LNAPL in SA-MW1 area (6.6 to 12 ug/l).
Toluene	100	640	Primarily associated with LNAPL in SA-MW1 area (290 to 480 ug/l).
Ethylbenzene	21	700	Associated with LNAPL in SA-MW1 area (240 to 420 ug/l) and P15 (87 ug/l)
Vinyl Chloride	0.18	0.29	Highest vinyl chloride concentrations in SA-MW1 area (2.5 to 19 ug/l). Source appears to be degradation of PCE and TCE. These compounds were intermittently detected in groundwater at concentrations of 6.1 to 9.0 ug/l - PCE and 0.79 to 2.3 ug/l - TCE.
1,3- and 1,4-Dichlo-robenzene (DCB)	2/4.9	na/75	Primarily associated with LNAPL in SA-MW1 area (highest conc. 1,3-DCB-5.2 ug/l; 1,4-DCB-14 ug/l)
Naphthalene, 2-Methylnaphthalene	1.4/14	160/32	Primarily associated with LNAPL in SA-MW1 area (naphthalene 23 to 25 ug/l; 2-methynaphthene 46 to 80 ug/l).
GW-COCs Beneath and East of Drum Reconditioning Building			
Benzene	1.6	5	Detected above SL beneath and downgradient of the drum reconditioning building (1.7 to 70 ug/l)
Vinyl Chloride (+PCE, TCE)	0.18	0.29	Vinyl chloride detected above SL beneath and downgradient of the drum reconditioning building (0.26 to 2.1 ug/l). Appears to be created by the degradation of PCE, TCE.
GW COCs Posing Minimal Risk to Surface Water and Sediment			
Dissolved chromium	27	100	Detected above SLs within the site interior (Upper Zone beneath aquitard) up to 75 ug/l. Not detected above SLs along shoreline or east property line.
Dissolved copper	3.1	640	Detected above SLs within the site interior (Upper Zone beneath aquitard - up to 19 ug/l). Along shoreline only detected above SLs in samples from well SA-MW3 (4 to 9.2 ug/l).
Dissolved mercury	0.025	2	Detected in only one push-probe sample (P30) at 0.026 ug/l. Included as GW-COC to be included in future monitoring program.
Pentachlorophenol	0.025	1	Not consistently detected above SL (highest conc. 240 ug/l DOF-MW7;, not confirmed by later analyses - <0.025 ug/l)

Table A3.2 - FS Groundwater COC Associations by Area - ICS/NWC Property

Constituent	GW-CUL (ug/l)	DW/ LDW PCUL	Comment
Bis(2-ethylhexyl)phthalate	0.2	6	A common laboratory contaminant. The pattern of SL exceedances do not indicate a property source. The highest detected concentration was 10 ug/l in probe P14.
4,4'-DDE, 4,4'-DDD	0.0013	0.26/0.36	Primarily detected in push-probe samples drilled through contaminated materials (0.0026 to 0.040 ug/l). Presence not confirmed by monitoring well samples.
Trans- cis-Chlordane	0.0001	0.25	Primarily detected in samples from DOF-MW6 (0.003 to 0.005 ug/l). Source is unclear.
Dieldrin	0.0013	0.0055	Detected at two non-contiguous push-probe locations (P16-0.14 ug/l and P27B-0.036 ug/l). Not confirmed by monitoring well samples.

Notes: GRO - Gasoline Range Organics; DRO - Diesel Range Organics; RRO - Residual Range Organics.

GW-CUL - To protect surface water via groundwater discharge; human ingestion of fish/shell fish and to protect aquatic organisms.

DW/LDW PCUL - Lower Duwamish River - Preliminary Cleanup Level to protect drinking water (May 2021)

na - not available

Table A3.3 - Estimated Risks Groundwater COCs >DW Criteria - Utility Workers

ICS/NW Cooperage
Seattle, WA

Constituent	Type	CPF kg-day/mg	RfD mg/kg-day	Method B CUL - DW (ug/l)	LDW PCUL - DW (ug/l)	Highest Conc. (ug/l)	Worker Noncarcinogenic Risk (HQ)	Worker Carcinogenic Risk (a)	Comment
							Adult (b)	Adult(c)	
NAPL	Present along the middle portion of the embayment shoreline in SA-MW1 Area. Primary current source of GRO/DRO/RRO and PCBs to embayment.								Utility worker risks likely unacceptable with uncontrolled exposure because of PCBs and other constituents in NAPL
GRO	non carcinogen	-----	-----	-----	800	1800	(d)	-----	Highest concentration outside of NAPL area P15 (1800 ug/l)
DRO+ RRO	non carcinogen	-----	-----	-----	500	740	(d)	-----	Highest concentration outside of NAPL area MW-Ju (740 ug/l). Exceeded criterion in 1 of 3 spls.
2-Methyl-naphthalene	non carcinogen	-----	4.00E-03	32	32	59	0.003	-----	Highest concentration outside of NAPL area in well DOF-MW7; exceeded DW criterion in 1 of 4 samples.
Total PCBs	carcingoen	2.00E+00	-----	0.044	0.44	1.5	-----	8.00E-08	Highest concentration outside of NAPL area in well DOF-MW1; exceeded DW criterion in 2 of 4 samples.
Benzene	carcingoen	5.50E-02	-----	0.8	5	70	-----	1.90E-07	Highest concentration detected in samples from well DOF-MW8
Vinyl Chloride	carcingoen	1.50E+00	-----	0.029	0.29	8.8	-----	6.60E-07	Highest concentration outside of NAPL area detected in push-probe P15
Pentachloro-phenol	carcinogen	4.00E-01	-----	0.22	1.0	240	-----	2.40E-06	Not consistently detected above CUL (highest conc. 240 ug/l DOF-MW7; not confirmed by later analyses - <0.025 ug/l)
Dieldrin	carcingoen	1.60E+01	-----	0.0055	0.0055	0.14	-----	6.00E-08	Detected at two non-contiguous push-probe locations (P16-0.14 ug/l and P27B-0.036 ug/l). Not confirmed by monitoring well samples. P27B sample below point of compliance.

Notes: GRO - Gasoline Range Organics; DRO - Diesel Range Organics; RRO - Residual Range Organics.

na - not available ------- - Not applicable HQ - Hazard Quotient (acceptable <1.0) DW - To protect drinking water

LDW PCUL-DW - Lower Duwamish Waterway - Preliminary Cleanup Levels (May 2021) - to protect drinking water.

(a) - Carcinogenic risk - Acceptable risk <1E-6

(b) - MTCA default weight = 70 kg. HQ estimated using equation 720-1 in WAC 173-340-720 and adjusted ingestion rate and exposure duration.

(c) - Adult MTCA default weight = 70 kg. Risk estimated using equation 720-2 in WAC 173-340-720 and adjusted ingestion rate and exposure duration.

(d) - Data not available to calculate an HQ. Exposure mostly associated with LNAPL in SA-MW1 area.

Table A3.4 - Sediment COCs

Constituent	Units	ROD Cleanup Level	Exposure Pathway	Point of Compliance	Surface Sediment (0-10 cm)			Subsurface Sediment (+10 cm)			Ground-water COC
					COPC in Surface Sediment	Highest EF	% EF>1	COPC in Subsurface Sediment	Highest EF	% EF>1	
Arsenic	mg/kg-dw	7 (a)(b)	HDC(a)(b)	0-45 cm (a)(b)	X	8.7	83	X	4.4	54	No
Total Chromium	mg/kg-dw	260	EBC	0-10 cm	X	2.4	10	No	1.7	2.2	Yes
Lead	mg/kg-dw	450	EBC	0-10 cm	X	13	23	X	9.8	11	No
Mercury	mg/kg-dw	0.41	EBC	0-10 cm	X	35	33	X	95	20	Yes (c)
Zinc	mg/kg-dw	410	EBC	0-10 cm	X	3.3	10	No	7.9	8.7	No
DRO/RRO	mg/kg-dw	2000	EBC	0-10 cm	X	11	10	X	11	17	Yes (c)
1,4-Dichlorobenzene	ug/kg-OCN	3100	EBC	0-10 cm	No	69	3.3	X	9.5	12	No
Benzyl alcohol	ug/kg-dw	57	EBC	0-10 cm	X	11	17	X	3.3	32	No
1-2-Dichlorobenzene	ug/kg-OCN	2300	EBC	0-10 cm	X	343	6.7	X	1.9	12	No
2,4-Dimethylphenol	mg/kg-dw	29	EBC	0-10 cm	X	29	6.7	X	31	18	No
1,2,4-Trichlorobenzene	ug/kg-OCN	810	EBC	0-10 cm	X	45	3.3	X	10	10	No
2-Methynaphthalene	ug/kg-OCN	38000	EBC	0-10 cm	X	19	3.3	X	52	2.9	Yes
Acenaphthene	ug/kg-OCN	16000	EBC	0-10 cm	No	9.2	3.3	X	34	12	No
Fluorene	ug/kg-OCN	23000	EBC	0-10 cm	X	12	6.7	No	6.9	5.9	No
N-Nitrosodiphenylamine	ug/kg-OCN	11000	EBC	0-10 cm	X	143	3.3	No	8.8	2.9	No
Pentachlorophenol	mg/kg-dw	360	EBC	0-10 cm	X	18	23	No	2.4	5.9	Yes
Anthracene	ug/kg-OCN	220000	EBC	0-10 cm	X	17	3.3	No	1.9	2.9	No
Butylbenzylphthalate	ug/kg-OCN	4900	EBC	0-10 cm	X	17	13	No	1.9	2.9	No
B(a)PEq. (TEQ)	ugTEQ/kg-dw	150(b)	HDC(b)	0-45 cm(b)	X	753	57	X	4.8	29	No
		90(a)	HDC(a)	0-45 cm(a)	X	1254	63	X	8	32	No
Total PCBs (dry wt.)	ug/kg-dw	2	HSC	0-10 cm	X	97000	100	X	22055	61	Yes
		128	ROC	0-10 cm	X	1516	93	X	344	43	
		500(b)	HDC	0-45 cm(b)	X	388	87	X	88	28	
		1300	HDC	0-10 cm	X	151	60	X	34	26	
		1700(a)	HDC	0-45 cm (a)	X	116	47	X	26	22	
Total PCBs (OCN)	ug/kg-OCN	12000	EBC	0-10 cm	X	89	90	X	109	40	
PCDD/PCDF (n=3)	ngTEQ/kg/dw	2	HSC	0-10 cm	X	198	100	not analyzed	-----	-----	No
		13(b)	HDC	0-45 cm(b)	X	30	100	not analyzed	-----	-----	
		28(a)	HDC	0-45 cm(a)	X	14	100	not analyzed	-----	-----	
		37	HDC	0-10 cm	X	11	67	not analyzed	-----	-----	

Notes: HDC - Human Direct Contact; EBC - Ecological Benthic Contact; HSC - Human Seafood Consumption;ROC - River Otter Contact;
(a) - Individual beaches; (b) - Clamming areas; (c) - For monitoring purposes to confirm; n= Sample number; EF = Exceedance Factor

TABLE A4.1 - Primary GW-COC Associations in Soil - ICS/NWC Property

Location	Spl. Depth (feet)	PCBs (ug/kg)	DRO+RRO (mg/kg)	Lead (mg/kg)	PCP (ug/kg)	GRO (mg/kg)	Benzene (ug/kg)	Ethyl-benzene (ug/kg)	PCE ug/kg	TCE ug/kg	VC ug/kg
	Grouping Level	10000(a)	2000(a)	1000(a)	>100(b)	30(a)	30(a)	6000(a)	50(a)	30(a)	Detected
	SC-COC	Yes	Yes	Yes	No	Yes	No	No	No	No	No
	GW-COC	Yes	Yes (c)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LP3-10W	5-7	209300	31800	3100	-----	-----	-----	-----	-----	-----	-----
LP3-20S	6.2-7.2	170700	35800	2890	-----	-----	-----	-----	-----	-----	-----
P8-20N	0.5-1.5	129500	39790	3780	-----	-----	-----	-----	-----	-----	-----
P-8	0.5-1	119000	35000	687	-----	-----	-----	-----	-----	-----	-----
P-1	2.5-3	118000	1310	50	-----	-----	-----	-----	-----	-----	-----
LP-3	6-8	113000	17200	3600	5300	-----	1600	130000	<2500	2000	<2500
LP3-10S	5.5-6.5	96800	37500	5070	-----	-----	-----	-----	-----	-----	-----
LP3-10N	5-7	86360	33500	669	-----	-----	-----	-----	-----	-----	-----
SA-MW1	5-6.5	76500	64000	836	<10	260	-----	-----	-----	-----	-----
PP-18*	2-3	70070	32470	6270	-----	-----	-----	-----	-----	-----	-----
P8-30NW	0.5-1.5	64280	18450	74.9	-----	-----	-----	-----	-----	-----	-----
LP3-20N	5.5-6.5	60900	30600	2370	-----	-----	-----	-----	-----	-----	-----
LP-12	5-6	54700	15840	179	-----	-----	-----	-----	-----	-----	-----
PP-39	2-3	52010	53400	2170	-----	-----	-----	-----	-----	-----	-----
LP-6	10-11	52000	33440	892	-----	-----	-----	-----	-----	-----	-----
LP3-20W	5.5-6.5	48180	12760	1580	-----	-----	-----	-----	-----	-----	-----
PP-24	1.5-2.5	40620	33200	16	-----	-----	-----	-----	-----	-----	-----
PP-8*	2.5-3.5	40200	4710	-----	-----	-----	-----	-----	-----	-----	-----
PP-30	1-2	40120	27640	-----	-----	-----	-----	-----	-----	-----	-----
MW-Ju	3-4	39800	46000	49	1800	28	3.9	9.6	<2.1	<2.1	<2.1
P-17	4.5-6.5	34000	1240	8	<19	150	0.9	2.8	<1.4	2.2	<1.4
PP-39	7-8	33010	9210	296	-----	-----	-----	-----	-----	-----	-----
P-29	3-4	32300	65000	4590	410	340	1.6	1.9	<0.9	1	<0.9
LP-11	10.5-11.5	32130	2011	381	-----	-----	-----	-----	-----	-----	-----
PP-23	1-2	30810	6010	0.95	-----	-----	-----	-----	-----	-----	-----
P8-20NW	0.5-1.5	30760	20390	226	-----	-----	-----	-----	-----	-----	-----
P-3	5-5.5	28100	24800	7	-----	-----	-----	-----	-----	-----	-----
P8-10NE	0.5-1.5	25760	6260	6710	-----	-----	-----	-----	-----	-----	-----
PP-27*	1-2	25590	16250	-----	-----	-----	-----	-----	-----	-----	-----
PP-36	1-2	23680	7860	689	-----	-----	-----	-----	-----	-----	-----
PP-35*	1.7-2	23600	5510	-----	-----	-----	-----	-----	-----	-----	-----
LP3-10S	5-5.5	23210	1808	53	-----	-----	-----	-----	-----	-----	-----
LP-10	7-8	22400	14880	311	-----	-----	-----	-----	-----	-----	-----

TABLE A4.1 - Primary GW-COC Associations in Soil - ICS/NWC Property

ICS/NW Cooperage Site
Seattle, Washington

Location	Spl. Depth (feet)	PCBs (ug/kg)	DRO+RRO (mg/kg)	Lead (mg/kg)	PCP (ug/kg)	GRO (mg/kg)	Benzene (ug/kg)	Ethyl-benzene (ug/kg)	PCE ug/kg	TCE ug/kg	VC ug/kg
	Grouping Level	10000(a)	2000(a)	1000(a)	>100(b)	30(a)	30(a)	6000(a)	50(a)	30(a)	Detected
	SC-COC	Yes	Yes	Yes	No	Yes	No	No	No	No	No
	GW-COC	Yes	Yes (c)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P-2	5-6.5	20200	13200	3570	-----	-----	-----	-----	-----	-----	-----
LP-11	5.5-6.5	19110	1904	144	-----	-----	-----	-----	-----	-----	-----
P8-10SE	0.5-1.5	18890	3430	12	-----	-----	-----	-----	-----	-----	-----
PP-17	1-2	17830	21710	943	-----	-----	-----	-----	-----	-----	-----
PP-28	10-11	17000	32500	1090	-----	-----	-----	-----	-----	-----	-----
P8-30N	0.5-1.5	15870	9970	1440	-----	-----	-----	-----	-----	-----	-----
LP3-10W	10-12	15580	10930	80	-----	-----	-----	-----	-----	-----	-----
LP-4	8-10	15300	1920	748	210	-----	-----	-----	-----	-----	-----
HC-B2(EPA-B2)	5-7.5	15300	-----	444	nd	-----	nd	nd	nd	23	15
PP-16	2-3	15120	7710	11800	-----	-----	-----	-----	-----	-----	-----
P8-10N	0.5-1.5	15060	2930	78	-----	-----	-----	-----	-----	-----	-----
PP-31	1.5-2.5	13530	3405	154	-----	-----	-----	-----	-----	-----	-----
P-5	6-6.5	12700	7900	8	-----	-----	-----	-----	-----	-----	-----
SA-MW2	15-16.5	11900	3100	204	370	54	-----	-----	-----	-----	-----
PP-37	10-11	11720	3640	153	-----	-----	-----	-----	-----	-----	-----
P-18	14-16	11700	8400	950	100	190	6.3	<1.4	<1.4	<1.4	<1.4
LP3-20W	1.5-2.5	11659	7990	113	-----	-----	-----	-----	-----	-----	-----
P8-10NW	0.5-1.5	11190	16950	294	-----	-----	-----	-----	-----	-----	-----
PP-12	2.5-3.5	10640	13740	16	-----	-----	-----	-----	-----	-----	-----
LP-1	6.5-8	10600	2520	448	140	-----	1.1	1.1	<1.7	<1.7	<1.7
P-29	6-8	-----	28400	13.3	-----	-----	-----	-----	-----	-----	-----
LP-13	10-11	8970	29100	69	-----	-----	-----	-----	-----	-----	-----
PP-38	1.5-2.5	-----	21340	27	-----	-----	-----	-----	-----	-----	-----
DOF-MW6	3-5	470	19000	2.6	<260	3000	<280	3300	<280	<280	<280
P8-7W	1-2	2598	16400	31	-----	-----	-----	-----	-----	-----	-----
PP-28	2-3	1528	13920	20	-----	-----	-----	-----	-----	-----	-----
DOF-MW6	6-8	1460	12000	2.3	<110	2300	<270	2300	<270	<270	<270
PP-12*	5-6	3506	8482	-----	-----	-----	-----	-----	-----	-----	-----
LP-18	7-8	4080	8330	447	-----	-----	-----	-----	-----	-----	-----
PP-13	2-3	5	8030	26	-----	-----	-----	-----	-----	-----	-----
P8-10E	1-2	2233	7590	148	-----	-----	-----	-----	-----	-----	-----
PP-31	6.5-7.5	1033	6330	14	-----	-----	-----	-----	-----	-----	-----
P8-15SW	0.5-1.5	8690	6240	212	-----	-----	-----	-----	-----	-----	-----

TABLE A4.1 - Primary GW-COC Associations in Soil - ICS/NWC Property

Location	Spl. Depth (feet)	PCBs (ug/kg)	DRO+RRO (mg/kg)	Lead (mg/kg)	PCP (ug/kg)	GRO (mg/kg)	Benzene (ug/kg)	Ethyl-benzene (ug/kg)	PCE ug/kg	TCE ug/kg	VC ug/kg
	Grouping Level	10000(a)	2000(a)	1000(a)	>100(b)	30(a)	30(a)	6000(a)	50(a)	30(a)	Detected
	SC-COC	Yes	Yes	Yes	No	Yes	No	No	No	No	No
	GW-COC	Yes	Yes (c)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LP-14	5-6	9330	6220	42	-----	-----	-----	-----	-----	-----	-----
PP-22	2-3	671	5180	42	-----	-----	-----	-----	-----	-----	-----
P-8	10-10.5	2500	4900	161	-----	-----	-----	-----	-----	-----	-----
P8-10S	1-2	7242	4600	15	-----	-----	-----	-----	-----	-----	-----
PP-10	2-3	38	4419	2.4	-----	-----	-----	-----	-----	-----	-----
PP-3	1-2	62.6	4378	88	-----	-----	-----	-----	-----	-----	-----
LP-15	7-8	1166	4370	48	-----	-----	-----	-----	-----	-----	-----
P-9	10-10.5	6300	4040	52	-----	-----	-----	-----	-----	-----	-----
SA-MW2	7.5-8	211	4000	77	<2	10	-----	-----	-----	-----	-----
PP-38	5-6	5433	3962	43	-----	-----	-----	-----	-----	-----	-----
PP-19	2-3	1572	3650	386	-----	-----	-----	-----	-----	-----	-----
PP-18	5-6	1785	3310	2410	-----	-----	-----	-----	-----	-----	-----
P-30	6-7	980	3300	71	50	100	4.1	2700	0.8	1.3	<1.0
LP-17	10-11	281	3300	238	-----	-----	-----	-----	-----	-----	-----
P-24	9-10.5	2800	2810	34	34	<7.6	3.9	<1.5	<1.5	2.7	<1.5
PP-37*	12-13	2599	2766	-----	-----	-----	-----	-----	-----	-----	-----
P-13	4-6	1610	2360	147	220	<80	0.9	<1.4	5.1	<1.4	<1.4
HC-B1(EPA-B1)	5-7	6580	-----	158	nd	-----	nd	nd	420	nd	nd
HC-B1(EPA-B1)	7-8.5	5520	-----	171	nd	-----	nd	nd	350	nd	nd
LP-4	10-12	2150	1200	118	150	-----	78	1800	<110	200	<110
P-21	12-14	4300	980	24	54	28	50	280	<2.2	3.7	<2.2
DOF-MW7	3-4	890	1790	8.4	160000	54	<91	1500	<91	120	<91
DOF-MW8	11-12	<3.8	<13	2.4	250	<7.8	29	0.9	<1.2	<1.2	<1.2
P-28	15-17	13	<12	1.2	<18	<9.2	21	28	<1.1	<1.1	<1.1
P-30	12.5-13.5	1160	1040	42	36	40	21	2	<1.0	<1.0	<1.0
P-12	9.8-11	<3.9	<14	3.1	11	<9.0	20	<1.8	<1.8	<1.6	<1.8
P-29	9-10	1070	330	8.2	35	32	18	720	5.8	14	<1.6
P-21	6-8	9200	770	127	150	94	17	1.6	<1.7	<1.7	<1.7
LP-3	3-5	3300	132	110	460	-----	-----	-----	-----	-----	-----
P-15	3-5	26	420	46	29	<7.5	9.3	48	0.8	7.3	32
P-29	15-17	365	66	2.1	50	44	8	66	<1.6	4.8	<1.6
P-18	9-10	369	620	69	<19	150	4.8	8.7	<1.5	<1.5	<1.5
MW-Ju	10-11	107	229	401	43	92	4.1	<2.4	<2.4	<2.4	<2.4

TABLE A4.1 - Primary GW-COC Associations in Soil - ICS/NWC Property

Location	Spl. Depth (feet)	PCBs (ug/kg)	DRO+RRO (mg/kg)	Lead (mg/kg)	PCP (ug/kg)	GRO (mg/kg)	Benzene (ug/kg)	Ethyl-benzene (ug/kg)	PCE ug/kg	TCE ug/kg	VC ug/kg
	Grouping Level	10000(a)	2000(a)	1000(a)	>100(b)	30(a)	30(a)	6000(a)	50(a)	30(a)	Detected
	SC-COC	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**
	GW-COC	**Yes**	**Yes (c)**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
P-18	3-5	5520	1580	38	50	46	3.4	4.4	<2.5	<2.5	<2.5
P-14	10-11.5	<3.9	<13	3.4	18	<96	2.2	1.9	<1.4	1.0	0.7
DOF-MW7	7-8	9.6	<13	3	88	<8.9	2.1	5.3	<1.2	<1.2	<1.2
DOF-MW7	11-12	8.2	<13	2.4	62	<7.8	0.8	6.7	<1.3	<1.3	<1.3
LP-3	10-12	2070	290	4.2	56	-----	-----	-----	-----	-----	-----
LP-3	15-16	1050	262	23	72	-----	-----	-----	-----	-----	-----
P-27	1-3	40	43	388	72	<8.7	2.3	<1.5	<1.5	<1.5	<1.5

Notes: (a) - Grouping level based on Method A CUL (WAC 173-340-900 - Table 745-1)
(b) - Shaded grouping based on upper 15% to 20% of sample concentrations
(c) - DRO+RRO identified as GW-COPCs for future monitoring purposes.
COCs associated with PCBs and DRO+RRO in soil
COCS associated with benzene in soil

SC - COC - Soil Contact COPC
GW - COC - Groundwater COPC
----- - Not analyzed
< - Not detected - less than
COC Scattered

TABLE A5.1 - Summary of COC Cleanup Levels

Constituent of Concern	Embayment	ICS Upland							
	Sediment	Soil Leaching		Soil Contact		Contact GW	Groundwater Fm ICS Upland to Surface Water	
Receptor	Aquatic Organisms (mg/kg)(a)	Surface Water (mg/kg) (a)	Sediment (mg/kg (a)	Wildlife (mg/kg) (h)	Utility Workers (mg/kg)	Utility Workers	Aquatic Organisms (ug/l)(a)	Protect Sediment (ug/l)(a)
NAPL	-----	-----	-----	-----	-----	No NAPL or sheens on water table		
Arsenic	57/7(HH)	-----	-----	20	-----	-----	-----	-----
Total Chromium	260	27 (III)	85(III)	135	-----	(j)	27 (as Cr+3)	85 (as Cr+3)
Copper	-----	0.07	0.3	-----	-----	(j)	3.1 (b)	14 (b)
Lead	450	56	190	220	1000 (e)	-----	-----	-----
Mercury	0.41	0.03	0.11	-----	2	(j)	0.025	2
Zinc	410	100	48	570	-----	-----	-----	-----
GRO (weathered)	-----	100	na	-----	30	(j)	800	800
Benzene	-----	0.0006	10	-----	-----	(j)	1.6	30000
Ethylbenzene	-----	0.01	2700	-----	-----	(j)	21	5400000
Toluene	-----	0.04	2500	-----	-----	(j)	100	6000000
Tetrachloroethene	-----	0.002	140	-----	-----	(j)	2.9	250000
Trichloroethene	-----	2.70E-04	2	-----	-----	(j)	0.7	26000
cis-1,2-Dichloroethene	-----	-----	-----	-----	-----	(j)	na	384000
vinyl chloride	-----	5.60E-05	0.59	-----	-----	(j)	0.18	2000
DRO+RRO (weathered)	2000	-----	-----	15000	2000	(j)	500	500
1,3-Dichlorobenzene	-----	0.001	na	-----	-----	(j)	2	na
1,4-Dichlorobenzene (k)	3.1/0.11	0.05	0.008	-----	-----	(j)	60	8.9
Benzyl alcohol	0.06	-----	-----	-----	-----	-----	-----	-----
1,2-Dichlorobenzene (k)	2.3/0.04	-----	-----	-----	-----	-----	-----	-----
2,4-Dimethyl phenol	0.03	-----	-----	-----	-----	-----	-----	-----
1,2,4-Trichlorobenzene (k)	0.81/0.03	-----	-----	-----	-----	-----	-----	-----
Naphthalene	-----	0.002	0.03	-----	-----	(j)	1.4	90
2-Methylnaphthalene (k)	38/0.67	na	0.04	-----	-----	(j)	na	14
Acenaphthene (k)	16/0.50	-----	-----	-----	-----	-----	-----	-----
Fluorene (k)	23/0.54	-----	-----	-----	-----	-----	-----	-----
N-Nitrosodiphenylamine (k)	11/0.03	-----	-----	-----	-----	-----	-----	-----
Pentachlorophenol	0.36	1.80E-06	7.70E-04	-----	-----	(j)	0.025 (c)	0.88
Anthracene (k)	220/0.96	-----	-----	-----	-----	-----	-----	-----

TABLE A5.1 - Summary of COC Cleanup Levels

Constituent of Concern	Embayment	ICS Upland						
	Sediment	Soil Leaching		Soil Contact		Contact GW	Groundwater Fm ICS Upland to Surface Water	
Receptor	Aquatic Organisms (mg/kg)(a)	Surface Water (mg/kg) (a)	Sediment (mg/kg (a)	Wildlife (mg/kg) (h)	Utility Workers (mg/kg)	Utility Workers	Aquatic Organisms (ug/l)(a)	Protect Sediment (ug/l)(a)
Bis(2-ethylhexyl)phthalate	-----	0.005	0.07	-----	-----	(j)	0.20 (c)	0.62
Butylbenzylphthalate	4.9/0.06	-----	-----	-----	-----	-----	-----	-----
Benzo(a)anthracene	-----	-----	-----	-----	-----	-----	-----	-----
Chrysene	-----	-----	-----	-----	-----	-----	-----	-----
Benzo(a)pyrene	-----	-----	-----	-----	-----	-----	-----	-----
Indeno(1,2,3-cd)pyrene	-----	-----	-----	-----	-----	-----	-----	-----
Dieldrin	-----	3.10E-08	5.30E-06	-----	-----	(j)	0.0013 (c)	0.0013 (c)
cPAH (TEQ)	0.09 (HH)	-----	-----	-----	-----	-----	0.01 (c)	0.01 (c)
4,4-DDE +-DDD+-DDT	-----	na	na	1	-----	-----	-----	-----
4,4-DDE	-----	8.70E-05	4.50E-01	-----	-----	(j)	0.0013 (c)	3.8
4,4'-DDD	-----	3.60E-07	2.90E-01	-----	-----	(j)	0.0013 (c)	7.9
4,4'-DDT	-----	8.10E-07	5.30E-06	-----	-----	(j)	0.0013 (c)	0.0013 (c)
trans-chlordane	-----	na	7.00E-06	-----	-----	(j)	0.0004	0.0001
cis-chlordane	-----	na	7.00E-06	-----	-----	(j)	0.0004	0.0001
Total Aroclor PCBs (dw)	12/0.13	5.50E-07	0.007	2	10(d)	(j)	0.01 (c)	0.02
Total Congener PCBs (dw)	0.13	5.50E-07	1.10E-04	-----	-----	-----	0.0001 (c)	0.0003
2,3,7,8 TCDD (ng TEQ/kg-dw)	2	-----	-----	-----	-----	-----	-----	-----

Notes:
(a) - Sediment and surface water (SW) CULs updated using the LDW Wookbook (August 2022). CULs for aquatic organisms are protective of human visitors.
(b) - As dissolved fraction. (c) - Based on PQL
(d) - Assumes environmental cap is placed and maintained. (e) - Assumes industrial landuse w/o environmental cap
(f) - Groundwater (GW) discharge to marine surface water. CULs to protect drinking water - DW (LDW Wookbook August 2022). Unadjusted for incidental ingestion (significantly reduced possible exposure). CULs for aquatic organisms are protective of recreational human visitors.
(g) - From CLARC (Feb. 2021) - Method B CULs if available; Method A if Method B not available. Unadjusted for incidental ingestion (significantly reduced exposure. CULs for aquatic organisms are protective of recreational human visitors except for cPAH-TEQ.
(h) - Applies to unpaved portion of ICS upland property.
(i) - Based on background.
(j) - CULs not available. Highest concentrations below DW CULs or acceptable risk levels (see Tbl. A3.3).
(k) - Sediment aquatic organism CUL - Organic carbon normalized/dry weight (AET if TOC <0.5% or >3.5%).
----- - Not a COC for indicated media or not available. HH - ROD CUL to protect human health.

TABLE A5.1 - Summary of COC Cleanup Levels

Douglas Upland	
Groundwater Fm. Douglas Upland to Surface Water	
Aquatic Organisms (ug/l)(a)	Protect Sediment (ug/l)(a)
-----	-----
-----	-----
-----	-----
-----	-----
-----	-----
-----	-----
-----	-----
-----	-----
1.6	30000
-----	-----
-----	-----
-----	-----
-----	-----
-----	-----
-----	-----
500	500
-----	-----
-----	-----
-----	-----
-----	-----
-----	-----
-----	-----
1.4	90
-----	-----
-----	-----
-----	-----
-----	-----
-----	-----
-----	-----

TABLE A5.1 - Summary of COC Cleanup Levels

Douglas Upland	
Groundwater Fm. Douglas Upland to Surface Water	
Aquatic Organisms (ug/l)(a)	Protect Sediment (ug/l)(a)
-----	-----
-----	-----
0.01 (c)	see cPAH TEQ
0.016	
0.01 (c)	
0.01 (c)	
-----	-----
0.01	0.01 (c)
-----	-----
-----	-----
-----	-----
-----	-----
-----	-----
-----	-----
0.01 (c)	0.02
0.0001 (c)	0.0003
-----	0.0003

Notes:
(a) - Sediment and surface water (SW) CULs updated using the LDW Wookbook (August 2022). CULs for aquatic organisms are protective of human visitors.
(b) - As dissolved fraction. (c) - Based on PQL
(d) - Assumes environmental cap is placed and maintained. (e) - Assumes industrial landuse w/o environmental cap
(f) - Groundwater (GW) discharge to marine surface water. CULs to protect drinking water - DW (LDW Wookbook August 2022). Unadjusted for incidental ingestion (significantly reduced possible exposure). CULs for aquatic organisms are protective of recreational human visitors.
(g) - From CLARC (Feb. 2021) - Method B CULs if available; Method A if Method B not available. Unadjusted for incidental ingestion (significantly reduced exposure. CULs for aquatic organisms are protective of recreational human visitors except for cPAH-TEQ.
(h) - Applies to unpaved portion of ICS upland property.
(i) - Based on background.
(j) - CULs not available. Highest concentrations below DW CULs or acceptable risk levels (see Tbl. A3.3).
(k) - Sediment aquatic organism CUL - Organic carbon normalized/dry weight (AET if TOC <0.5% or >3.5%).
----- - Not a COC for indicated media or not available. HH - ROD CUL to protect human health.

TABLE A7.1 - Subsurface Sediment Sample Analyses - Comparison w/ Human Health CULs

Core Location	Mid-Point Depth (feet)	Depth to Top of Silt (feet)	% solids %	Wet density lb/ft^3	Moisture content %	Dry density lb/ft^3	TOC %	Arsenic mg/kg, dry	Detected Total PCBs µg/kg, dry	TEQ Sum BaPEq µg/kg, dry
							ROD Human Health CUL (a)	**7**	**2**	**90**
							ROD Point of Compliance (cm)	**0-45**	**0-45**	**0-45**
ICS-A-SE-2	1.3	3.3	76	-----	-----	-----	1.37	**12**	**2,370**	-----
ICS-A-SE-3	2.7			-----	-----	-----	-----	-----	-----	-----
ICS-A-SE-4	3.9		61	-----	-----	-----	2.77	**10**	**99**	**69**
ICS-A-SE-5	5.1		66	-----	-----	-----	1.61	**7**	**27**	**8**
ICS-A-SE-6	6.3		59	-----	-----	-----	3.22	**10**	4.8 U	**11**
ICS-A-SE-7	7.2		62	-----	-----	-----	4.22	**9**	6.3 U	**12**
ICS-B-SE-1	1.1	2.9	65	-----	-----	-----	0.775	**20**	**430**	-----
ICS-B-SE-2	2.2		-----	-----	-----	-----	-----	-----	-----	-----
ICS-B-SE-3	3.3		49	-----	-----	-----	3.96	**31**	**29,200**	**717**
ICS-B-SE-4	4.4		64	-----	-----	-----	3.37	**9**	**44,100**	**287**
ICS-B-SE-5	5.5		61	-----	-----	-----	3.64	**8**	**97**	**8**
ICS-B-SE-6	6.6		60	100.6	65.8	60.7	2.66	**10**	5.6 U	**11**
ICS-C-SE-1	0.5	2.5	-----	-----	-----	-----	-----	-----	-----	-----
ICS-C-SE-2	2.3		73	-----	-----	-----	0.894	**6**	**55**	-----
ICS-C-SE-3	3.3		62	-----	-----	-----	2.29	**7**	3.8 U	**5**
ICS-C-SE-4	4.4		80	-----	-----	-----	1.57	**4**	3.9 U	**41**
ICS-D-SE-1	0.7	2.9	-----	-----	-----	-----	-----	-----	-----	-----
ICS-D-SE-2	2.1		66	-----	-----	-----	6.91	**15**	**17,000**	-----
ICS-D-SE-3	3.8		65	-----	-----	-----	2.07	**9**	**67**	**77**
ICS-D-SE-4	5.3		62	-----	-----	-----	2.70	**9**	3.9 U	**10**
ICS-D-SE-5	6.7		61	-----	-----	-----	2.26	**9**	3.9 U	**13**
ICS-F-SE-1	0.5	2.4	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-2	1.7		56	-----	-----	-----	3.15	**13**	**330**	**293**
ICS-F-SE-3	3.1		-----	99.5	70.8	58.3	-----	-----	-----	-----
ICS-F-SE-4	4.5		60	-----	-----	-----	2.22	**9**	4 U	**10**
ICS-F-SE-5	5.8		60	-----	-----	-----	2.67	**11**	4 U	-----
ICS-F-SE-6	7		-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-7	8.3		66	-----	-----	-----	1.26	**6**	3.9 U	**5**
ICS-F-SE-8	9.7		76	115.7	28.5	90.1	0.436	**2**	3.9 U	**0**

TABLE A7.1 - Subsurface Sediment Sample Analyses - Comparison w/ Human Health CULs

Core Location	Mid-Point Depth (feet)	Depth to Top of Silt (feet)	% solids %	Wet density lb/ft^3	Moisture content %	Dry density lb/ft^3	TOC %	Arsenic mg/kg, dry	Detected Total PCBs µg/kg, dry	TEQ Sum BaPEq µg/kg, dry
							ROD Human Health CUL (a)	**7**	**2**	**90**
ICS-G-SE-1	0.6	2.4	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-2	1.8		-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-3	3		63	-----	-----	-----	1.78	**12**	**1,550**	-----
ICS-G-SE-4	4.1		-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-5	5.1		58	-----	-----	-----	1.85	**25**	**10,000**	**195**
ICS-G-SE-6	6.8		60	-----	-----	-----	1.60	**12**	4 U	**161**
ICS-H-SE-1	0.4	2.5	-----	-----	-----	-----	-----	-----	-----	-----
ICS-H-SE-2	1.7		79	-----	-----	-----	2.00	**5**	**18,100**	-----
ICS-H-SE-3	3.3		69	-----	-----	-----	3.41	**7**	**38,100**	**382**
ICS-H-SE-4	4.7		74	-----	-----	-----	0.856	**3**	**260**	**4**
ICS-I-SE-1	0.9	3.2	-----	-----	-----	-----	-----	-----	-----	-----
ICS-I-SE-2	2.6		70	-----	-----	-----	3.13	**10**	**13,000**	-----
ICS-I-SE-3	4.2		58	96.2	84.7	52.1	2.28	**7**	**395**	**554**
ICS-I-SE-4	5.9		61	-----	-----	-----	2.84	**11**	**143**	**14**
ICS-I-SE-5	7.8		67	114	35.6	84.1	1.02	**5**	**42**	**532**
ICS-I-SE-6	9.5		-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-1	0.8	1.5	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-2	2.6		-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-3	4.9		56	-----	-----	-----	2.31	**26**	**337**	-----
ICS-J-SE-4	6.8		66	-----	-----	-----	0.96	**6**	4 U	**6**
ICS-J-SE-5	8.5		67	-----	-----	-----	1.33	**6**	3.8 U	**112**
ICS-J-SE-6	10.4		63	-----	-----	-----	1.55	**7**	3.9 U	**104**
ICS-K-SE-1	0.7	4.3	-----	-----	-----	-----	-----	-----	-----	-----
ICS-K-SE-2	2.2		57	-----	-----	-----	2.37	**11**	**13,000**	
ICS-K-SE-3	3.8		88	-----	-----	-----	0.88	**4**	**1,610**	**31**
ICS-K-SE-4	5.5		60	-----	-----	-----	2.31	**21**	**103**	**56**
ICS-K-SE-5	7		73	-----	-----	-----	1.83	**7**	3.7 U	**167**
ICS-L-SE-1	0.7	2.5	-----	-----	-----	-----	-----	-----	-----	-----
ICS-L-SE-2	1.9		74	-----	-----	-----	1.66	**6**	**2,310**	-----
ICS-L-SE-3	3.5		62	-----	-----	-----	1.55	**7**	**23**	**145**
ICS-L-SE-4	5		70	-----	-----	-----	1.44	**6**	3.9 U	**13**
ICS-L-SE-5	6.7		-----	-----	-----	-----	-----	-----	-----	-----

TABLE A7.1 - Subsurface Sediment Sample Analyses - Comparison w/ Human Health CULs

Core Location	Mid-Point Depth (feet)	Depth to Top of Silt (feet)	% solids %	Wet density lb/ft^3	Moisture content %	Dry density lb/ft^3	TOC %	Arsenic mg/kg, dry	Detected Total PCBs µg/kg, dry	TEQ Sum BaPEq µg/kg, dry
							ROD Human Health CUL (a)	**7**	**2**	**90**
ICS-M-SE-1	0.6	0	66	-----	-----	-----	2.55	**8**	**1,110**	-----
ICS-M-SE-2	1.6		84	-----	-----	-----	2.95	**3**	**312**	**12**
ICS-M-SE-3	2.7		80	-----	-----	-----	0.283	**1**	3.7 U	nd
LDW-SC40	0.7	0.5	73	-----	-----	-----	0.75	**7**	**160**	**47**
LDW-SC40	1.7		81	-----	-----	-----	0.33	6 U	4 U	20 U
LDW-SC40	3		82	-----	-----	-----	0.21	6 U	4 U	20 U
HS-6	2-3	+3	-----	-----	-----	-----	-----	-----	**42**	-----
HS-7	3-4	+4	-----	-----	-----	-----	-----	-----	**61,800**	-----
HS-8	2.5-3.5	+3.5	-----	-----	-----	-----	-----	-----	**37,320**	-----
HSA-1	1-2	1	-----	-----	-----	-----	-----	-----	**54,900**	-----
HSA-1	2-3		-----	-----	-----	-----	-----	-----	**5,785**	-----
HSA-1	3-4		-----	-----	-----	-----	-----	-----	**632**	-----
HSA-1	4.5-5		-----	-----	-----	-----	-----	-----	**12,740**	-----
HSA-2	2-3	+5	-----	-----	-----	-----	-----	-----	**129,600**	-----
HSA-2	3-4		-----	-----	-----	-----	-----	-----	**47,070**	-----
HSA-2	4-5		-----	-----	-----	-----	-----	-----	**6,240**	-----
HSA-3	2-3	2	-----	-----	-----	-----	-----	-----	**43,410**	-----
HSA-3	3-3.5		-----	-----	-----	-----	-----	-----	**4,212**	-----
HSA-3	5-6		-----	-----	-----	-----	-----	-----	**67**	-----
HSA-4	2-3	+7	-----	-----	-----	-----	-----	-----	**171,400**	-----
HSA-4	3-4		-----	-----	-----	-----	-----	-----	**15,530**	-----
HSA-4	4-5		-----	-----	-----	-----	-----	-----	**33,200**	-----
HSA-4	5-6		-----	-----	-----	-----	-----	-----	**2,914**	-----
HSA-4	6-7		-----	-----	-----	-----	-----	-----	**2,003**	-----

Notes: U = Not detected at the associated lower reporting limit.
nd - Not detected
(a) -Human health CUL from Table 19. To be achieved at point of compliance after cleanup is complete (including natural recovery or enhanced natural recovery).
- Higher than human health CUL

TABLE A7.2 - Subsurface Sediment Sample Analyses - Comparison w/ Benthic CULs

Core Location	Mid-Point Depth (feet)	Depth to Top of Silt (feet)	% solids %	Wet density lb/ft^3	Moisture content %	Dry density lb/ft^3	TOC %	Arsenic mg/kg, dry	Total Chromium mg/kg, dry	Lead mg/kg, dry	Mercury mg/kg, dry	Zinc mg/kg, dry
ROD Benthic CUL								**57**	**260**	**450**	**0.41**	**410**
ROD Point of Compliance (cm)								**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-A-SE-2	1.3	3.3	76	-----	-----	-----	1.37	**12**	**20**	**87**	**0.24**	**111**
ICS-A-SE-3	2.7			-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-A-SE-4	3.9		61	-----	-----	-----	2.77	**10**	**22**	**10**	**0.17**	**61**
ICS-A-SE-5	5.1		66	-----	-----	-----	1.61	**7**	**22**	**11**	**0.12**	**52**
ICS-A-SE-6	6.3		59	-----	-----	-----	3.22	**10**	**26**	**12**	**0.15**	**72**
ICS-A-SE-7	7.2		62	-----	-----	-----	4.22	**9**	**23**	**10**	**0.14**	**63**
ICS-B-SE-1	1.1	2.9	65	-----	-----	-----	0.775	**20**	**23**	**15**	**0.04**	**80**
ICS-B-SE-2	2.2		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-B-SE-3	3.3		49	-----	-----	-----	3.96	**31**	**153**	**796**	**13 J**	**670**
ICS-B-SE-4	4.4		64	-----	-----	-----	3.37	**9**	**46**	**218**	**1.8 J**	**286**
ICS-B-SE-5	5.5		61	-----	-----	-----	3.64	**8**	**24**	**12**	**0.13**	**65**
ICS-B-SE-6	6.6		60	100.6	65.8	60.7	2.66	**10**	**25**	**13**	**0.19 J**	**74**
ICS-C-SE-1	0.5	2.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-C-SE-2	2.3		73	-----	-----	-----	0.894	**6**	**11**	**13**	**0.04**	**31**
ICS-C-SE-3	3.3		62	-----	-----	-----	2.29	**7**	**19**	**8**	**0.12**	**53**
ICS-C-SE-4	4.4		80	-----	-----	-----	1.57	**4**	**11**	**8**	**0.03**	**26**
ICS-D-SE-1	0.7	2.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-D-SE-2	2.1		66	-----	-----	-----	6.91	**15**	**431**	**4,430**	**39**	**3240**
ICS-D-SE-3	3.8		65	-----	-----	-----	2.07	**9**	**25**	**28**	**2**	**79**
ICS-D-SE-4	5.3		62	-----	-----	-----	2.70	**9**	**27**	**11**	**0.14**	**68**
ICS-D-SE-5	6.7		61	-----	-----	-----	2.26	**9**	**25**	**12**	**0.15 J**	**67**
ICS-F-SE-1	0.5	2.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-2	1.7		56	-----	-----	-----	3.15	**13**	**114**	**4,380**	**0.29 J**	**1420**
ICS-F-SE-3	3.1		-----	99.5	70.8	58.3	-----	-----	-----	-----	-----	-----
ICS-F-SE-4	4.5		60	-----	-----	-----	2.22	**9**	**25**	**12**	**0.16 J**	**70**
ICS-F-SE-5	5.8		60	-----	-----	-----	2.67	**11**	**24**	**17**	**0.17**	**66**
ICS-F-SE-6	7		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-7	8.3		66	-----	-----	-----	1.26	**6**	**18**	**12**	**0.09**	**54**
ICS-F-SE-8	9.7		76	115.7	28.5	90.1	0.436	**2**	**12**	**2**	**0.02**	**28**
ICS-F-SE-9	10.9		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

TABLE A7.2 - Subsurface Sediment Sample Analyses - Comparison w/ Benthic CULs

Core Location	Mid-Point Depth (feet)	Depth to Top of Silt (feet)	% solids %	Wet density lb/ft^3	Moisture content %	Dry density lb/ft^3	TOC %	Arsenic mg/kg, dry	Total Chromium mg/kg, dry	Lead mg/kg, dry	Mercury mg/kg, dry	Zinc mg/kg, dry
ROD Benthic CUL								**57**	**260**	**450**	**0.41**	**410**
ROD Point of Compliance (cm)								**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-G-SE-1	0.6	2.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-2	1.8		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-3	3		63	-----	-----	-----	1.78	**12**	**24**	**23**	**0.20**	**91**
ICS-G-SE-4	4.1		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-5	5.1		58	-----	-----	-----	1.85	**25**	**112**	**1,340**	**0.49**	**840**
ICS-G-SE-6	6.8		60	-----	-----	-----	1.60	**12**	**23**	**34**	**0.20**	**81**
ICS-H-SE-1	0.4	2.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-H-SE-2	1.7		79	-----	-----	-----	2.00	**5**	**60**	**168**	**0.39**	**149**
ICS-H-SE-3	3.3		69	-----	-----	-----	3.41	**7**	**96**	**936**	**4.9**	**377**
ICS-H-SE-4	4.7		74	-----	-----	-----	0.856	**3**	**14**	**7**	**0.04**	**37**
ICS-I-SE-1	0.9	3.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-I-SE-2	2.6		70	-----	-----	-----	3.13	**10**	**25**	**123**	**1.8**	**109**
ICS-I-SE-3	4.2		58	96.2	84.7	52.1	2.28	**7**	**18**	**25**	**0.30**	**60**
ICS-I-SE-4	5.9		61	-----	-----	-----	2.84	**11**	**26**	**39**	**0.24 J**	**91**
ICS-I-SE-5	7.8		67	114	35.6	84.1	1.02	**5**	**14**	**19**	**0.14**	**40**
ICS-I-SE-6	9.5		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-1	0.8	1.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-2	2.6		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-3	4.9		56	-----	-----	-----	2.31	**26**	**64**	**224**	**0.29**	**201**
ICS-J-SE-4	6.8		66	-----	-----	-----	0.96	**6**	**16**	**11**	**0.08 J**	**51**
ICS-J-SE-5	8.5		67	-----	-----	-----	1.33	**6**	**15**	**14**	**0.11**	**44**
ICS-J-SE-6	10.4		63	-----	-----	-----	1.55	**7**	**18**	**22**	**0.11**	**56**
ICS-K-SE-1	0.7	4.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-K-SE-2	2.2		57	-----	-----	-----	2.37	**11**	**52**	**310**	**2.0**	**213**
ICS-K-SE-3	3.8		88	-----	-----	-----	0.88	**4**	**26**	**79**	**0.38**	**70**
ICS-K-SE-4	5.5		60	-----	-----	-----	2.31	**21**	**45**	**241**	**0.21**	**143**
ICS-K-SE-5	7		73	-----	-----	-----	1.83	**7**	**15**	**18**	**0.12**	**46**
ICS-L-SE-1	0.7	2.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-L-SE-2	1.9		74	-----	-----	-----	1.66	**6**	**24**	**87**	**0.34**	**82**
ICS-L-SE-3	3.5		62	-----	-----	-----	1.55	**7**	**18**	**62**	**0.63**	**89**
ICS-L-SE-4	5		70	-----	-----	-----	1.44	**6**	**18**	**12**	**0.31**	**52**

TABLE A7.2 - Subsurface Sediment Sample Analyses - Comparison w/ Benthic CULs

Core Location	Mid-Point Depth (feet)	Depth to Top of Silt (feet)	% solids %	Wet density lb/ft^3	Moisture content %	Dry density lb/ft^3	TOC %	Arsenic mg/kg, dry	Total Chromium mg/kg, dry	Lead mg/kg, dry	Mercury mg/kg, dry	Zinc mg/kg, dry
ROD Benthic CUL								**57**	**260**	**450**	**0.41**	**410**
ROD Point of Compliance (cm)								**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-M-SE-1	0.6	0	66	-----	-----	-----	2.55	**8**	**22**	**58**	**0.21**	**116**
ICS-M-SE-2	1.6		84	-----	-----	-----	2.95	**3**	**13**	**24**	**0.04**	**48**
ICS-M-SE-3	2.7		80	-----	-----	-----	0.283	**1**	**9**	**2**	0.3 U	**21**
LDW-SC40	0.7	0.5	73	-----	-----	-----	0.75	**7**	**14**	**18**	0.05	**47**
LDW-SC40	1.7		81	-----	-----	-----	0.33	6 U	**17**	**44**	0.05 U	**27**
LDW-SC40	3		82	-----	-----	-----	0.21	6 U	**12**	2 U	0.05 U	**25**
HS-6	2-3	+3	-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----
HS-7	3-4	+4	-----	-----	-----	-----	2.1(b)	-----	-----	**1280**	**31**	-----
HS-8	2.5-3.5	+3.5	-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----
HSA-1	1-2	1	-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----
HSA-1	2-3		-----	-----	-----	-----	2.1(b)	-----	-----	**880**	-----	-----
HSA-1	3-4		-----	-----	-----	-----	2.1(b)	-----	-----	**36**	**0.26**	-----
HSA-1	4.5-5		-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----
HSA-2	2-3	+5	-----	-----	-----	-----	2.1(b)	-----	-----	**12400**	-----	-----
HSA-2	3-4		-----	-----	-----	-----	2.1(b)	-----	-----	**8440**	**1.2**	-----
HSA-2	4-5		-----	-----	-----	-----	2.1(b)	-----	-----	**4050**	-----	-----
HSA-3	2-3	2	-----	-----	-----	-----	2.1(b)	-----	-----	**7290**	-----	-----
HSA-3	3-3.5		-----	-----	-----	-----	2.1(b)	-----	-----	**609**	**2**	-----
HSA-3	5-6		-----	-----	-----	-----	2.1(b)	-----	-----	**16**	-----	-----
HSA-4	2-3	+7	-----	-----	-----	-----	2.1(b)	-----	-----	**14900**	**52**	-----
HSA-4	3-4		-----	-----	-----	-----	2.1(b)	-----	-----	**7200**	**3**	-----
HSA-4	4-5		-----	-----	-----	-----	2.1(b)	-----	-----	**1110**	-----	-----
HSA-4	5-6		-----	-----	-----	-----	2.1(b)	-----	-----	**213**	-----	-----
HSA-4	6-7		-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----

Notes: U = Not detected at the associated lower reporting limit. Values greater than the CUL are shown in bold type.
J = Estimated value
nd - Not detected na - Not available
CUL - Cleanup Level from ROD Tables 19 and 20
OC - Organic carbon normalized
(a) - ROD CUL not available. Value based on MTCA Method A.

(b) - Based on average TOC content in subsurface embayment sediment.

- Exceeds CUL

TABLE A7.2 - Subsurface Sediment Sample Analyses - Comparison w/ Benthic CULs

Core Location	Mid-Point Depth (feet)	DRO+RRO mg/kg,dry	2,4-Dimethyl-phenol µg/kg, dry	Benzyl alcohol µg/kg, dry	Penta-chloro-phenol µg/kg, dry	Acenaph-thene µg/kg, OC	Anthra-cene µg/kg, OC	Fluorene µg/kg, OC	Butyl-benzyl-phthalate µg/kg, OC	1,2-Dichloro-benzene µg/kg, OC
ROD Benthic CUL		2000(a)	29	57	360	16000	220000	23000	4900	2300
ROD Point of Compliance (cm)		0-10	0-10	0-10	0-10	0-10	0-10	0-10	0-10	0-10
ICS-A-SE-2	1.3	630	-----	-----	-----	-----	-----	-----	-----	-----
ICS-A-SE-3	2.7	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-A-SE-4	3.9	84	15 J	130	18 J	1,661	1,625	1841	177 U	235
ICS-A-SE-5	5.1	72	4.6 J	130	48 U	1,304	1,366	2050	298 U	621
ICS-A-SE-6	6.3	87	25 U	190	20 U	839	901	1366	255	155 U
ICS-A-SE-7	7.2	121	24 U	140	19 U	592	782	924	156	114 U
ICS-B-SE-1	1.1	85	-----	-----	-----	-----	-----	-----	-----	-----
ICS-B-SE-2	2.2	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-B-SE-3	3.3	14,300	58	57 U	800	22,980	15,152	11364	1,187	2,449
ICS-B-SE-4	4.4	14,200	120	52 U	52 U	6,528	4,748	7715	386 U	4,451
ICS-B-SE-5	5.5	114	5.4 J	150	49 U	797	714	1236	135 U	604
ICS-B-SE-6	6.6	147	25 U	160	20 U	1,203	1,053	2030	195	184 U
ICS-C-SE-1	0.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-C-SE-2	2.3	91	-----	-----	-----	-----	-----	-----	-----	-----
ICS-C-SE-3	3.3	66	92	54	46 U	917	655	961	140	201 U
ICS-C-SE-4	4.4	61	22	20 U	49 U	1,465	892	828	312 U	178
ICS-D-SE-1	0.7	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-D-SE-2	2.1	21,900	-----	-----	-----	-----	-----	-----	-----	-----
ICS-D-SE-3	3.8	103	82	41	48 U	1,643	1,884	2464	232 U	3,671
ICS-D-SE-4	5.3	71	4.3 J	100	50 U	1,148	1,111	1889	185 U	185 U
ICS-D-SE-5	6.7	119	24 U	170	19 U	1,018	1,504	1770	221	212 U
ICS-F-SE-1	0.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-2	1.7	14,100	890	59 U	59 U	31,111	13,968	158730	476 U	302
ICS-F-SE-3	3.1	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-4	4.5	115	24 U	120	20 U	991	1,081	1892	221 U	221 U
ICS-F-SE-5	5.8	89	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-6	7	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-7	8.3	43	20 U	42	49 U	1587 U	1,270	1587	389 U	389 U
ICS-F-SE-8	9.7	13 U	18 U	18 U	46 U	4128 U	4128 U	4128 U	1055 U	1055 U
ICS-F-SE-9	10.9	-----	-----	-----	-----	-----	-----	-----	-----	-----

TABLE A7.2 - Subsurface Sediment Sample Analyses - Comparison w/ Benthic CULs

Core Location	Mid-Point Depth (feet)	DRO+RRO mg/kg,dry	2,4-Dimethyl-phenol µg/kg, dry	Benzyl alcohol µg/kg, dry	Penta-chloro-phenol µg/kg, dry	Acenaph-thene µg/kg, OC	Anthra-cene µg/kg, OC	Fluorene µg/kg, OC	Butyl-benzyl-phthalate µg/kg, OC	1,2-Dichloro-benzene µg/kg, OC
ROD Benthic CUL		**2000(a)**	**29**	**57**	**360**	**16000**	**220000**	**23000**	**4900**	**2300**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-G-SE-1	0.6	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-2	1.8	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-3	3	**225**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-4	4.1	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-5	5.1	**16,300**	**58 J**	**110 U**	**880 J**	**17,838**	**39,459**	**64865**	**9,189**	1568 U
ICS-G-SE-6	6.8	**193**	**4.9 J**	**61**	48 U	**2,125**	**3,688**	**3250**	300 U	**200**
ICS-H-SE-1	0.4	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-H-SE-2	1.7	**880**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-H-SE-3	3.3	**3,400**	**15 J**	26 U	**190 J**	**7,038**	**8,798**	**14370**	**1,496**	**2,933**
ICS-H-SE-4	4.7	**78**	**6.4 J**	19 U	49 U	2220 U	2220 U	**1869**	572 U	**864**
ICS-I-SE-1	0.9	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-I-SE-2	2.6	**850**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-I-SE-3	4.2	**206**	**57 U**	**36 J**	140 U	**3,377**	**4,254**	**2281**	614 U	614 U
ICS-I-SE-4	5.9	**181**	24 U	**72**	19 U	**10,211**	**880**	**2077**	**335**	**106**
ICS-I-SE-5	7.8	**710**	18 U	18 U	46 U	**50,980**	**14,706**	**4020**	451 U	451 U
ICS-I-SE-6	9.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-1	0.8	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-2	2.6	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-3	4.9	**3,000**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-4	6.8	**112**	24 U	**37**	19 U	**1,977**	**2,081**	**2185**	**4,995**	489 U
ICS-J-SE-5	8.5	**95**	**3.0 J**	**27**	47 U	**3,308**	**4,286**	**2632**	353 U	353 U
ICS-J-SE-6	10.4	**99**	19 U	**44**	48 U	**1,484**	**2,129**	**1355**	309 U	310 U
ICS-K-SE-1	0.7	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-K-SE-2	2.2	**1,760**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-K-SE-3	3.8	**250**	24 U	19 U	19 U	**2,048**	**1,706**	**1365**	**580**	**353**
ICS-K-SE-4	5.5	**1,060**	**11 J**	**57**	**59 J**	**2,684**	**1,905**	**2121**	216 U	216 U
ICS-K-SE-5	7	**83**	20 U	20 U	49 U	**4,372**	**3,880**	**2131**	268 U	268 U
ICS-L-SE-1	0.7	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-L-SE-2	1.9	**2,600**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-L-SE-3	3.5	**197**	**6.4 J**	**25**	49 U	**4,258**	**4,194**	**3806**	316 U	316 U
ICS-L-SE-4	5	**66**	**3.5 J**	**27**	48 U	**1,597**	**2,569**	**3125**	333 U	333 U

TABLE A7.2 - Subsurface Sediment Sample Analyses - Comparison w/ Benthic CULs

Core Location	Mid-Point Depth (feet)	DRO+RRO mg/kg,dry	2,4-Dimethyl-phenol µg/kg, dry	Benzyl alcohol µg/kg, dry	Penta-chloro-phenol µg/kg, dry	Acenaph-thene µg/kg, OC	Anthra-cene µg/kg, OC	Fluorene µg/kg, OC	Butyl-benzyl-phthalate µg/kg, OC	1,2-Dichloro-benzene µg/kg, OC
ROD Benthic CUL		**2000(a)**	**29**	**57**	**360**	**16000**	**220000**	**23000**	**4900**	**2300**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-M-SE-1	0.6	**215**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-M-SE-2	1.6	**45**	20 U	20 U	49 U	678 U	678 U	678 U	166 U	166 U
ICS-M-SE-3	2.7	12 U	19 U	19 U	47 U	6714 U	6714 U	6714 U	1661 U	1661 U
LDW-SC40	0.7	-----	6 U	30 U	30 U	nd	**43**	nd	**13**	nd
LDW-SC40	1.7	-----	5.9 U	30 U	30 U	nd	nd	nd	nd	nd
LDW-SC40	3	-----	6 U	30 U	30 U	nd	nd	nd	nd	nd
HS-6	2-3	-----	-----	-----	-----	-----	-----	-----	-----	-----
HS-7	3-4	**13010**	-----	-----	-----	-----	-----	-----	-----	-----
HS-8	2.5-3.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-1	1-2	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-1	2-3	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-1	3-4	**452**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-1	4.5-5	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-2	2-3	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-2	3-4	**44800**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-2	4-5	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-3	2-3	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-3	3-3.5	**2736**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-3	5-6	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	2-3	**142400**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	3-4	**46200**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	4-5	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	5-6	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	6-7	-----	-----	-----	-----	-----	-----	-----	-----	-----

Notes: U = Not detected at the associated lower reporting limit. Values greater than CUL are shown in bold type.
J = Estimated value
nd - Not detected
na - Not available
- Exceeds CUL
CUL - Cleanup Level from ROD Tables 19 and 20
OC - Organic carbon normalized
(a) - ROD CUL not available. Value based on MTCA Method A.

TABLE A7.2 - Subsurface Sediment Sample Analyses - Comparison w/ Benthic CULs

Core Location	Mid-Point Depth (feet)	1,4-Dichloro-benzene µg/kg, OC	1,2,4-Tri-chloro-benzene µg/kg, OC	2-Methyl-naph-thalene µg/kg, OC	n-Nitroso-dipheny-lomine µg/kg, OC	Detected Total PCBs µg/kg, OC
ROD Benthic CUL		**3100**	**810**	**38000**	**11000**	**12000**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-A-SE-2	1.3	-----	-----	-----	-----	**172,993**
ICS-A-SE-3	2.7	-----	-----	-----	-----	-----
ICS-A-SE-4	3.9	**108**	**249**	**1,480**	722 U	**3,574**
ICS-A-SE-5	5.1	**180**	298 U	**2,112**	**683**	**1,683**
ICS-A-SE-6	6.3	155 U	155 U	**1,366**	155 U	149 U
ICS-A-SE-7	7.2	114 U	114 U	**924**	114 U	149 U
ICS-B-SE-1	1.1	-----	-----	-----	-----	**55,484**
ICS-B-SE-2	2.2	-----	-----	-----	-----	-----
ICS-B-SE-3	3.3	**7,576**	**1,667**	**6,566**	1439 U	**737,374**
ICS-B-SE-4	4.4	**10,979**	**1,543**	**5,341**	386 U	**1,308,605**
ICS-B-SE-5	5.5	**604**	135 U	**1,209**	**181**	**2,665**
ICS-B-SE-6	6.6	184 U	184 U	**1,805**	184 U	211 U
ICS-C-SE-1	0.5	-----	-----	-----	-----	-----
ICS-C-SE-2	2.3	-----	-----	-----	-----	**6,152**
ICS-C-SE-3	3.3	201 U	201 U	**568**	**105**	166 U
ICS-C-SE-4	4.4	**2,102**	312 U	1274 U	1274 U	229 U
ICS-D-SE-1	0.7	-----	-----	-----	-----	-----
ICS-D-SE-2	2.1	-----	-----	-----	-----	**246,020**
ICS-D-SE-3	3.8	**725**	232 U	**25,121**	**295**	**3,237**
ICS-D-SE-4	5.3	185 U	185 U	**1,667**	**130**	144 U
ICS-D-SE-5	6.7	212 U	212 U	**2,788**	212 U	173 U
ICS-F-SE-1	0.5	-----	-----	-----	-----	-----
ICS-F-SE-2	1.7	**349**	476 U	**1,968,254**	476 U	**10,476**
ICS-F-SE-3	3.1	-----	-----	-----	-----	-----
ICS-F-SE-4	4.5	221 U	221 U	**5,405**	221 U	180 U
ICS-F-SE-5	5.8	-----	-----	-----	-----	150 U
ICS-F-SE-6	7	-----	-----	-----	-----	-----
ICS-F-SE-7	8.3	389 U	389 U	**1,587**	1587 U	310 U
ICS-F-SE-8	9.7	1055 U	**1055 U**	4128 U	4128 U	849 U
ICS-F-SE-9	10.9	-----	-----	-----	-----	-----

TABLE A7.2 - Subsurface Sediment Sample Analyses - Comparison w/ Benthic CULs

Core Location	Mid-Point Depth (feet)	1,4-Dichloro-benzene µg/kg, OC	1,2,4-Tri-chloro-benzene µg/kg, OC	2-Methyl-naph-thalene µg/kg, OC	n-Nitroso-dipheny-lomine µg/kg, OC	Detected Total PCBs µg/kg, OC
ROD Benthic CUL		3100	810	38000	11000	12000
ROD Point of Compliance (cm)		0-10	0-10	0-10	0-10	0-10
ICS-G-SE-1	0.6	-----	-----	-----	-----	-----
ICS-G-SE-2	1.8	-----	-----	-----	-----	-----
ICS-G-SE-3	3	-----	-----	-----	-----	**87,079**
ICS-G-SE-4	4.1	-----	-----	-----	-----	-----
ICS-G-SE-5	5.1	**7,568**	**1568 U**	**11,892**	**97,297**	**540,541**
ICS-G-SE-6	6.8	300 U	300 U	**2,500**	**600**	250 U
ICS-H-SE-1	0.4	-----	-----	-----	-----	-----
ICS-H-SE-2	1.7	-----	-----	-----	-----	**905,000**
ICS-H-SE-3	3.3	**29,326**	**1,056**	**2,669**	**7,625**	**1,117,302**
ICS-H-SE-4	4.7	**2,804**	**713**	2220 U	**386**	**30,374**
ICS-I-SE-1	0.9	-----	-----	-----	-----	-----
ICS-I-SE-2	2.6	-----	-----	-----	-----	**415,335**
ICS-I-SE-3	4.2	614 U	614 U	**1,272**	**390**	**17,325**
ICS-I-SE-4	5.9	169 U	169 U	**669**	169 U	**5,035**
ICS-I-SE-5	7.8	451 U	451 U	**1,078**	**275**	**4,078**
ICS-I-SE-6	9.5	-----	-----	-----	-----	-----
ICS-J-SE-1	0.8	-----	-----	-----	-----	-----
ICS-J-SE-2	2.6	-----	-----	-----	-----	-----
ICS-J-SE-3	4.9	-----	-----	-----	-----	**14,589**
ICS-J-SE-4	6.8	489 U	489 U	**4,475**	489 U	416 U
ICS-J-SE-5	8.5	353 U	353 U	**1,278**	1429 U	286 U
ICS-J-SE-6	10.4	310 U	310 U	**2,323**	1226 U	252 U
ICS-K-SE-1	0.7	-----	-----	-----	-----	-----
ICS-K-SE-2	2.2	-----	-----	-----	-----	**548,523**
ICS-K-SE-3	3.8	**569**	**432**	**1,479**	535 U	**183,163**
ICS-K-SE-4	5.5	**117**	216 U	**6,061**	866 U	**4,459**
ICS-K-SE-5	7	268 U	268 U	**1,148**	1093 U	202 U
ICS-L-SE-1	0.7	-----	-----	-----	-----	-----
ICS-L-SE-2	1.9	-----	-----	-----	-----	**139,157**
ICS-L-SE-3	3.5	316 U	316 U	**2,516**	**258**	**1,497**
ICS-L-SE-4	5	333 U	333 U	**2,639**	**181**	271 U

TABLE A7.2 - Subsurface Sediment Sample Analyses - Comparison w/ Benthic CULs

Core Location	Mid-Point Depth (feet)	1,4-Dichloro-benzene µg/kg, OC	1,2,4-Tri-chloro-benzene µg/kg, OC	2-Methyl-naph-thalene µg/kg, OC	n-Nitroso-dipheny-lomine µg/kg, OC	Detected Total PCBs µg/kg, OC
ROD Benthic CUL		**3100**	**810**	**38000**	**11000**	**12000**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-M-SE-1	0.6	-----	-----	-----	-----	**43,529**
ICS-M-SE-2	1.6	166 U	166 U	678 U	678 U	**10,576**
ICS-M-SE-3	2.7	1661 U	**1661 U**	6714 U	6714 U	1307 U
LDW-SC40	0.7	nd	nd	nd	nd	**21,333**
LDW-SC40	1.7	nd	nd	nd	nd	1212 U
LDW-SC40	3	nd	nd	nd	nd	1857 U
HS-6	2-3	-----	-----	-----	-----	**1995**
HS-7	3-4	-----	-----	-----	-----	**2942857**
HS-8	2.5-3.5	-----	-----	-----	-----	**1777143**
HSA-1	1-2	-----	-----	-----	-----	**2614286**
HSA-1	2-3	-----	-----	-----	-----	**275476**
HSA-1	3-4	-----	-----	-----	-----	**30095**
HSA-1	4.5-5	-----	-----	-----	-----	**606667**
HSA-2	2-3	-----	-----	-----	-----	**6171429**
HSA-2	3-4	-----	-----	-----	-----	**2241429**
HSA-2	4-5	-----	-----	-----	-----	**297143**
HSA-3	2-3	-----	-----	-----	-----	**2067143**
HSA-3	3-3.5	-----	-----	-----	-----	**200571**
HSA-3	5-6	-----	-----	-----	-----	**3176**
HSA-4	2-3	-----	-----	-----	-----	**8161905**
HSA-4	3-4	-----	-----	-----	-----	**739524**
HSA-4	4-5	-----	-----	-----	-----	**1580952**
HSA-4	5-6	-----	-----	-----	-----	**138761**
HSA-4	6-7	-----	-----	-----	-----	**95381**

Notes: U = Not detected at the associated lower reporting limit. Values greater than CUL are shown in bold type.
J = Estimated value
nd - Not detected na - Not available
CUL - Cleanup Level from ROD Tables 19 and 20
OC - Organic carbon normalized
(a) - ROD CUL not available. Value based on MTCA Method A.

- Exceeds CUL

TABLE A7.3 - Subsurface Sediment Sample Analyses - Comparison w/ RALs

Core Location	Mid-Point Depth (feet)	Depth to Top of Silt (feet)	% solids %	Wet density lb/ft^3	Moisture content %	Dry density lb/ft^3	TOC %	Arsenic mg/kg, dry	Total Chromium mg/kg, dry	Lead mg/kg, dry	Mercury mg/kg, dry	Zinc mg/kg, dry
ROD RAL								28	520	900	0.82	820
ROD Point of Compliance (cm)								0-10	0-10	0-10	0-10	0-10
ICS-A-SE-2	1.3	3.3	76	-----	-----	-----	1.37	12	20	87	0.24	111
ICS-A-SE-3	2.7			-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-A-SE-4	3.9		61	-----	-----	-----	2.77	10	22	10	0.17	61
ICS-A-SE-5	5.1		66	-----	-----	-----	1.61	7	22	11	0.12	52
ICS-A-SE-6	6.3		59	-----	-----	-----	3.22	10	26	12	0.15	72
ICS-A-SE-7	7.2		62	-----	-----	-----	4.22	9	23	10	0.14	63
ICS-B-SE-1	1.1	2.9	65	-----	-----	-----	0.775	20	23	15	0.04	80
ICS-B-SE-2	2.2		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-B-SE-3	3.3		49	-----	-----	-----	3.96	31	153	796	13 J	670
ICS-B-SE-4	4.4		64	-----	-----	-----	3.37	9	46	218	1.8 J	286
ICS-B-SE-5	5.5		61	-----	-----	-----	3.64	8	24	12	0.13	65
ICS-B-SE-6	6.6		60	100.6	65.8	60.7	2.66	10	25	13	0.19 J	74
ICS-C-SE-1	0.5	2.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-C-SE-2	2.3		73	-----	-----	-----	0.894	6	11	13	0.04	31
ICS-C-SE-3	3.3		62	-----	-----	-----	2.29	7	19	8	0.12	53
ICS-C-SE-4	4.4		80	-----	-----	-----	1.57	4	11	8	0.03	26
ICS-D-SE-1	0.7	2.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-D-SE-2	2.1		66	-----	-----	-----	6.91	15	431	4,430	39	3240
ICS-D-SE-3	3.8		65	-----	-----	-----	2.07	9	25	28	2	79
ICS-D-SE-4	5.3		62	-----	-----	-----	2.70	9	27	11	0.14	68
ICS-D-SE-5	6.7		61	-----	-----	-----	2.26	9	25	12	0.15 J	67
ICS-F-SE-1	0.5	2.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-2	1.7		56	-----	-----	-----	3.15	13	114	4,380	0.29 J	1420
ICS-F-SE-3	3.1		-----	99.5	70.8	58.3	-----	-----	-----	-----	-----	-----
ICS-F-SE-4	4.5		60	-----	-----	-----	2.22	9	25	12	0.16 J	70
ICS-F-SE-5	5.8		60	-----	-----	-----	2.67	11	24	17	0.17	66
ICS-F-SE-7	8.3		66	-----	-----	-----	1.26	6	18	12	0.09	54
ICS-F-SE-8	9.7		76	115.7	28.5	90.1	0.436	2	12	2	0.02	28
ICS-F-SE-9	10.9		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

TABLE A7.3 - Subsurface Sediment Sample Analyses - Comparison w/ RALs

Core Location	Mid-Point Depth (feet)	Depth to Top of Silt (feet)	% solids %	Wet density lb/ft^3	Moisture content %	Dry density lb/ft^3	TOC %	Arsenic mg/kg, dry	Total Chromium mg/kg, dry	Lead mg/kg, dry	Mercury mg/kg, dry	Zinc mg/kg, dry
ROD RAL								**28**	**520**	**900**	**0.82**	**820**
ROD Point of Compliance (cm)								**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-G-SE-1	0.6	2.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-2	1.8		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-3	3		63	-----	-----	-----	1.78	**12**	**24**	**23**	**0.20**	**91**
ICS-G-SE-4	4.1		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-5	5.1		58	-----	-----	-----	1.85	**25**	**112**	**1,340**	**0.49**	**840**
ICS-G-SE-6	6.8		60	-----	-----	-----	1.60	**12**	**23**	**34**	**0.20**	**81**
ICS-H-SE-1	0.4	2.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-H-SE-2	1.7		79	-----	-----	-----	2.00	**5**	**60**	**168**	**0.39**	**149**
ICS-H-SE-3	3.3		69	-----	-----	-----	3.41	**7**	**96**	**936**	**4.9**	**377**
ICS-H-SE-4	4.7		74	-----	-----	-----	0.856	**3**	**14**	**7**	**0.04**	**37**
ICS-I-SE-1	0.9	3.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-I-SE-2	2.6		70	-----	-----	-----	3.13	**10**	**25**	**123**	**1.8**	**109**
ICS-I-SE-3	4.2		58	96.2	84.7	52.1	2.28	**7**	**18**	**25**	**0.30**	**60**
ICS-I-SE-4	5.9		61	-----	-----	-----	2.84	**11**	**26**	**39**	**0.24 J**	**91**
ICS-I-SE-5	7.8		67	114	35.6	84.1	1.02	**5**	**14**	**19**	**0.14**	**40**
ICS-J-SE-1	0.8	1.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-2	2.6		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-3	4.9		56	-----	-----	-----	2.31	**26**	**64**	**224**	**0.29**	**201**
ICS-J-SE-4	6.8		66	-----	-----	-----	0.96	**6**	**16**	**11**	**0.08 J**	**51**
ICS-J-SE-5	8.5		67	-----	-----	-----	1.33	**6**	**15**	**14**	**0.11**	**44**
ICS-J-SE-6	10.4		63	-----	-----	-----	1.55	**7**	**18**	**22**	**0.11**	**56**
ICS-K-SE-1	0.7	4.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-K-SE-2	2.2		57	-----	-----	-----	2.37	**11**	**52**	**310**	**2.0**	**213**
ICS-K-SE-3	3.8		88	-----	-----	-----	0.88	**4**	**26**	**79**	**0.38**	**70**
ICS-K-SE-4	5.5		60	-----	-----	-----	2.31	**21**	**45**	**241**	**0.21**	**143**
ICS-K-SE-5	7		73	-----	-----	-----	1.83	**7**	**15**	**18**	**0.12**	**46**
ICS-L-SE-1	0.7	2.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-L-SE-2	1.9		74	-----	-----	-----	1.66	**6**	**24**	**87**	**0.34**	**82**
ICS-L-SE-3	3.5		62	-----	-----	-----	1.55	**7**	**18**	**62**	**0.63**	**89**
ICS-L-SE-4	5		70	-----	-----	-----	1.44	**6**	**18**	**12**	**0.31**	**52**

TABLE A7.3 - Subsurface Sediment Sample Analyses - Comparison w/ RALs

Core Location	Mid-Point Depth (feet)	Depth to Top of Silt (feet)	% solids %	Wet density lb/ft^3	Moisture content %	Dry density lb/ft^3	TOC %	Arsenic mg/kg, dry	Total Chromium mg/kg, dry	Lead mg/kg, dry	Mercury mg/kg, dry	Zinc mg/kg, dry
ROD RAL								**28**	**520**	**900**	**0.82**	**820**
ROD Point of Compliance (cm)								**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-M-SE-1	0.6	0	66	-----	-----	-----	2.55	**8**	**22**	**58**	**0.21**	**116**
ICS-M-SE-2	1.6		84	-----	-----	-----	2.95	**3**	**13**	**24**	**0.04**	**48**
ICS-M-SE-3	2.7		80	-----	-----	-----	0.283	**1**	**9**	**2**	0.3 U	**21**
LDW-SC40	0.7	0.5	73	-----	-----	-----	0.75	**7**	**14**	**18**	0.05	**47**
LDW-SC40	1.7		81	-----	-----	-----	0.33	6 U	**17**	**44**	0.05 U	**27**
LDW-SC40	3		82	-----	-----	-----	0.21	6 U	**12**	2 U	0.05 U	**25**
HS-6	2-3	+3	-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----
HS-7	3-4	+4	-----	-----	-----	-----	2.1(b)	-----	-----	**1280**	**31**	-----
HS-8	2.5-3.5	+3.5	-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----
HSA-1	1-2	1	-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----
HSA-1	2-3		-----	-----	-----	-----	2.1(b)	-----	-----	**880**		-----
HSA-1	3-4		-----	-----	-----	-----	2.1(b)	-----	-----	**36**	**0.26**	-----
HSA-1	4.5-5		-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----
HSA-2	2-3	+5	-----	-----	-----	-----	2.1(b)	-----	-----	**12400**	-----	-----
HSA-2	3-4		-----	-----	-----	-----	2.1(b)	-----	-----	**8440**	**1.2**	-----
HSA-2	4-5		-----	-----	-----	-----	2.1(b)	-----	-----	**4050**	-----	-----
HSA-3	2-3	2	-----	-----	-----	-----	2.1(b)	-----	-----	**7290**	-----	-----
HSA-3	3-3.5		-----	-----	-----	-----	2.1(b)	-----	-----	**609**	**2**	-----
HSA-3	5-6		-----	-----	-----	-----	2.1(b)	-----	-----	**16**	-----	-----
HSA-4	2-3	+7	-----	-----	-----	-----	2.1(b)	-----	-----	**14900**	**52**	-----
HSA-4	3-4		-----	-----	-----	-----	2.1(b)	-----	-----	**7200**	**3**	-----
HSA-4	4-5		-----	-----	-----	-----	2.1(b)	-----	-----	**1110**	-----	-----
HSA-4	5-6		-----	-----	-----	-----	2.1(b)	-----	-----	**213**	-----	-----
HSA-4	6-7		-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----

Notes:
U = Not detected at the associated lower reporting limit.
J = Estimated value
nd - Not detected
na - Not available
ENR UL - ROD Table 28
OC - Organic carbon normalized
(a) - ROD CUL not available. Value based on MTCA Method A.

(b) - Based on average TOC content in subsurface embayment sediment.

[yellow box] - Exceeds ENR UL

TABLE A7.3 - Subsurface Sediment Sample Analyses - Comparison w/ RALs

Core Location	Mid-Point Depth (feet)	DRO+RRO mg/kg,dry	2,4-Dimethyl-phenol µg/kg, dry	Benzyl alcohol µg/kg, dry	Penta-chloro-phenol µg/kg, dry	Acenaph-thene µg/kg, OC	Anthra-cene µg/kg, OC	Fluorene µg/kg, OC	Butyl-benzyl-phthalate µg/kg, OC	1,2-Dichloro-benzene µg/kg, OC
ROD RAL		**2000(a)**	**58**	**114**	**720**	**32000**	**660000**	**46000**	**9800**	**4600**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-A-SE-2	1.3	**630**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-A-SE-3	2.7	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-A-SE-4	3.9	**84**	**15 J**	**130**	**18 J**	**1,661**	**1,625**	**1841**	177 U	**235**
ICS-A-SE-5	5.1	**72**	**4.6 J**	**130**	48 U	**1,304**	**1,366**	**2050**	298 U	**621**
ICS-A-SE-6	6.3	**87**	25 U	**190**	20 U	**839**	**901**	**1366**	**255**	155 U
ICS-A-SE-7	7.2	**121**	24 U	**140**	19 U	**592**	**782**	**924**	**156**	114 U
ICS-B-SE-1	1.1	**85**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-B-SE-2	2.2	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-B-SE-3	3.3	**14,300**	**58**	57 U	**800**	**22,980**	**15,152**	**11364**	**1,187**	**2,449**
ICS-B-SE-4	4.4	**14,200**	**120**	52 U	52 U	**6,528**	**4,748**	**7715**	386 U	**4,451**
ICS-B-SE-5	5.5	**114**	**5.4 J**	**150**	49 U	**797**	**714**	**1236**	135 U	**604**
ICS-B-SE-6	6.6	**147**	25 U	**160**	20 U	**1,203**	**1,053**	**2030**	**195**	184 U
ICS-C-SE-1	0.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-C-SE-2	2.3	**91**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-C-SE-3	3.3	**66**	**92**	**54**	46 U	**917**	**655**	**961**	**140**	201 U
ICS-C-SE-4	4.4	**61**	**22**	20 U	49 U	**1,465**	**892**	**828**	312 U	**178**
ICS-D-SE-1	0.7	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-D-SE-2	2.1	**21,900**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-D-SE-3	3.8	**103**	**82**	**41**	48 U	**1,643**	**1,884**	**2464**	232 U	**3,671**
ICS-D-SE-4	5.3	**71**	**4.3 J**	**100**	50 U	**1,148**	**1,111**	**1889**	185 U	185 U
ICS-D-SE-5	6.7	**119**	24 U	**170**	19 U	**1,018**	**1,504**	**1770**	**221**	212 U
ICS-F-SE-1	0.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-2	1.7	**14,100**	**890**	59 U	59 U	**31,111**	**13,968**	**158730**	476 U	**302**
ICS-F-SE-3	3.1	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-4	4.5	**115**	24 U	**120**	20 U	**991**	**1,081**	**1892**	221 U	221 U
ICS-F-SE-5	5.8	**89**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-7	8.3	**43**	20 U	**42**	49 U	1587 U	**1,270**	**1587**	389 U	389 U
ICS-F-SE-8	9.7	13 U	18 U	18 U	46 U	4128 U	4128 U	4128 U	1055 U	1055 U
ICS-F-SE-9	10.9	-----	-----	-----	-----	-----	-----	-----	-----	-----

TABLE A7.3 - Subsurface Sediment Sample Analyses - Comparison w/ RALs

Core Location	Mid-Point Depth (feet)	DRO+RRO mg/kg,dry	2,4-Dimethyl-phenol µg/kg, dry	Benzyl alcohol µg/kg, dry	Penta-chloro-phenol µg/kg, dry	Acenaph-thene µg/kg, OC	Anthra-cene µg/kg, OC	Fluorene µg/kg, OC	Butyl-benzyl-phthalate µg/kg, OC	1,2-Dichloro-benzene µg/kg, OC
ROD RAL		2000(a)	58	114	720	32000	660000	46000	9800	4600
ROD Point of Compliance (cm)		0-10	0-10	0-10	0-10	0-10	0-10	0-10	0-10	0-10
ICS-G-SE-1	0.6	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-2	1.8	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-3	3	225	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-4	4.1	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-5	5.1	16,300	58 J	110 U	880 J	17,838	39,459	64865	9,189	1568 U
ICS-G-SE-6	6.8	193	4.9 J	61	48 U	2,125	3,688	3250	300 U	200
ICS-H-SE-1	0.4	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-H-SE-2	1.7	880	-----	-----	-----	-----	-----	-----	-----	-----
ICS-H-SE-3	3.3	3,400	15 J	26 U	190 J	7,038	8,798	14370	1,496	2,933
ICS-H-SE-4	4.7	78	6.4 J	19 U	49 U	2220 U	2220 U	1869	572 U	864
ICS-I-SE-1	0.9	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-I-SE-2	2.6	850	-----	-----	-----	-----	-----	-----	-----	-----
ICS-I-SE-3	4.2	206	57 U	36 J	140 U	3,377	4,254	2281	614 U	614 U
ICS-I-SE-4	5.9	181	24 U	72	19 U	10,211	880	2077	335	106
ICS-I-SE-5	7.8	710	18 U	18 U	46 U	50,980	14,706	4020	451 U	451 U
ICS-J-SE-1	0.8	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-2	2.6	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-3	4.9	3,000	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-4	6.8	112	24 U	37	19 U	1,977	2,081	2185	4,995	489 U
ICS-J-SE-5	8.5	95	3.0 J	27	47 U	3,308	4,286	2632	353 U	353 U
ICS-J-SE-6	10.4	99	19 U	44	48 U	1,484	2,129	1355	309 U	310 U
ICS-K-SE-1	0.7	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-K-SE-2	2.2	1,760	-----	-----	-----	-----	-----	-----	-----	-----
ICS-K-SE-3	3.8	250	24 U	19 U	19 U	2,048	1,706	1365	580	353
ICS-K-SE-4	5.5	1,060	11 J	57	59 J	2,684	1,905	2121	216 U	216 U
ICS-K-SE-5	7	83	20 U	20 U	49 U	4,372	3,880	2131	268 U	268 U
ICS-L-SE-1	0.7	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-L-SE-2	1.9	2,600	-----	-----	-----	-----	-----	-----	-----	-----
ICS-L-SE-3	3.5	197	6.4 J	25	49 U	4,258	4,194	3806	316 U	316 U
ICS-L-SE-4	5	66	3.5 J	27	48 U	1,597	2,569	3125	333 U	333 U

TABLE A7.3 - Subsurface Sediment Sample Analyses - Comparison w/ RALs

Core Location	Mid-Point Depth (feet)	DRO+RRO mg/kg,dry	2,4-Dimethyl-phenol µg/kg, dry	Benzyl alcohol µg/kg, dry	Penta-chloro-phenol µg/kg, dry	Acenaph-thene µg/kg, OC	Anthra-cene µg/kg, OC	Fluorene µg/kg, OC	Butyl-benzyl-phthalate µg/kg, OC	1,2-Dichloro-benzene µg/kg, OC
ROD RAL		**2000(a)**	**58**	**114**	**720**	**32000**	**660000**	**46000**	**9800**	**4600**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-M-SE-1	0.6	**215**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-M-SE-2	1.6	**45**	20 U	20 U	49 U	678 U	678 U	678 U	166 U	166 U
ICS-M-SE-3	2.7	12 U	19 U	19 U	47 U	6714 U	6714 U	6714 U	1661 U	1661 U
LDW-SC40	0.7	-----	6 U	30 U	30 U	nd	**43**	nd	**13**	nd
LDW-SC40	1.7	-----	5.9 U	30 U	30 U	nd	nd	nd	nd	nd
LDW-SC40	3	-----	6 U	30 U	30 U	nd	nd	nd	nd	nd
HS-6	2-3	-----	-----	-----	-----	-----	-----	-----	-----	-----
HS-7	3-4	**13010**	-----	-----	-----	-----	-----	-----	-----	-----
HS-8	2.5-3.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-1	1-2	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-1	2-3	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-1	3-4	**452**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-1	4.5-5	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-2	2-3	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-2	3-4	**44800**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-2	4-5	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-3	2-3	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-3	3-3.5	**2736**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-3	5-6	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	2-3	**142400**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	3-4	**46200**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	4-5	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	5-6	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	6-7	-----	-----	-----	-----	-----	-----	-----	-----	-----

Notes: U = Not detected at the associated lower reporting limit.
J = Estimated value
nd - Not detected — na - Not available — (yellow) - Exceeds ENR UL
ENR UL - ROD Table 28
OC - Organic carbon normalized
(a) - ROD CUL not available. Value based on MTCA Method A.

TABLE A7.3 - Subsurface Sediment Sample Analyses - Comparison w/ RALs

Core Location	Mid-Point Depth (feet)	1,4-Dichloro-benzene µg/kg, OC	1,2,4-Tri-chloro-benzene µg/kg, OC	2-Methylnaph-thalene µg/kg, OC	n-Nitroso-dipheny-lomine µg/kg, OC	Detected Total PCBs µg/kg, OC
ROD RAL		**6200**	**1620**	**76000**	**22000**	**65000**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-A-SE-2	1.3	-----	-----	-----	-----	**172,993**
ICS-A-SE-3	2.7	-----	-----	-----	-----	-----
ICS-A-SE-4	3.9	**108**	**249**	**1,480**	722 U	**3,574**
ICS-A-SE-5	5.1	**180**	298 U	**2,112**	**683**	**1,683**
ICS-A-SE-6	6.3	155 U	155 U	**1,366**	155 U	149 U
ICS-A-SE-7	7.2	114 U	114 U	**924**	114 U	149 U
ICS-B-SE-1	1.1	-----	-----	-----	-----	**55,484**
ICS-B-SE-2	2.2	-----	-----	-----	-----	-----
ICS-B-SE-3	3.3	**7,576**	**1,667**	**6,566**	1439 U	**737,374**
ICS-B-SE-4	4.4	**10,979**	**1,543**	**5,341**	386 U	**1,308,605**
ICS-B-SE-5	5.5	**604**	135 U	**1,209**	**181**	**2,665**
ICS-B-SE-6	6.6	184 U	184 U	**1,805**	184 U	211 U
ICS-C-SE-1	0.5	-----	-----	-----	-----	-----
ICS-C-SE-2	2.3	-----	-----	-----	-----	**6,152**
ICS-C-SE-3	3.3	201 U	201 U	**568**	**105**	166 U
ICS-C-SE-4	4.4	**2,102**	312 U	1274 U	1274 U	229 U
ICS-D-SE-1	0.7	-----	-----	-----	-----	-----
ICS-D-SE-2	2.1	-----	-----	-----	-----	**246,020**
ICS-D-SE-3	3.8	**725**	232 U	**25,121**	**295**	**3,237**
ICS-D-SE-4	5.3	185 U	185 U	**1,667**	**130**	144 U
ICS-D-SE-5	6.7	212 U	212 U	**2,788**	212 U	173 U
ICS-F-SE-1	0.5	-----	-----	-----	-----	-----
ICS-F-SE-2	1.7	**349**	476 U	**1,968,254**	476 U	**10,476**
ICS-F-SE-3	3.1	-----	-----	-----	-----	-----
ICS-F-SE-4	4.5	221 U	221 U	**5,405**	221 U	180 U
ICS-F-SE-5	5.8	-----	-----	-----	-----	150 U
ICS-F-SE-7	8.3	389 U	389 U	**1,587**	1587 U	310 U
ICS-F-SE-8	9.7	1055 U	1055 U	4128 U	4128 U	849 U
ICS-F-SE-9	10.9	-----	-----	-----	-----	-----

TABLE A7.3 - Subsurface Sediment Sample Analyses - Comparison w/ RALs

Core Location	Mid-Point Depth (feet)	1,4-Dichloro-benzene µg/kg, OC	1,2,4-Tri-chloro-benzene µg/kg, OC	2-Methylnaph-thalene µg/kg, OC	n-Nitroso-dipheny-lomine µg/kg, OC	Detected Total PCBs µg/kg, OC
ROD RAL		**6200**	**1620**	**76000**	**22000**	**65000**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-G-SE-1	0.6	-----	-----	-----	-----	-----
ICS-G-SE-2	1.8	-----	-----	-----	-----	-----
ICS-G-SE-3	3	-----	-----	-----	-----	**87,079**
ICS-G-SE-4	4.1	-----	-----	-----	-----	-----
ICS-G-SE-5	5.1	**7,568**	1568 U	**11,892**	**97,297**	**540,541**
ICS-G-SE-6	6.8	300 U	300 U	**2,500**	**600**	250 U
ICS-H-SE-1	0.4	-----	-----	-----	-----	-----
ICS-H-SE-2	1.7	-----	-----	-----	-----	**905,000**
ICS-H-SE-3	3.3	**29,326**	**1,056**	**2,669**	**7,625**	**1,117,302**
ICS-H-SE-4	4.7	**2,804**	**713**	2220 U	**386**	**30,374**
ICS-I-SE-1	0.9	-----	-----	-----	-----	-----
ICS-I-SE-2	2.6	-----	-----	-----	-----	**415,335**
ICS-I-SE-3	4.2	614 U	614 U	**1,272**	**390**	**17,325**
ICS-I-SE-4	5.9	169 U	169 U	**669**	169 U	**5,035**
ICS-I-SE-5	7.8	451 U	451 U	**1,078**	**275**	**4,078**
ICS-J-SE-1	0.8	-----	-----	-----	-----	-----
ICS-J-SE-2	2.6	-----	-----	-----	-----	-----
ICS-J-SE-3	4.9	-----	-----	-----	-----	**14,589**
ICS-J-SE-4	6.8	489 U	489 U	**4,475**	489 U	416 U
ICS-J-SE-5	8.5	353 U	353 U	**1,278**	1429 U	286 U
ICS-J-SE-6	10.4	310 U	310 U	**2,323**	1226 U	252 U
ICS-K-SE-1	0.7	-----	-----	-----	-----	-----
ICS-K-SE-2	2.2	-----	-----	-----	-----	**548,523**
ICS-K-SE-3	3.8	**569**	**432**	**1,479**	535 U	**183,163**
ICS-K-SE-4	5.5	**117**	216 U	**6,061**	866 U	**4,459**
ICS-K-SE-5	7	268 U	268 U	**1,148**	1093 U	202 U
ICS-L-SE-1	0.7	-----	-----	-----	-----	-----
ICS-L-SE-2	1.9	-----	-----	-----	-----	**139,157**
ICS-L-SE-3	3.5	316 U	316 U	**2,516**	**258**	**1,497**
ICS-L-SE-4	5	333 U	333 U	**2,639**	**181**	271 U

TABLE A7.3 - Subsurface Sediment Sample Analyses - Comparison w/ RALs

Core Location	Mid-Point Depth (feet)	1,4-Dichloro-benzene µg/kg, OC	1,2,4-Tri-chloro-benzene µg/kg, OC	2-Methylnaph-thalene µg/kg, OC	n-Nitroso-dipheny-lomine µg/kg, OC	Detected Total PCBs µg/kg, OC
ROD RAL		**6200**	**1620**	**76000**	**22000**	**65000**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-M-SE-1	0.6	-----	-----	-----	-----	**43,529**
ICS-M-SE-2	1.6	166 U	166 U	678 U	678 U	**10,576**
ICS-M-SE-3	2.7	1661 U	1661 U	6714 U	6714 U	1307 U
LDW-SC40	0.7	nd	nd	nd	nd	**21,333**
LDW-SC40	1.7	nd	nd	nd	nd	1212 U
LDW-SC40	3	nd	nd	nd	nd	1857 U
HS-6	2-3	-----	-----	-----	-----	**1995**
HS-7	3-4	-----	-----	-----	-----	**2,942,857**
HS-8	2.5-3.5	-----	-----	-----	-----	**1,777,143**
HSA-1	1-2	-----	-----	-----	-----	**2,614,286**
HSA-1	2-3	-----	-----	-----	-----	**275,476**
HSA-1	3-4	-----	-----	-----	-----	**30,095**
HSA-1	4.5-5	-----	-----	-----	-----	**606,667**
HSA-2	2-3	-----	-----	-----	-----	**6,171,429**
HSA-2	3-4	-----	-----	-----	-----	**2,241,429**
HSA-2	4-5	-----	-----	-----	-----	**297,143**
HSA-3	2-3	-----	-----	-----	-----	**2,067,143**
HSA-3	3-3.5	-----	-----	-----	-----	**200,571**
HSA-3	5-6	-----	-----	-----	-----	**3,176**
HSA-4	2-3	-----	-----	-----	-----	**8,161,905**
HSA-4	3-4	-----	-----	-----	-----	**739,524**
HSA-4	4-5	-----	-----	-----	-----	**1,580,952**
HSA-4	5-6	-----	-----	-----	-----	**138,761**
HSA-4	6-7	-----	-----	-----	-----	**95,381**

Notes: U = Not detected at the associated lower reporting limit.
J = Estimated value
nd - Not detected   na - Not available
ENR UL - ROD Table 28
OC - Organic carbon normalized
(a) - ROD CUL not available. Value based on MTCA Method A.

- Exceeds ENR UL

TABLE A7.4 - Subsurface Sediment Sample Analyses - Comparison w/ ENR ULs

Core Location	Mid-Point Depth (feet)	Depth to Top of Silt (feet)	% solids %	Wet density lb/ft^3	Moisture content %	Dry density lb/ft^3	TOC %	Arsenic mg/kg, dry	Total Chromium mg/kg, dry	Lead mg/kg, dry	Mercury mg/kg, dry	Zinc mg/kg, dry
ROD ENR UL								**42**	**780**	**1350**	**1.23**	**1230**
ROD Point of Compliance (cm)								**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-A-SE-2	1.3	3.3	76	-----	-----	-----	1.37	**12**	**20**	**87**	**0.24**	**111**
ICS-A-SE-3	2.7			-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-A-SE-4	3.9		61	-----	-----	-----	2.77	**10**	**22**	**10**	**0.17**	**61**
ICS-A-SE-5	5.1		66	-----	-----	-----	1.61	**7**	**22**	**11**	**0.12**	**52**
ICS-A-SE-6	6.3		59	-----	-----	-----	3.22	**10**	**26**	**12**	**0.15**	**72**
ICS-A-SE-7	7.2		62	-----	-----	-----	4.22	**9**	**23**	**10**	**0.14**	**63**
ICS-B-SE-1	1.1	2.9	65	-----	-----	-----	0.775	**20**	**23**	**15**	**0.04**	**80**
ICS-B-SE-2	2.2		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-B-SE-3	3.3		49	-----	-----	-----	3.96	**31**	**153**	**796**	**13 J**	**670**
ICS-B-SE-4	4.4		64	-----	-----	-----	3.37	**9**	**46**	**218**	**1.8 J**	**286**
ICS-B-SE-5	5.5		61	-----	-----	-----	3.64	**8**	**24**	**12**	**0.13**	**65**
ICS-B-SE-6	6.6		60	100.6	65.8	60.7	2.66	**10**	**25**	**13**	**0.19 J**	**74**
ICS-C-SE-1	0.5	2.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-C-SE-2	2.3		73	-----	-----	-----	0.894	**6**	**11**	**13**	**0.04**	**31**
ICS-C-SE-3	3.3		62	-----	-----	-----	2.29	**7**	**19**	**8**	**0.12**	**53**
ICS-C-SE-4	4.4		80	-----	-----	-----	1.57	**4**	**11**	**8**	**0.03**	**26**
ICS-D-SE-1	0.7	2.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-D-SE-2	2.1		66	-----	-----	-----	6.91	**15**	**431**	**4,430**	**39**	**3240**
ICS-D-SE-3	3.8		65	-----	-----	-----	2.07	**9**	**25**	**28**	**2**	**79**
ICS-D-SE-4	5.3		62	-----	-----	-----	2.70	**9**	**27**	**11**	**0.14**	**68**
ICS-D-SE-5	6.7		61	-----	-----	-----	2.26	**9**	**25**	**12**	**0.15 J**	**67**
ICS-F-SE-1	0.5	2.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-2	1.7		56	-----	-----	-----	3.15	**13**	**114**	**4,380**	**0.29 J**	**1420**
ICS-F-SE-3	3.1		-----	99.5	70.8	58.3	-----	-----	-----	-----	-----	-----
ICS-F-SE-4	4.5		60	-----	-----	-----	2.22	**9**	**25**	**12**	**0.16 J**	**70**
ICS-F-SE-5	5.8		60	-----	-----	-----	2.67	**11**	**24**	**17**	**0.17**	**66**
ICS-F-SE-6	7		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-7	8.3		66	-----	-----	-----	1.26	**6**	**18**	**12**	**0.09**	**54**
ICS-F-SE-8	9.7		76	115.7	28.5	90.1	0.436	**2**	**12**	**2**	**0.02**	**28**
ICS-F-SE-9	10.9		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

TABLE A7.4 - Subsurface Sediment Sample Analyses - Comparison w/ ENR ULs

Core Location	Mid-Point Depth (feet)	Depth to Top of Silt (feet)	% solids %	Wet density lb/ft^3	Moisture content %	Dry density lb/ft^3	TOC %	Arsenic mg/kg, dry	Total Chromium mg/kg, dry	Lead mg/kg, dry	Mercury mg/kg, dry	Zinc mg/kg, dry
ROD ENR UL								**42**	**780**	**1350**	**1.23**	**1230**
ROD Point of Compliance (cm)								**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-G-SE-1	0.6	2.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-2	1.8		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-3	3		63	-----	-----	-----	1.78	**12**	**24**	**23**	**0.20**	**91**
ICS-G-SE-4	4.1		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-5	5.1		58	-----	-----	-----	1.85	**25**	**112**	**1,340**	**0.49**	**840**
ICS-G-SE-6	6.8		60	-----	-----	-----	1.60	**12**	**23**	**34**	**0.20**	**81**
ICS-H-SE-1	0.4	2.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-H-SE-2	1.7		79	-----	-----	-----	2.00	**5**	**60**	**168**	**0.39**	**149**
ICS-H-SE-3	3.3		69	-----	-----	-----	3.41	**7**	**96**	**936**	**4.9**	**377**
ICS-H-SE-4	4.7		74	-----	-----	-----	0.856	**3**	**14**	**7**	**0.04**	**37**
ICS-I-SE-1	0.9	3.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-I-SE-2	2.6		70	-----	-----	-----	3.13	**10**	**25**	**123**	**1.8**	**109**
ICS-I-SE-3	4.2		58	96.2	84.7	52.1	2.28	**7**	**18**	**25**	**0.30**	**60**
ICS-I-SE-4	5.9		61	-----	-----	-----	2.84	**11**	**26**	**39**	**0.24 J**	**91**
ICS-I-SE-5	7.8		67	114	35.6	84.1	1.02	**5**	**14**	**19**	**0.14**	**40**
ICS-J-SE-1	0.8	1.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-2	2.6		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-3	4.9		56	-----	-----	-----	2.31	**26**	**64**	**224**	**0.29**	**201**
ICS-J-SE-4	6.8		66	-----	-----	-----	0.96	**6**	**16**	**11**	**0.08 J**	**51**
ICS-J-SE-5	8.5		67	-----	-----	-----	1.33	**6**	**15**	**14**	**0.11**	**44**
ICS-J-SE-6	10.4		63	-----	-----	-----	1.55	**7**	**18**	**22**	**0.11**	**56**
ICS-K-SE-1	0.7	4.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-K-SE-2	2.2		57	-----	-----	-----	2.37	**11**	**52**	**310**	**2.0**	**213**
ICS-K-SE-3	3.8		88	-----	-----	-----	0.88	**4**	**26**	**79**	**0.38**	**70**
ICS-K-SE-4	5.5		60	-----	-----	-----	2.31	**21**	**45**	**241**	**0.21**	**143**
ICS-K-SE-5	7		73	-----	-----	-----	1.83	**7**	**15**	**18**	**0.12**	**46**
ICS-L-SE-1	0.7	2.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-L-SE-2	1.9		74	-----	-----	-----	1.66	**6**	**24**	**87**	**0.34**	**82**
ICS-L-SE-3	3.5		62	-----	-----	-----	1.55	**7**	**18**	**62**	**0.63**	**89**
ICS-L-SE-4	5		70	-----	-----	-----	1.44	**6**	**18**	**12**	**0.31**	**52**

TABLE A7.4 - Subsurface Sediment Sample Analyses - Comparison w/ ENR ULs

Core Location	Mid-Point Depth (feet)	Depth to Top of Silt (feet)	% solids %	Wet density lb/ft^3	Moisture content %	Dry density lb/ft^3	TOC %	Arsenic mg/kg, dry	Total Chromium mg/kg, dry	Lead mg/kg, dry	Mercury mg/kg, dry	Zinc mg/kg, dry
ROD ENR UL								**42**	**780**	**1350**	**1.23**	**1230**
ROD Point of Compliance (cm)								**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-M-SE-1	0.6		66	-----	-----	-----	2.55	**8**	**22**	**58**	**0.21**	**116**
ICS-M-SE-2	1.6	0	84	-----	-----	-----	2.95	**3**	**13**	**24**	**0.04**	**48**
ICS-M-SE-3	2.7		80	-----	-----	-----	0.283	**1**	**9**	**2**	0.3 U	**21**
LDW-SC40	0.7		73	-----	-----	-----	0.75	**7**	**14**	**18**	0.05	**47**
LDW-SC40	1.7	0.5	81	-----	-----	-----	0.33	6 U	**17**	**44**	0.05 U	**27**
LDW-SC40	3		82	-----	-----	-----	0.21	6 U	**12**	2 U	0.05 U	**25**
HS-6	2-3	+3	-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----
HS-7	3-4	+4	-----	-----	-----	-----	2.1(b)	-----	-----	**1280**	**31**	-----
HS-8	2.5-3.5	+3.5	-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----
HSA-1	1-2		-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----
HSA-1	2-3	1	-----	-----	-----	-----	2.1(b)	-----	-----	**880**		-----
HSA-1	3-4		-----	-----	-----	-----	2.1(b)	-----	-----	**36**	**0.26**	-----
HSA-1	4.5-5		-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----
HSA-2	2-3		-----	-----	-----	-----	2.1(b)	-----	-----	**12400**	-----	-----
HSA-2	3-4	+5	-----	-----	-----	-----	2.1(b)	-----	-----	**8440**	**1.2**	-----
HSA-2	4-5		-----	-----	-----	-----	2.1(b)	-----	-----	**4050**	-----	-----
HSA-3	2-3		-----	-----	-----	-----	2.1(b)	-----	-----	**7290**	-----	-----
HSA-3	3-3.5	2	-----	-----	-----	-----	2.1(b)	-----	-----	**609**	**2**	-----
HSA-3	5-6		-----	-----	-----	-----	2.1(b)	-----	-----	**16**	-----	-----
HSA-4	2-3		-----	-----	-----	-----	2.1(b)	-----	-----	**14900**	**52**	-----
HSA-4	3-4		-----	-----	-----	-----	2.1(b)	-----	-----	**7200**	**3**	-----
HSA-4	4-5	+7	-----	-----	-----	-----	2.1(b)	-----	-----	**1110**	-----	-----
HSA-4	5-6		-----	-----	-----	-----	2.1(b)	-----	-----	**213**	-----	-----
HSA-4	6-7		-----	-----	-----	-----	2.1(b)	-----	-----	-----	-----	-----

Notes:
U = Not detected at the associated lower reporting limit.
J = Estimated value
nd - Not detected
na - Not available
ENR UL - ROD Table 28
OC - Organic carbon normalized
(a) - ROD CUL not available. Value based on MTCA Method A.
(b) - Based on average TOC content in subsurface embayment sediment.
- Exceeds ENR UL

TABLE A7.4 - Subsurface Sediment Sample Analyses - Comparison w/ ENR ULs

Core Location	Mid-Point Depth (feet)	DRO+RRO mg/kg,dry	2,4-Dimethyl-phenol µg/kg, dry	Benzyl alcohol µg/kg, dry	Penta-chloro-phenol µg/kg, dry	Acenaph-thene µg/kg, OC	Anthra-cene µg/kg, OC	Fluorene µg/kg, OC	Butyl-benzyl-phthalate µg/kg, OC	1,2-Dichloro-benzene µg/kg, OC
ROD ENR UL		**2000(a)**	**87**	**171**	**1080**	**48000**	**660000**	**69000**	**14700**	**6900**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-A-SE-2	1.3	**630**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-A-SE-3	2.7	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-A-SE-4	3.9	**84**	**15 J**	**130**	**18 J**	**1,661**	**1,625**	**1841**	177 U	**235**
ICS-A-SE-5	5.1	**72**	**4.6 J**	**130**	48 U	**1,304**	**1,366**	**2050**	298 U	**621**
ICS-A-SE-6	6.3	**87**	25 U	**190**	20 U	**839**	**901**	**1366**	**255**	155 U
ICS-A-SE-7	7.2	**121**	24 U	**140**	19 U	**592**	**782**	**924**	**156**	114 U
ICS-B-SE-1	1.1	**85**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-B-SE-2	2.2	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-B-SE-3	3.3	**14,300**	**58**	57 U	**800**	**22,980**	**15,152**	**11364**	**1,187**	**2,449**
ICS-B-SE-4	4.4	**14,200**	**120**	52 U	52 U	**6,528**	**4,748**	**7715**	386 U	**4,451**
ICS-B-SE-5	5.5	**114**	**5.4 J**	**150**	49 U	**797**	**714**	**1236**	135 U	**604**
ICS-B-SE-6	6.6	**147**	25 U	**160**	20 U	**1,203**	**1,053**	**2030**	**195**	184 U
ICS-C-SE-1	0.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-C-SE-2	2.3	**91**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-C-SE-3	3.3	**66**	**92**	**54**	46 U	**917**	**655**	**961**	**140**	201 U
ICS-C-SE-4	4.4	**61**	**22**	20 U	49 U	**1,465**	**892**	**828**	312 U	**178**
ICS-D-SE-1	0.7	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-D-SE-2	2.1	**21,900**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-D-SE-3	3.8	**103**	**82**	**41**	48 U	**1,643**	**1,884**	**2464**	232 U	**3,671**
ICS-D-SE-4	5.3	**71**	**4.3 J**	**100**	50 U	**1,148**	**1,111**	**1889**	185 U	185 U
ICS-D-SE-5	6.7	**119**	24 U	**170**	19 U	**1,018**	**1,504**	**1770**	**221**	212 U
ICS-F-SE-1	0.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-2	1.7	**14,100**	**890**	59 U	59 U	**31,111**	**13,968**	**158730**	476 U	**302**
ICS-F-SE-3	3.1	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-4	4.5	**115**	24 U	**120**	20 U	**991**	**1,081**	**1892**	221 U	221 U
ICS-F-SE-5	5.8	**89**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-6	7	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-F-SE-7	8.3	**43**	20 U	**42**	49 U	1587 U	**1,270**	**1587**	389 U	389 U
ICS-F-SE-8	9.7	13 U	18 U	18 U	46 U	4128 U	4128 U	4128 U	1055 U	1055 U
ICS-F-SE-9	10.9	-----	-----	-----	-----	-----	-----	-----	-----	-----

TABLE A7.4 - Subsurface Sediment Sample Analyses - Comparison w/ ENR ULs

Core Location	Mid-Point Depth (feet)	DRO+RRO mg/kg,dry	2,4-Dimethyl-phenol µg/kg, dry	Benzyl alcohol µg/kg, dry	Penta-chloro-phenol µg/kg, dry	Acenaph-thene µg/kg, OC	Anthra-cene µg/kg, OC	Fluorene µg/kg, OC	Butyl-benzyl-phthalate µg/kg, OC	1,2-Dichloro-benzene µg/kg, OC
ROD ENR UL		**2000(a)**	**87**	**171**	**1080**	**48000**	**660000**	**69000**	**14700**	**6900**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-G-SE-1	0.6	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-2	1.8	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-3	3	**225**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-4	4.1	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-G-SE-5	5.1	**16,300**	**58 J**	110 U	**880 J**	**17,838**	**39,459**	**64865**	**9,189**	1568 U
ICS-G-SE-6	6.8	**193**	**4.9 J**	**61**	48 U	**2,125**	**3,688**	**3250**	300 U	**200**
ICS-H-SE-1	0.4	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-H-SE-2	1.7	**880**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-H-SE-3	3.3	**3,400**	**15 J**	26 U	**190 J**	**7,038**	**8,798**	**14370**	**1,496**	**2,933**
ICS-H-SE-4	4.7	**78**	**6.4 J**	19 U	49 U	2220 U	2220 U	**1869**	572 U	**864**
ICS-I-SE-1	0.9	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-I-SE-2	2.6	**850**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-I-SE-3	4.2	**206**	57 U	**36 J**	140 U	**3,377**	**4,254**	**2281**	614 U	614 U
ICS-I-SE-4	5.9	**181**	24 U	**72**	19 U	**10,211**	**880**	**2077**	**335**	**106**
ICS-I-SE-5	7.8	**710**	18 U	18 U	46 U	**50,980**	**14,706**	**4020**	451 U	451 U
ICS-J-SE-1	0.8	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-2	2.6	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-3	4.9	**3,000**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-J-SE-4	6.8	**112**	24 U	**37**	19 U	**1,977**	**2,081**	**2185**	**4,995**	489 U
ICS-J-SE-5	8.5	**95**	**3.0 J**	**27**	47 U	**3,308**	**4,286**	**2632**	353 U	353 U
ICS-J-SE-6	10.4	**99**	19 U	**44**	48 U	**1,484**	**2,129**	**1355**	309 U	310 U
ICS-K-SE-1	0.7	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-K-SE-2	2.2	**1,760**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-K-SE-3	3.8	**250**	24 U	19 U	19 U	**2,048**	**1,706**	**1365**	**580**	**353**
ICS-K-SE-4	5.5	**1,060**	**11 J**	**57**	**59 J**	**2,684**	**1,905**	**2121**	216 U	216 U
ICS-K-SE-5	7	**83**	20 U	20 U	49 U	**4,372**	**3,880**	**2131**	268 U	268 U
ICS-L-SE-1	0.7	-----	-----	-----	-----	-----	-----	-----	-----	-----
ICS-L-SE-2	1.9	**2,600**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-L-SE-3	3.5	**197**	**6.4 J**	**25**	49 U	**4,258**	**4,194**	**3806**	316 U	316 U
ICS-L-SE-4	5	**66**	**3.5 J**	**27**	48 U	**1,597**	**2,569**	**3125**	333 U	333 U

TABLE A7.4 - Subsurface Sediment Sample Analyses - Comparison w/ ENR ULs

Core Location	Mid-Point Depth (feet)	DRO+RRO mg/kg,dry	2,4-Dimethyl-phenol µg/kg, dry	Benzyl alcohol µg/kg, dry	Penta-chloro-phenol µg/kg, dry	Acenaph-thene µg/kg, OC	Anthra-cene µg/kg, OC	Fluorene µg/kg, OC	Butyl-benzyl-phthalate µg/kg, OC	1,2-Dichloro-benzene µg/kg, OC
ROD ENR UL		**2000(a)**	**87**	**171**	**1080**	**48000**	**660000**	**69000**	**14700**	**6900**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-M-SE-1	0.6	**215**	-----	-----	-----	-----	-----	-----	-----	-----
ICS-M-SE-2	1.6	**45**	20 U	20 U	49 U	678 U	678 U	678 U	166 U	166 U
ICS-M-SE-3	2.7	12 U	19 U	19 U	47 U	6714 U	6714 U	6714 U	1661 U	1661 U
LDW-SC40	0.7	-----	6 U	30 U	30 U	nd	**43**	nd	**13**	nd
LDW-SC40	1.7	-----	5.9 U	30 U	30 U	nd	nd	nd	nd	nd
LDW-SC40	3	-----	6 U	30 U	30 U	nd	nd	nd	nd	nd
HS-6	2-3	-----	-----	-----	-----	-----	-----	-----	-----	-----
HS-7	3-4	**13010**	-----	-----	-----	-----	-----	-----	-----	-----
HS-8	2.5-3.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-1	1-2	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-1	2-3	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-1	3-4	**452**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-1	4.5-5	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-2	2-3	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-2	3-4	**44800**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-2	4-5	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-3	2-3	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-3	3-3.5	**2736**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-3	5-6	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	2-3	**142400**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	3-4	**46200**	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	4-5	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	5-6	-----	-----	-----	-----	-----	-----	-----	-----	-----
HSA-4	6-7	-----	-----	-----	-----	-----	-----	-----	-----	-----

Notes: U = Not detected at the associated lower reporting limit.
J = Estimated value
nd - Not detected   na - Not available   - Exceeds ENR UL
ENR UL - ROD Table 28
OC - Organic carbon normalized
(a) - ROD CUL not available. Value based on MTCA Method A.

TABLE A7.4 - Subsurface Sediment Sample Analyses - Comparison w/ ENR ULs

Core Location	Mid-Point Depth (feet)	1,4-Dichloro-benzene µg/kg, OC	1,2,4-Tri-chloro-benzene µg/kg, OC	2-Methylnaph-thalene µg/kg, OC	n-Nitroso-dipheny-lomine µg/kg, OC	Detected Total PCBs µg/kg, OC
ROD ENR UL		**9300**	**2400**	**114000**	**33000**	**97000**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-A-SE-2	1.3	-----	-----	-----	-----	**172,993**
ICS-A-SE-3	2.7	-----	-----	-----	-----	-----
ICS-A-SE-4	3.9	**108**	**249**	**1,480**	722 U	**3,574**
ICS-A-SE-5	5.1	**180**	298 U	**2,112**	**683**	**1,683**
ICS-A-SE-6	6.3	155 U	155 U	**1,366**	155 U	149 U
ICS-A-SE-7	7.2	114 U	114 U	**924**	114 U	149 U
ICS-B-SE-1	1.1	-----	-----	-----	-----	**55,484**
ICS-B-SE-2	2.2	-----	-----	-----	-----	-----
ICS-B-SE-3	3.3	**7,576**	**1,667**	**6,566**	1439 U	**737,374**
ICS-B-SE-4	4.4	**10,979**	**1,543**	**5,341**	386 U	**1,308,605**
ICS-B-SE-5	5.5	**604**	135 U	**1,209**	**181**	**2,665**
ICS-B-SE-6	6.6	184 U	184 U	**1,805**	184 U	211 U
ICS-C-SE-1	0.5	-----	-----	-----	-----	-----
ICS-C-SE-2	2.3	-----	-----	-----	-----	**6,152**
ICS-C-SE-3	3.3	201 U	201 U	**568**	**105**	166 U
ICS-C-SE-4	4.4	**2,102**	312 U	1274 U	1274 U	229 U
ICS-D-SE-1	0.7	-----	-----	-----	-----	-----
ICS-D-SE-2	2.1	-----	-----	-----	-----	**246,020**
ICS-D-SE-3	3.8	**725**	232 U	**25,121**	**295**	**3,237**
ICS-D-SE-4	5.3	185 U	185 U	**1,667**	**130**	144 U
ICS-D-SE-5	6.7	212 U	212 U	**2,788**	212 U	173 U
ICS-F-SE-1	0.5	-----	-----	-----	-----	-----
ICS-F-SE-2	1.7	**349**	476 U	**1,968,254**	476 U	**10,476**
ICS-F-SE-3	3.1	-----	-----	-----	-----	-----
ICS-F-SE-4	4.5	221 U	221 U	**5,405**	221 U	180 U
ICS-F-SE-5	5.8	-----	-----	-----	-----	150 U
ICS-F-SE-6	7	-----	-----	-----	-----	-----
ICS-F-SE-7	8.3	389 U	389 U	**1,587**	1587 U	310 U
ICS-F-SE-8	9.7	1055 U	1055 U	4128 U	4128 U	849 U
ICS-F-SE-9	10.9	-----	-----	-----	-----	-----

TABLE A7.4 - Subsurface Sediment Sample Analyses - Comparison w/ ENR ULs

Core Location	Mid-Point Depth (feet)	1,4-Dichloro-benzene µg/kg, OC	1,2,4-Tri-chloro-benzene µg/kg, OC	2-Methylnaph-thalene µg/kg, OC	n-Nitroso-dipheny-lomine µg/kg, OC	Detected Total PCBs µg/kg, OC
ROD ENR UL		**9300**	**2400**	**114000**	**33000**	**97000**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-G-SE-1	0.6	-----	-----	-----	-----	-----
ICS-G-SE-2	1.8	-----	-----	-----	-----	-----
ICS-G-SE-3	3	-----	-----	-----	-----	**87,079**
ICS-G-SE-4	4.1	-----	-----	-----	-----	-----
ICS-G-SE-5	5.1	**7,568**	1568 U	**11,892**	**97,297**	**540,541**
ICS-G-SE-6	6.8	300 U	300 U	**2,500**	**600**	250 U
ICS-H-SE-1	0.4	-----	-----	-----	-----	-----
ICS-H-SE-2	1.7	-----	-----	-----	-----	**905,000**
ICS-H-SE-3	3.3	**29,326**	**1,056**	**2,669**	**7,625**	**1,117,302**
ICS-H-SE-4	4.7	**2,804**	**713**	2220 U	**386**	**30,374**
ICS-I-SE-1	0.9	-----	-----	-----	-----	-----
ICS-I-SE-2	2.6	-----	-----	-----	-----	**415,335**
ICS-I-SE-3	4.2	614 U	614 U	**1,272**	**390**	**17,325**
ICS-I-SE-4	5.9	169 U	169 U	**669**	169 U	**5,035**
ICS-I-SE-5	7.8	451 U	451 U	**1,078**	**275**	**4,078**
ICS-J-SE-1	0.8	-----	-----	-----	-----	-----
ICS-J-SE-2	2.6	-----	-----	-----	-----	-----
ICS-J-SE-3	4.9	-----	-----	-----	-----	**14,589**
ICS-J-SE-4	6.8	489 U	489 U	**4,475**	489 U	416 U
ICS-J-SE-5	8.5	353 U	353 U	**1,278**	1429 U	286 U
ICS-J-SE-6	10.4	310 U	310 U	**2,323**	1226 U	252 U
ICS-K-SE-1	0.7	-----	-----	-----	-----	-----
ICS-K-SE-2	2.2	-----	-----	-----	-----	**548,523**
ICS-K-SE-3	3.8	**569**	**432**	**1,479**	535 U	**183,163**
ICS-K-SE-4	5.5	**117**	216 U	**6,061**	866 U	**4,459**
ICS-K-SE-5	7	268 U	268 U	**1,148**	1093 U	202 U
ICS-L-SE-1	0.7	-----	-----	-----	-----	-----
ICS-L-SE-2	1.9	-----	-----	-----	-----	**139,157**
ICS-L-SE-3	3.5	316 U	316 U	**2,516**	**258**	**1,497**
ICS-L-SE-4	5	333 U	333 U	**2,639**	**181**	271 U

TABLE A7.4 - Subsurface Sediment Sample Analyses - Comparison w/ ENR ULs

Core Location	Mid-Point Depth (feet)	1,4-Dichloro-benzene µg/kg, OC	1,2,4-Tri-chloro-benzene µg/kg, OC	2-Methylnaph-thalene µg/kg, OC	n-Nitroso-dipheny-lomine µg/kg, OC	Detected Total PCBs µg/kg, OC
ROD ENR UL		**9300**	**2400**	**114000**	**33000**	**97000**
ROD Point of Compliance (cm)		**0-10**	**0-10**	**0-10**	**0-10**	**0-10**
ICS-M-SE-1	0.6	-----	-----	-----	-----	**43,529**
ICS-M-SE-2	1.6	166 U	166 U	678 U	678 U	**10,576**
ICS-M-SE-3	2.7	1661 U	1661 U	6714 U	6714 U	1307 U
LDW-SC40	0.7	nd	nd	nd	nd	**21,333**
LDW-SC40	1.7	nd	nd	nd	nd	1212 U
LDW-SC40	3	nd	nd	nd	nd	1857 U
HS-6	2-3	-----	-----	-----	-----	**1995**
HS-7	3-4	-----	-----	-----	-----	**2,942,857**
HS-8	2.5-3.5	-----	-----	-----	-----	**1,777,143**
HSA-1	1-2	-----	-----	-----	-----	**2,614,286**
HSA-1	2-3	-----	-----	-----	-----	**275,476**
HSA-1	3-4	-----	-----	-----	-----	**30,095**
HSA-1	4.5-5	-----	-----	-----	-----	**606,667**
HSA-2	2-3	-----	-----	-----	-----	**6,171,429**
HSA-2	3-4	-----	-----	-----	-----	**2,241,429**
HSA-2	4-5	-----	-----	-----	-----	**297,143**
HSA-3	2-3	-----	-----	-----	-----	**2,067,143**
HSA-3	3-3.5	-----	-----	-----	-----	**200,571**
HSA-3	5-6	-----	-----	-----	-----	**3,176**
HSA-4	2-3	-----	-----	-----	-----	**8,161,905**
HSA-4	3-4	-----	-----	-----	-----	**739,524**
HSA-4	4-5	-----	-----	-----	-----	**1,580,952**
HSA-4	5-6	-----	-----	-----	-----	**138,761**
HSA-4	6-7	-----	-----	-----	-----	**95,381**

Notes:
U = Not detected at the associated lower reporting limit.
J = Estimated value
nd - Not detected   na - Not available
ENR UL - ROD Table 28
OC - Organic carbon normalized
(a) - ROD CUL not available. Value based on MTCA Method A.

- Exceeds ENR UL

TABLE A7.5 - Depth of Core Sample Exceedances

CORE	Depth > HH-CUL	Depth > Benthic CUL	Depth > RAL	Depth > ENR UL
A	As - +7.2' PCBs - 5.7'	Benzyl Alcohol - +7.2' PCBs - 3.3'	Benzyl Alcohol - +6.8' PCBs - 3.3'	Benzyl Alcohol - 6.8' PCBs - 3.3'
B	As - +6.6' PCB - 6.1' cPAHs - 5.0'	Lead - 3.9' Mercury - 5.0' Zinc - 3.9' DRO+RRO - 5.0' 2,4-Dimethylphenol - 5.0' Benyl Alcohol - +6.6' Pentachlorophenol - 3.9' Acenaphthalene. - 3.9' 1,2-Dichlorobenzene - 5.0' 1,4-Dichlorobenzene - 5.0 ' 1,2,4-Trichlorobenzene - 5.0' PCBs - 5.0'	Arsenic - 3.9' Mercury - 5.0' DRO+RRO - 5' 2,4-Dimethylphenol - 5.0' Benzyl Alchol - +6.6' PCP - 3.9' 1,4-Dichlorobenzene - 5' 1,2,4-Trichlorobenzene - 5' PCBs - 5'	Mercury - 5.0' DRO+RRO - 5.0' 2,4-Dimethylphenol - 5.0' PCBs - 5.0'
C	PCBs - 2.8'	2,4-DMP - 3.9'	2,4-Dimethylphenol - 3.9'	2,4 - DMP 3.9'
D	As - +6.7' PCBS - 4.6'	Chromium - 3' Lead - 3' Mercury - 4.6' Zinc - 3' DRO+RRO - 3.0' 2,4-Dimethylphenol - 4.6' Benzyl Alcohol - +6.7' 1,2-Dichlorobenzene - 4.6' PCBs - 3.0'	Lead - 3.0' Mercury - 4.6' Zinc - 3.0' DRO + RRO - 3.0' 2,4-Dimethylphenol - 4.6' Benzyl Alcohol - +6.7' PCBs - 3.0'	Lead - 3.0' Mercury - 4.6' Zinc - 3.0' DRO+RRO - 3.0' PCBs - 3.0'
F	As - 6.4' PCBs - 3.8' cPAHs - 3.8'	Lead - 3.8' Zinc - 3.8' DRO + RRO - 3.8' 2,4-Dimethylphenol - 3.8' Benzyl Alcohol - 5.2' Acenaphthalene. - 3.8' Fluorene - 3.8' 2-Methylnaphthlene - 3.8'	Lead - 3.8' Zinc - 3.8' DRO+RRO - 3.8' 2,4-Dimethylphenol - 3.8' Benzyl Alcohol - 6.4' Acenaphthalene. - 3.8' Fluorene - 3.8' 2-methylnaphthalene - 3.8'	Lead - 3.8' Zinc - 3.8' DRO+RRO - 3.8' 2,4-Dimethylphenol - 3.8' Fluorene - 3.8' 2-Methylnaphthalene- 3.8'
G	As - +6.8' PCBs - 6.0' cPAHs - +6.8'	Lead - 6.0' Mercury - 6.0' Zinc - 6.0' DRO+RRO - 6' 2,4-Dimethylphenol - 6.0' Benzyl Alcohol - +6.8' Pentachlorophenol - 6.0' Acenaphthalene. - 6.0' Fluorene - 6.0' Butyl Benzyl Phthalate - 6.0' 1,4-Dichlorobenzene - 6.0' n-Nitrosodiphenylomine - 6.0' PCBs - 6.0'	Lead - 6.0' Zinc - 6.0' DRO+RRO - 6.0' 2-4-Dimethylphenol - 6.0' Pentachlorophenol - 6.0' Fluorene - 6.0' 1,4-Dichlorobenzene - 6.0' n-Nitrosodiphenylomine - 6.0' PCBs - 6.0'	DRO + RRO - 6.0' 2,4-Dimethylphenol - 6.0' n-Nitrosodiphenylomine - 6.0' PCBs - 6.0'
H	PCBs - +4.7' cPAHs - 4.0'	Lead - 4.0' Mercury - 4.0' DRO + RRO - 4.0' 1,2-Dichlorobenzene - 4.0' 1,4-Dichlorobenzene - 4.0' 1,2,4-Trichlorobenzene - 4.0' PCBs - +4.7'	Lead - 4.0' Mercury - 4.0' DRO + RRO - 4.0' Pentachlorophenol - 4.0' 1,4-Dichlorobenzene - 4.0' PCBs - 4.0'	Mercury 4.0' DRO + RRO - 4.0' 1,4-Dichhlorobenzene - 4.0' PCBs - 4.0'

TABLE A7.5 - Depth of Core Sample Exceedances

CORE	Depth > HH-CUL	Depth > Benthic CUL	Depth > RAL	Depth > ENR UL
I	As - 6.9' PCBs - 8.7' cPAHs - +8.7'	Mercury - 3.4' Benzyl Alcohol - 6.9' Acenaphthalene. +7.8' PCBs - 5.1'	Mercury - 3.4' Acenaphthalene. +7.8' PCBs - 3.4'	Mercury - 3.4' Acenaphthalene - +7.8' PCBs - 3.4'
J	As - 5.9' PCBs - 5.9' cPAHs - +10'	DRO + RRO - 5.9' PCBs - 5.9'	DRO + RRO - 5.9'	DRO + RRO - 5.9'
K	As - 6.3' PCBs - 6.3' cPAHs - +7.0'	Mercury - 3.0' PCBs - 4.7'	Mercury - 3.0' PCBs - 4.7'	Mercury - 3.0' PCBs - 4.7'
L	PCBs - 4.3' cPAHs - 4.3'	Mercury - 4.3' DRO + RRO - 2.7' PCBs - 2.7'	DRO + RRO - 2.7 PCBs - 2.7'	DRO + RRO - 2.7' PCBs - 2.7'
M	PCBs - 2.2'	PCBs - 1.1'	none	none
SC-40	PCBs - 1.2'	PCBs - 1.2'	none	none
HS-6	PCBs +3'	----	-----	----
HS-7	PCBs +4'	Lead - +4.0' Mercury - +4.0' DRO + RRO +4.0' PCBs - +4.0'	Lead - +4.0' Mercury - +4.0' DRO + RRO +4.0' PCBs - +4.0'	Mercury - +4.0' DRO+RRO - +4.0' PCBs - +4.0'
HS-8	PCBs +3.5'	PCBs - +3.5'	PCBS - +3.5'	PCBs - +3.5'
HSA-1	PCBs - +5.0'	Lead - 3.0' PCBs - +5.0'	PCBs - +5.0'	PCBs - +5.0'
HSA -2	PCBs - +5.0'	Lead - +5.0' Mercury - +5.0' DRO+RRO - +4.0' PCBs - +5.0'	Lead - +5.0' Mercury - +5.0' DRO+RRO - +4.0' PCBs - +5.0'	Lead - +5.0' DRO+RRO - +5.0' PCBs - +5.0'
HSA-3	PCBs - +6.0'	Lead - 4.3' Mercury - +4.3' DRO+RRO - +3.5' PCBs - 4.3'	Lead - 3.0' Mercury - +3.5' DRO+RRO - +3.5' PCBs - 4.3'	Lead - 3.0' Mercury - +3.5' DRO+RRO - +3.5' PCBs - 4.3'
HSA-4	PCBs - +7.0'	Lead - 5.0' Mercury - +5.0' DRO+RRO - +4.0' PCBs - +7.0'	Lead - 5.0' Mercury - +5.0' DRO+RRO - +4.0' PCBs - +7.0'	Lead - 4.0' Mercury - +4.0' DRO+RRO - +5.0' PCBs - 6.0'

CUL - Cleanup Level
HH - CUL - Human Health Cleanup Level
RAL - Remedial Action Level
ENR UL - Enhanced Natural Recovery - Upper Limit
5.0' - Feet below mud-line
+7.0' - Exceedance likely greater than indicated value in feet.

TABLE A7.6 - Summary of Selected Subsurface Sediment Data

Location	Material Types	Mid-Point Depth (feet)	Sheen/ PID (ppm)	PCBs (ug/kg)	DRO+RRO (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Comment
Core A	Sandy gravel/silty Sand (0-1.5')	0.4	None/1.0	-----	-----	-----	-----	Top of silt at approximately 3'
	Precipitate (1.5'-1.8') Black	1.3	Light/2.5	2370	630	86.7	0.24	
	silty Sand (1.8'-3.3')	2.7	Light/3.8	-----	-----	-----	-----	
	Black to gray fine sandy SILT (3.3'-4.5')	3.9	None/1.3	99	84	10.3	0.17	
	Gray, silty, fine Sand (4.5'-6.2')	5.1	None/1.9	27.1	72	10.6	0.12	
		6.3	None/1.5	<4.8	87	12.4	0.15	
	Silt (6.2'-+8')	7.2	None/1.8	<6.3	121	10	0.14	
Core B	Sandy gravel (0-0.5');precipitate (0.5'-1.8'); sandy gravel (1.8'-2.9')	1.1	-----	430	85	14.9	0.04	Top of silt at approximaely 3'
		2.2	None/5.6	-----	-----	-----	-----	
	Fine sandy Silt (2.9'-5.2')	3.3	Moderate/14.2	29200	14300	796	13.1	
		4.4	Moderate/14.5	44100	14200	218	1.8	
	Dark gray Silt (5.2'-7.7')	5.5	None/2.6	97	114	12.4	0.13	
		6.6	None/1.1	<5.6	147	13.3	0.19	
Core C	Fine Sand to silty fine Sand (0'-2.5')	0.5	Moderate/46.2	-----	-----	-----	-----	Top of silt at approximately 2.5'
		2.3	Light/2.4	55	91	13.1	0.04	
	Silt (2.5'-4.0')	3.3	None/2.5	<3.8	66	7.9	0.12	
	Fine to medium Sand (4'-5')	4.4	None/4.2	<3.6	61	8	0.03	
Core D	Sand w/ precipitate (0-1.5')	0.7	Heavy/368	-----	-----	-----	-----	Top of silt approximately 3'
	Silty Sand w/ scattered precipitate (1.5'-2.9')	2.1	Heavy/240	17000	21900	4430	38.8	
	Mottled Silt to Silt (2.9'-8.0')	3.8	Light/33.7	67	103	28.3	2.05	
		5.3	None/4.2	<3.9	71	10.6	0.14	
		6.7	None/3.2	<3.9	119	11.6	0.15	
Core F	Gravelly Sand (0'-1.0')	0.5	Heavy/42	-----	-----	-----	-----	Top of silt approximately 3'
	Fine sandy Silt (1'-2.4')	1.7	Heavy/365	330	14100	4380	0.29	
	Banded Silt (2.4'-5.2')	3.1	Light/5.4	-----	-----	-----	-----	
		4.5	None/2.9	<4	115	11.5	0.16	
	Silt (5.2'-9.1')	5.8	None/68	<4	89	17.4	0.17	
		7	None/2.8	-----	-----	-----	-----	
		8.3	None/2.5	<3.9	43	11.5	0.09	
	Fine Sand (9.1'-12')	9.7	None/1.4	<3.7	<13	2.1	0.02	
		10.9	None/3.2	-----	-----	-----	-----	

TABLE A7.6 - Summary of Selected Subsurface Sediment Data

Location	Material Types	Mid-Point Depth (feet)	Sheen/ PID (ppm)	PCBs (ug/kg)	DRO+RRO (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Comment
Core G	Sandy Gravel (0-1.2')	0.6	-----	-----	-----	-----	-----	Top of silt at approximaely 2.5'
	Silty Sand (1.2'-2.4')	1.8	Light/1.4	-----	-----	-----	-----	
	Black Silt (2.4'-5.6')	3	Light/1.2	1550	225	22.5	0.2	
		4.1	Light/1.2	-----	-----	-----	-----	
		5.1	Heavy/36.5	10000	16300	1340	0.49	
	Gray Silt (5.6'-8')	6.8	None/1.0	<4	193	33.9	0.2	
Core H	Sandy Gravel (0-0.8')	0.4	Light/1.4	-----	-----	-----	-----	Top of Interbedded Silt/Sand Layer approximately 2.5'
	Silty Sand (0.8'-2.5')	1.7	Moderate/4.3	18100	880	168	0.39	
	Interbedded Silt/fine Sand (2.5'-4.1')	3.3	Heavy/28.8	38100	3400	936	4.85	
	Fine Sand (4.1'-5.6')	4.7	None/2.1	260	78	6.5	0.04	
Core I	Fine Sand (0-1.8')	0.9	None/0.9	-----	-----	-----	-----	Top of Silt at approximaely 3.0'
	Gravelly Sand (1.8'-3.2')	2.6	None/2.5	13000	850	123	1.77	
	Silt (3.2'-6.5')	4.2	None/1.9	395	206	25.4	0.3	
		5.9	None/1.9	143	181	38.5	0.24	
	Fine Sand (6.5'-11.8')	7.8	None/1.5	42	710	18.8	0.14	
		9.5	None/1.0	-----	-----	-----	-----	
Core J	Gravelly Sand (0'-1.5')	0.8	None/1.3	-----	-----	-----	-----	Top of Silt at approximaely 1.5'
	Banded Silt (1.5'-3.7')	2.6	Light/0.8	-----	-----	-----	-----	
	Black Silt (3.7'-6.0')	4.9	Moderate/3.3	337	3000	224	0.29	
	Fine Sand (6'-12')	6.8	None/1.5	<4.0	112	11.4	0.08	
		8.5	None/1.5	<3.8	95	13.7	0.11	
		10.4	None/1.5	<3.9	99	22.4	0.11	
Core K	Black/fine sandy Silt (0-3.3')	0.7	None/1.8	-----	-----	-----	-----	Top of silt approximaely 4.3'
		2.2	None/1.6	13000	1760	310	1.95	
	Coarse Sand (3.3'-4.3')	3.8	None/1.0	1610	250	79.3	0.38	
	Silt (4.3'-6.6')	5.5	None/6.9	103	1060	241	0.21	
	Silty Sand (6.6'-8')	7	None/1.1	<3.7	83	17.7	0.12	
Core L	Silty, fine Sand (0-2.5')	0.7	None/2.6	-----	-----	-----	-----	Top of silt approximaely 2.5')
		1.9	Light/5.4	2310	2600	87.2	0.34	
	Fine, sandy Silt (2.5'-4.3')	3.5	None/2.3	23	197	62	0.63	
	Fine Sand (4.3'-5.8')	5	None/2.4	<3.9	66	11.9	0.31	
	Fine to medium Sand (5.8'-8')	6.7	None/1.9	-----	-----	-----	-----	
Core M	Silt (0-2')	0.6	None/1.6	1110	215	57.9	0.21	Silt at surface
	Fine to medium Sand (2'-7.1')	1.6	None/1.7	312	45	23.7	0.04	
		2.7	None/1.2	<3.7	<12	1.9	<0.3	

(Summary Core Logs.xlsx-Sheet1)

TABLE A7.6 - Summary of Selected Subsurface Sediment Data

Location	Material Types	Mid-Point Depth (feet)	Sheen/ PID (ppm)	PCBs (ug/kg)	DRO+RRO (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Comment
Core LDW -SC-40 (R3)	Medium Sand (0-0.5')	-----	none noted	-----	-----	-----	-----	Top of silt approximaely
	Organic Silt (0.5-1.7')	0-1.3	none noted	161	-----	18	0.05	
	Medium to coarse Sand (1.7-13')	1.3-2	none noted	<4.0	-----	44	<0.05	
		2-4	none noted	<3.9	-----	<2	<0.05	
HS-6	Precipitate (0-2')	-----	none noted	-----	-----	-----	-----	
	Silty Sand (2'-3')	2-3	none noted	41.9	-----	-----	-----	
HS-7	Precipitate (0-3')	-----	none noted	-----	-----	-----	-----	
	Gravelly Sand (3'-4')	3-4	Moderate/nm	61800	13010	1280	31	
HS-8	Precipitate (0-2.5')	-----	None noted	-----	-----	-----	-----	
	Gravelly Sand (2.5-3.5')	2.5-3.5	Heavy/na	37320	-----	-----	-----	
HSA-1	Black Silt (gaskets)	1-2	Heavy/nm	54900	-----	-----	-----	
	Silt to fine, sandy Silt	2-3	Moderate/na	5785	-----	880	-----	
		3-4	Light/nm	632	452	36	0.26	
		4.5-5	carry down/nm	12740				
HSA-2	Black silty Sand w/ bung caps	2-3	Heavy/nm	129600	-----	12400	-----	
		3-4	Heavy/nm	47070	44800	8440	1.2	
	Dark gray, fine Sand	4-5	Heavy/nm	6240	-----	4050	-----	
HSA-3	Black sandy Silt	2-3	Moderate/na	43410	-----	7290	-----	
	Gray, fine Sand	3-3.5	Light/nm	4212	2736	609	2	
		5-6	none noted	66.7	-----	16	-----	
HSA-4	Black, silty Sand (paint solids)	2-3	Moderate/nm	171400	142400	14900	52	
	Black, silty Sand	3-4	Moderate/nm	15530	46200	7200	2.7	
		4-5	Heavy/nm	33200	-----	1110	-----	
	Dark gray, fine Sand	5-6	carry down	2914	-----	213	-----	
		6-7	carry down	2003	-----	-----	-----	

(shaded) - Fine grain low permeability layer
nm; ----- - Not measured

Table A7.7- Embayment Capital Cost Estimate
Embayment Sediment Remediation (2' Removal) **Revision Date** - 10/31/2022
Feasibility Level Estimate (-15%/+30%)

	Descritpion	Quantity	Unit	Unit Cost (2022)	Estimated Total Cost (2022)
1	**General**				
a	Mobilization/Demobilization	1	LS	$331,500	$331,500
b	Utility Locate	1	EA	$788	$800
c	Pre- and Post-Construction Surveys	2	EA	$16,275	$32,600
d	Temporary Breakroom/Shower Trailer for ICS	6	MO	$12,644	$75,900
2	**Site Preparation**				
a	Site Access (inc. upland building removal)	1	LS	$9,503	$9,500
b	Construction Fence and Signage	1	LW	$22,050	$22,100
3	**Storm Water Bypass and Contact Water**				
a	Bypass Storm Water at Manholes	1	EA	$5,670	$5,700
b	Construct Contact Water Treatment System	1	LS	$9,503	$9,500
c	Drive, Seal and Removal Diversion Dam	1	EA	$66,300	$66,300
d	Operation of Water Bypass & Treatment	72	DAY	$5,525	$397,800
e	Disposal of Treated Water in Sanitary Sewer	6700	1000 Gal	$27	$180,900
4	**Permanent Sheet Pile Wall**				
a	Construct North Wall	29160	SF	$80	$2,332,800
5	**Demolition of Existing Structures**				
a	Dock Structures	3000	SF	$36	$109,400
6	**Excavate Sediment >0' MLLW**				
a	Remove Concrete & Debris	5000	TON	$66	$331,500
b	**Excavate Sediments (+0' MLLW)**	3000	CY	$25	$74,600
7	**Dredge Seds<0'MLLW & Outside Dam**				
a	**Dredge Sediments From Water (<0' MLLW)**	750	CY	$80	$59,700
b	**Offload and Dispose of Dredged Sediments**	1125	TON	$106	$119,300
c	**Treat & Dispose of Dredged Water**	200	1000 Gal	$75	$15,000
8	**Stabilization, Transport, & Disposal**				
a	**Construct Sediment Processing Pad**	6000	SF	$34	$201,800
b	**Sediment Stabilization**	3750	CY	$13	$49,700
c	**Load Stabilized Sediments & Debris**	10600	TON	$5	$49,800
d	**Transport/Dispose (Subtitle D Landfill) - inc debris**	10000	TON	$95	$950,000
e	**Transport/Dispose (TSCA Facility)**	600	TON	$380	$228,000
9	**Place Cap & Shoreline Stabilization**				
a	**Procure & Place GAC Amended Sand (1'-0.5%)**	2800	TON	$80	$224,000
b	**Procure & Place Sand**	0	TON	$48	$0
c	**Procure & Place Gravelly Sand (clam matrix)**	2800	TON	$72	$201,400
b	**Procure & Place 3" Streambed (erosion protect.)**	3100	TON	$72	$223,000
c	**Procure & Place Planting Media**	600	CY	$165	$98,800
d	**Procure & Place Shoreline Stabilization Materials**	2500	TON	$93	$232,000
10	**Site Restoration**				
a	**Repair Security Fencing (Conventional/Electric)**	1400	LF	$160	$224,300
b	**Embayment Planting**	0.4	Acre	$70,350	$28,100
c	**Repair/Patch Pavement at Wheel Wash**	1600	SF	$9	$13,900
d	**Site Cleanup**	1	LS	$12,155	$12,200
e	**Remove Sediment Processing Pad**	6000	SF	$9	$56,400

Table A7.7- Embayment Capital Cost Estimate
Embayment Sediment Remediation (2' Removal) **Revision Date** - 10/31/2022
Feasibility Level Estimate (-15%/+30%)

	Descritpion	Quantity	Unit	Unit Cost (2022)	Estimated Total Cost (2022)
11	**Equipment Decomtamination**				
a	**Equipment Decontamination**	1	LS	$110,500	$110,500
	Capital Cost Subtotal				$7,078,800
	WSST @ 10.1%				$714,959
	Estimated Capital Cost w/o Contingency				$7,793,759
	Estimated Total Capital Cost				**$7,793,759**

Table A7.8- Embayment Capital Cost Estimate
Embayment Sediment Remediation (3' Nominal Removal) **Revision Date** - 10/31/2022
Feasibility Level Estimate (-15%/+30%)

	Descritpion	Quantity	Unit	Unit Cost (2022)	Estimated Total Cost (2022)
1	**General**				
a	Mobilization/Demobilization	1	LS	$331,500	$331,500
b	Utility Locate	1	EA	$788	$800
c	Pre- and Post-Construction Surveys	2	EA	$16,275	$32,600
d	Temporary Breakroom/Shower Trailer for ICS	6	MO	$12,644	$75,900
2	**Site Preparation**				
a	Site Access (inc. upland building removal)	1	LS	$9,503	$9,500
b	Construction Fence and Signage	1	LW	$22,050	$22,100
3	**Storm Water Bypass and Contact Water**				
a	Bypass Storm Water at Manholes	1	EA	$5,670	$5,700
b	Construct Contact Water Treatment System	1	LS	$9,503	$9,500
c	Drive, Seal and Removal Diversion Dam	1	EA	$66,300	$66,300
d	Operation of Water Bypass & Treatment	72	DAY	$5,525	$397,800
e	Disposal of Treated Water in Sanitary Sewer	6700	1000 Gal	$27	$180,900
4	**Permanent Sheet Pile Wall**				
a	Construct North Wall	29160	SF	$80	$2,332,800
5	**Demolition of Existing Structures**				
a	Dock Structures	3000	SF	$36	$109,400
6	**Excavate Sediment >0' MLLW**				
a	Remove Concrete & Debris	5000	TON	$66	$331,500
b	**Excavate Sediments (+0' MLLW)**	4200	CY	$25	$104,400
7	**Dredge Seds<0'MLLW & Outside Dam**				
a	**Dredge Sediments From Water (<0' MLLW)**	1000	CY	$80	$79,600
b	**Offload and Dispose of Dredged Sediments**	1500	TON	$106	$159,000
c	**Treat & Dispose of Dredged Water**	300	1000 Gal	$75	$22,500
8	**Stabilization, Transport, & Disposal**				
a	**Construct Sediment Processing Pad**	6000	SF	$34	$201,800
b	**Sediment Stabilization**	5200	CY	$13	$69,000
c	**Load Stabilized Sediments & Debris**	12800	TON	$5	$60,100
d	**Transport/Dispose (Subtitle D Landfill) - inc debris**	11960	TON	$95	$1,136,200
e	**Transport/Dispose (TSCA Facility)**	840	TON	$380	$319,200
9	**Place Cap & Shoreline Stabilization**				
a	**Procure & Place GAC Amended Sand (1'-0.5%)**	2800	TON	$80	$224,000
b	**Procure & Place Sand**	0	TON	$48	$0
c	**Procure & Place Gravelly Sand (clam matrix)**	5125	TON	$72	$368,600
b	**Procure & Place 3" Streambed (erosion protect.)**	3100	TON	$72	$223,000
c	**Procure & Place Planting Media**	600	CY	$165	$98,800
d	**Procure & Place Shoreline Stabilization Materials**	2500	TON	$93	$232,000
10	**Site Restoration**				
a	**Repair Security Fencing (Conventional/Electric)**	1400	LF	$160	$224,300
b	**Embayment Planting**	0.4	Acre	$70,350	$28,100
c	**Repair/Patch Pavement at Wheel Wash**	1600	SF	$9	$13,900
d	**Site Cleanup**	1	LS	$12,155	$12,200
e	**Remove Sediment Processing Pad**	6000	SF	$9	$56,400

Table A7.8- Embayment Capital Cost Estimate
Embayment Sediment Remediation (3' Nominal Removal) **Revision Date** - 10/31/2022
Feasibility Level Estimate (-15%/+30%)

	Descritpion	**Quantity**	**Unit**	**Unit Cost (2022)**	**Estimated Total Cost (2022)**
11	**Equipment Decomtamination**				
a	**Equipment Decontamination**	1	LS	$110,500	$110,500
			Capital Cost Subtotal		$7,649,900
			WSST @ 10.1%		$772,640
			Estimated Capital Cost w/o Contingency		$8,422,540
			Estimated Total Capital Cost		**$8,422,540**

Table A7.9- Embayment Capital Cost Estimate
Embayment Sediment Remediation (2' to 5' Removal) **Revision Date:** 10/31/2022
Feasibility Level Estimate (-15%/+30%)

	Descritpion	**Quantity**	**Unit**	**Unit Cost (2022)**	**Estimated Total Cost (2022)**
1	**General**				
a	Mobilization/Demobilization	1	LS	$331,500	$331,500
b	Utility Locate	1	EA	$788	$800
c	Pre- and Post-Construction Surveys	2	EA	$16,275	$32,600
d	Temporary Breakroom/Shower Trailer for ICS	6	MO	$12,644	$75,900
2	**Site Preparation**				
a	Site Access (inc. upland building removal)	1	LS	$9,503	$9,500
b	Construction Fence and Signage	1	LW	$22,050	$22,100
3	**Storm Water Bypass and Contact Water**				
a	Bypass Storm Water at Manholes	1	EA	$5,670	$5,700
b	Construct Contact Water Treatment System	1	LS	$9,503	$9,500
c	Drive, Seal and Removal Diversion Dam	1	EA	$66,300	$66,300
d	Operation of Water Bypass & Treatment	72	DAY	$5,525	$397,800
e	Disposal of Treated Water in Sanitary Sewer	6700	1000 Gal	$27	$180,900
4	**Permanent Sheet Pile Wall**				
a	Construct North Wall	29160	SF	$80	$2,332,800
5	**Demolition of Existing Structures**				
a	Dock Structures	3000	SF	$36	$109,400
6	**Excavate Sediment >0' MLLW**				
a	Remove Concrete & Debris	5000	TON	$66	$331,500
b	**Excavate Sediments (+0' MLLW)**	5225	CY	$25	$129,900
7	**Dredge Seds<0'MLLW & Outside Dam**				
a	**Dredge Sediments From Water (<0' MLLW)**	1130	CY	$80	$89,900
b	**Offload and Dispose of Dredged Sediments**	1695	TON	$106	$179,700
c	**Treat & Dispose of Dredged Water**	400	1000 Gal	$75	$30,000
8	**Stabilization, Transport, & Disposal**				
a	**Construct Sediment Processing Pad**	6000	SF	$34	$201,800
b	**Sediment Stabilization**	6355	CY	$13	$84,300
c	**Load Stabilized Sediments & Debris**	14533	TON	$5	$68,200
d	**Transport/Dispose (Subtitle D Landfill) - inc debris**	13408	TON	$95	$1,273,700
e	**Transport/Dispose (TSCA Facility)**	1125	TON	$380	$427,500
9	**Place Cap & Shoreline Stabilization**				
a	**Procure & Place GAC Amended Sand (1'-0.5%)**	2800	TON	$80	$224,000
b	**Procure & Place Sand**	3000	TON	$48	$142,700
c	**Procure & Place Gravelly Sand (clam matrix)**	3200	TON	$72	$230,100
b	**Procure & Place 3" Streambed (erosion protect.)**	3100	TON	$72	$223,000
c	**Procure & Place Planting Media**	600	CY	$165	$98,800
d	**Procure & Place Shoreline Stabilization Materials**	2500	TON	$93	$232,000
10	**Site Restoration**				
a	**Repair Security Fencing (Conventional/Electric)**	1400	LF	$160	$224,300
b	**Embayment Planting**	0.4	Acre	$70,350	$28,100
c	**Repair/Patch Pavement at Wheel Wash**	1600	SF	$9	$13,900
d	**Site Cleanup**	1	LS	$12,155	$12,200
e	**Remove Sediment Processing Pad**	6000	SF	$9	$56,400

Table A7.9- Embayment Capital Cost Estimate
Embayment Sediment Remediation (2' to 5' Removal) **Revision Date:** 10/31/2022
Feasibility Level Estimate (-15%/+30%)

	Descritpion	**Quantity**	**Unit**	**Unit Cost (2022)**	**Estimated Total Cost (2022)**
11	**Equipment Decomtamination**				
a	**Equipment Decontamination**	1	LS	$110,500	$110,500
	Capital Cost Subtotal				$7,987,300
	WSST @ 10.1%				$806,717
	Estimated Capital Cost w/o Contingency				$8,794,017
	Estimated Total Capital Cost				**$8,794,017**

Candidate Technology	Objectives/Description	Comment	Media to Address		Remedial Action Objective			
			Soil	Ground-water	RAO-1 Sediment	RAO-2 Soil Contact (Workers)	RAO-3 Soil Contact (Wildlife)	RAO-4/5 Ground-water (a)
Excavation w/ Off-Site Disposal (Section 8.2)	Remove higher concentration source materials to reduce: 1) human health/terrestrial soil contact risks,2) potential for leaching into groundwater, 3) potential for LNAPL leakage into the embayment (SA-MW1 area). Replace excavated soil with compacted fill, possibly agumented with organic carbon below the water table to sequester COPCs.	Most applicable to address "*hot-spot*" source soils on the ICS/NWC property that contain PCBs, petroleum hydrocarbons, lead and VOCs. Some soils would be TSCA wastes because of PCB concentrations greater than 50 ppm.	X		X	X	X	X
Excavation w/ On-Site Treatment and Off-site Disposal (Section 8.3)	Same as excavation w/ off-site disposal; reduce costs of off-site disposal by removing DW designation.	Data suggest soils would not designate as characteristic dangerous wastes (DW) in sufficient volumes to be cost effective. If used, the focus would likely be lead.	X		X	X	X	X
Excavation w/ On-Site Ex-Situ Solidification/Stabilization and Placement (Section 8.4)	Physically solidify/stabilize contaminated soil with cement (or other material) in a pug-mill or soil mixer to reduce human health/terrestrial soil contact risks and leaching to groundwater. Place treated material on-site above the water table and cover with a low permeability cap.	Most applicable to address "hot-spot" source soils on the ICS/NWC property that contain PCBs, petroleum hydrocarbons, lead and VOCs. Could not be used for soils containing PCBs above 50 ppm. Soils from the SA-MW1 area may be difficult to treat because of the presence of LNAPL. Would require long-term monitoring and maintenace of treated and capped soils.	X		X	X	X	X
In-Situ Soil Solidification/ Stabilization (Section 8.5)	Physically solidify/stabilize contaminated soil with cement (or other material) using specialty mixing augers in an overlapping pattern to reduce: 1) human health/terrestrial soil contact risks, and/or 2) potential for leaching into groundwater. Capable of delivering a variety of treatments - chemical oxidants, chemical reductants, and stabilizing/solidification agents (cement, clays) to depths of 35-40 feet.	May be applicable to deeper soil hot-spots on the ICS/NWC property along the former ditch alighment (vicinity of SA-MW2). Would not be applicable to SA-MW1 hot-spot because of the presence of LNAPL which is difficult to solidify/stabilize. Mix design will need to account for saline water conditions.	X		X	X	X	X
Subsurface Barrier - Solidification/Stabilization (Section 8.5)	Use similar auger technology as for in-situ soil solidification/stabilization. Could be used to install barrier along embayment to support shoreline during sediment removal and be a barrier to groundwater flow.	Could be used to install Secant (structural) pile wall along embayment shoreline. Mix design would need to account for saline water conditions. Potential for damage to wall in a major earthquake, (sheet-pile wall would likely provide a more reliable barrier to groundwater flow).		X	X			X
Subsurface Barrier - Sheet Pile Wall (Section 8.6)	Install sheet pile wall along embayment shoreline to stabilize embayment slopes and lengthen groundwater flow paths to promote sequestration of hydrophobic constituents such as PCBs and cPAHs by adsorption onto organic carbon, and degradation of VOCs such as benzene and vinyl chloride.	May be needed to be installed along embayment shoreline to stabilize slopes and facilitate excavation of embayment sediments. Wall could remain to prevent shallow groundwater seepage and increase groundwater flow paths to embayment. Potential for damage to wall in a major earthquake. Could be used to locally contain NAPL.		X	X			X
Maintain Existing Paving and Extend Cover/Barrier to Unpaved Areas. Continue to Collect/Treat Stormwater (Section 8.7)	Maintain existing paving and place new paving or other barrier (e.g. quarry spalls) in unpaved areas where human health soil contact or terrestrial ecologic risks exist. Would also reduce potential for soil leaching by reducing groundwater recharge.	Paving and stormwater collection would continue to reduce the potential for soil leaching (above the water table). Would need to be combined with institutional controls to maintain long-term integrity of barrier. Could be combined with coarse cobble layer along eastern boundary to reduce risks to burrowing animals and not increase storm water volumes.	X	X	X	X	X	X

Candidate Technology	Objectives/Description	Comment	Media to Address: Soil	Media to Address: Ground-water	Remedial Action Objective: RAO-1 Sediment	RAO-2 Soil Contact (Workers)	RAO-3 Soil Contact (Wildlife)	RAO-4/5 Ground-water (a)
Hydraulic Containment - Pump and Treat of Groundwater Entering Embayment (Section 8.8)	Use extraction wells to prevent impacted groundwater entering embayment and LDW, treat groundwater in treatment plant and locally re-inject or infiltrate treated water to site, or discharge to King County sanitarty sewer system. GW-COPCs would be contained on the site including PCBs, PCP, benzene, and vinyl chloride.	While some source would be removed, pump and treat is primarily a containment technology that would need to be operated and maintained in perpetuity. In-situ measures, if needed, would be more reliable, be less costly over the long-term and not require intensive on-going operation and maintenance.		X	X			X
Collect Mobile LNAPL from SA-MW1 Area (Section 8.9)	A recovery well would be installed to remove LNAPL from the SA-MW1 area. Mobile LNAPL would be recovered using a skimmer or dual-phase extraction.	Available data indicate that that some LNAPL is seeping into the embayment. Mobile LNAPL recovery would prevent future seepage. However, residual LNAPL would remain and potentially impact groundwater. Could be used with physical containment but direct removal with soil appears feasible.	X (LNAPL)		X			X
Enhance Embayment Sediment Cap (Section 8.10)	Augment embayment sediment cap with organic carbon to sequester PCBs and other contaminants migrating in groundwater in the lower portions of the cap.	Shallow groundwater from the adjacent uplands discharges to the embayment. Organic carbon mixed with capping material below the point of compliance (45 cm depth) would be used to sequester COPCs before migration with groundwater into the upper portions of the cap.		X	X			X
In-Situ Chemical Oxidation (ISCO) (Section 8.11)	Use chemical oxidizers to destroy VOCs and other COPCs in soil and groundwater.	VOCs and other organic COPCs in groundwater and soil (below water table) could be destroyed by in-situ oxidation. Possible oxidizers include Fentons reagent (hydrogen peroxide), permanganent, and persulfate. Natural attentuation of aromatic hydrocarbons (BTEX) and vinyl chloride downgradient of the treatment area could be enhanced by increasing the oxygen concentrations in groundwater.	X	X	X			X
In-Situ Enhanced Aerobic Biodegradation (ISB) (Section 8.11)	Inject a solution of oxygen release compound (ORC) or equivalent in the benzene source area to enhance aerobic degradation of benzene and vinyl chloride.	Natural degradation appears to be occurring based on groundwater analytical data. This technology would enhance these natural processes.	X	X	X			X
In-Situ Chemical Reduction (ISCR) (Section 8.11)	Use chemical amendments to degrade (PCP, chlorinated VOCs and, possibly, congener-specific PCBs) in groundwater. Such amendments include Zero Valent Iron (ZVI) and emulsified vegetable oils.	Biological processes (biostimulation/bioaugmentation) and metallic particle driven abiotic pathways to chemically reduce chlorinated contaminants degraded by reductive dechlorination (PCP and chlorinated compounds). Reductive dechlorination appears to be occurring naturally. Only low concentrations of parent solvents (PCE and TCE) exist in soil on the site. Additional research would be required to support use for PCP and PCBs.	X	X	X			X
In-Situ Chemical Treatment - Permeable Treatment Medium (Section 8.12)	Install permeable treatment walls or place backfill to sequester constituents prior to discharge to surface water along the embayment shoreline.	Treatment walls containing organic carbon or activated carbon (e.g. Regenesis PlumeStop) could be combined with physical barriers to sequester COPCs prior to groundwater discharge to the embayment. Reactive materials could be incorporated into hot-spot backfill along the embayment shoreline. Injectable organic carbon could also be used as a contingency measure.		X	X			X

Candidate Technology	Objectives/Description	Comment	Media to Address: Soil	Media to Address: Ground-water	Remedial Action Objective: RAO-1 Sediment	RAO-2 Soil Contact (Workers)	RAO-3 Soil Contact (Wildlife)	RAO-4/5 Ground-water (a)
Air-sparging (Section 8.13)	Install air-sparging wells below the water table and inject ambient air into the subsurface. Use air-sparging strip VOCs from groundwater and to increase dissolved oxygen concentrations in groundwater to promote degradation of aromatic hydrocarbons and potentially degrade vinyl chloride. Would be combined with SVE.	Most applicable to the Upper Aquifer groundwater zone where the fine-grained unit (aquitard) is missing. Would be combined with SVE.	X	X	X			X
Soil Vapor Extraction (SVE) (Section 8.14)	Remove VOC vapors from subsurface and treat vapors. Would be combined with air-sparging.	By itself not viable for VOC removal because of high water table and most VOCs present in groundwater. Would be combined with air-sparging.	X	X	X			X
Upgrade 2nd Ave. Storm Water Conveyance (Section 8.15)	The storm water pipeline appears sound but could leak in the future. Slip-fitting a liner into the existing pipeline or installing a new water tight pipeline would reduce the potential for impacted ground water infiltration into the conveyance. The work could also include installation of a tide gate.	Does not seem practical to relocate the pipeline. Pipeline replacement could be coordinated with cleanup of the former ditch alignment. Slip-filling a liner would require an analysis that the smaller diameter liner could handle peak storm water flows. Will be addressed as part of the peripheral area remedy as part of design. Does not affect overalll remedy selection.	**To protect surface water**		X			
Monitored Natural Attenuation (MNA) (Section 8.16)	Monitor natural attenuation/degradation of VOCs and sequestration of PCBs to ensure compliance with CULs at point of compliance (where groundwater discharges to surface water).	Assumes sources have been controlled to an adequate extent (primarily LNAPL in SA-MW1 area). Data indicate that PCBs are not migrating in groundwater to a significant degree and that VOCs are attenuating/degrading before groundwater discharge to surface water.		X	X			X
Institutional Controls (Section 8.17)	Use environmental covenants to reduce human health and terrestrial risks and ensure the long term viability of implemented remedial measures. Prevent use of groundwater for drinking water purposes.	Not adequate to meet cleanup levels in and of itself but will be implemented as part of any conceivable remedy.	X	X	X	X	X	X
Performance Monitoring (Section 8.18)	Assess long-term effectiveness of implemented remedial measures. Primarily will include performance groundwater monitoring and inspection/maintenance monitoring of constructed remedial components	Not adequate to meet cleanup levels in and of itself but will be implemented as part of any conceivable technically feasible and practical remedy. Would be combined with MNA		X	X	X	X	X

Notes: X - Technology applicable to indicated media and Remedial Action Objectives (RAOs); Note (a) - Protect surface water and sediment via soil leaching and groundwater discharge.

Candidate Technology	Objectives/Description	Comment	Carry-Forward For Alternative Development: A. PA Area - Filled-In Ditch Alignment	B. PA Area - Upland Area Adjacent to Embayment	C. ED Area (East Bldg.)	D. Douglas Property
Excavation w/ Off-Site Disposal (Section 8.2)	Remove higher concentration source materials to reduce: 1) human health/terrestrial soil contact risks,2) potential for leaching into groundwater, 3) potential for LNAPL leakage into the embayment (SA-MW1 area). Replace excavated soil with compacted fill, possibly agumented with organic carbon below the water table to sequester COPCs.	Most applicable to address "*hot-spots*" on the ICS/NWC property. Some soils would be TSCA wastes because of PCB concentrations greater than 50 ppm.	X	X		
Excavation w/ On-Site Treatment and Off-site Disposal (Section 8.3)	Same as excavation w/ off-site disposal; reduce costs of off-site disposal by removing DW designation.	Data suggest soils would not designate as characteristic dangerous wastes (DW) in sufficient volumes to be cost effective.				
Excavation w/ On-Site Ex-Situ Solidification/Stabilization and Placement (Section 8.4)	Physically solidify/stabilize contaminated soil with cement (or other material) in a pug-mill or soil mixer to reduce human health/terrestrial soil contact risks and leaching to groundwater. Place treated material on-site above the water table and cover with a low permeability cap.	Could not be used for soils containing PCBs above 50 ppm. Soils from the SA-MW1 area may be difficult to treat because of the presence of LNAPL. Would require long-term monitoring and maintenace of treated and capped soils.				
In-Situ Soil Solidification/ Stabilization (Section 8.5)	Physically solidify/stabilize contaminated soil with cement (or other material) using specialty mixing augers in an overlapping pattern to reduce: 1) human health/terrestrial soil contact risks, and/or 2) potential for leaching into groundwater. Capable of delivering a variety of treatments - chemical oxidants, chemical reductants, and stabilizing/solidification agents (cement, clays) to depths of 35-40 feet.	May be applicable to deeper soil hot-spots on the ICS/NWC property along the former ditch alignment. However, geochemical analyses indicate that PCBs of much higher concentration are not leaching from groundwater to a significant degree. Would not be applicable to SA-MW1 hot-spot because of the presence of LNAPL which is difficult to solidify/stabilize. Mix design would need to account for saline water conditions.				
Subsurface Barrier - Solidification/Stabilization (Section 8.5)	Use similar auger technology as for in-situ soil solidification/stabilization. Could be used to install barrier along embayment to support shoreline during sediment removal and be a barrier to groundwater flow.	Could be used to install Secant (structural) pile wall along embayment shoreline. Mix design would need to account for saline water conditions. Potential for damage to wall in a major earthquake, (sheet-pile wall would likely provide a more reliable barrier to groundwater flow).				
Subsurface Barrier - Sheet Pile Wall (Section 8.6)	Install sheet pile wall along embayment shoreline to stabilize embayment slopes and lengthen groundwater flow paths to facilitate COPC attenuation. This latter objective may not be readily obtainable based on groundwater modelling that indicates lower zone flow is to LDW.	Will need to be installed along the north embayment shoreline to stabilize slopes and facilitate excavation of embayment sediments. Wall could remain to prevent shallow groundwater seepage to embayment. Potential for damage to wall in a major earthquake. Could be used to locally contain NAPL.		X		X
Maintain Existing Paving and Extend Cover/Barrier to Unpaved Areas. Continue to Collect/Treat Stormwater (Section 8.7)	Maintain existing paving and place new paving or other barrier (e.g. quarry spalls) in unpaved areas where human health soil contact or terrestrial ecologic risks exist. Would also reduce potential for soil leaching by reducing groundwater recharge.	Paving and stormwater collection would continue to reduce the potential for soil leaching (above the water table). Would need to be combined with institutional controls to maintain long-term integrity of barrier. Could be combined with coarse cobble layer along eastern boundary to reduce risks to burrowing animals and not increase storm water volumes.	X	X	X	

TABLE A8.2 - List of Remedial Technologies Carried Forward -ICS/NWC Site

Revised Draft: 11-10-22

Candidate Technology	Objectives/Description	Comment	Carry-Forward For Alternative Development A. PA Area - Filled-In Ditch Alignment	Carry-Forward For Alternative Development B. PA Area - Upland Area Adjacent to Embayment	Carry-Forward For Alternative Development C. ED Area (East Bldg.)	Carry-Forward For Alternative Development D. Douglas Property
Hydraulic Containment - Pump and Treat of Groundwater Entering Embayment (Section 8.8)	Use extraction wells to prevent impacted groundwater entering embayment and LDW, treat groundwater in treatment plant and locally re-inject or infiltrate treated water to site, or discharge to King County sanitarty sewer system.	While some source would be removed, pump and treat is primarily a containment technology that would need to be operated and maintained in perpetuity. In-situ measures would be more reliable, if needed, be less costly over the long-term and not require intensive on-going operation and maintenance.				
Collect Mobile LNAPL from SA-MW1 Area (Section 8.9)	A recovery well would be installed to remove LNAPL from the SA-MW1 area. Mobile LNAPL would be recovered using a skimmer or dual-phase extraction.	Available data indicate that that some LNAPL is seeping into the embayment. Mobile LNAPL recovery would prevent future seepage. However, residual LNAPL would remain and potentially impact groundwater. Could be used with physical containment but direct removal with soil appears feasible.				
Enhance Embayment Sediment Cap (Section 8.10)	Augment embayment sediment cap with organic carbon to sequester PCBs and other contaminants migrating in groundwater in the lower portions of the cap.	Shallow groundwater from the adjacent uplands discharges to the embayment. Organic carbon mixed with capping material below the point of compliance (45 cm depth) would be used to sequester COPCs before migration with groundwater into the upper portions of the cap.		X		
In-Situ Chemical Oxidation (ISCO) (Section 8.11)	Use chemical oxidizers to destroy VOCs and other organic COPCs in soil and groundwater.	VOCs and other organic COPCs in groundwater and soil (below water table) could be destroyed by in-situ oxidation. Possible oxidizers include Fentons reagent (hydrogen peroxide), permanganent, and persulfate. Natural attentuation of aromatic hydrocarbons (BTEX) and vinyl chloride downgradient of the treatment area could be enhanced by increasing the oxygen concentrations in groundwater. However, ISCO also destroys natural microbial populations that facilitate degradation.			X	
In-Situ Chemical Reduction (ISCR) (Section 8.11)	Use chemical amendments to degrade (PCP, chlorinated VOCs and, possibly, congener-specific PCBs) in groundwater. Such amendments include Zero Valent Iron (ZVI) and emulsified vegetable oils.	Biological processes (biostimulation/bioaugmentation) and metallic particle driven abiotic pathways to chemically reduce chlorinated contaminants degraded by reductive dechlorination (PCP and chlorinated compounds). Reductive dechlorination appears to be occurring naturally. Only low concentrations of parent solvents (PCE and TCE) exist in soil on the site. Additional research would be required to support use for PCP and PCBs.				
In-Situ Enhanced Aerobic Biodegradation (ISB) (Section 8.11)	Inject a solution of oxygen release compound (ORC) or equivalent in the benzene source area to enhance aerobic degradation of benzene and vinyl chloride.	Natural degradation appears to be occurring based on groundwater analytical data. This technology would enhance these natural processes.			X	

Candidate Technology	Objectives/Description	Comment	Carry-Forward For Alternative Development			
			A. PA Area - Filled-In Ditch Alignment	B. PA Area - Upland Area Adjacent to Embayment	C. ED Area (East Bldg.)	D. Douglas Property
In-Situ Chemical Treatment - Permeable Treatment Medium (Section 8.12)	Install permeable treatment walls or place backfill to sequester constituents prior to discharge to surface water along the embayment shoreline.	Treatment walls containing organic carbon or activated carbon (e.g. Regenesis PlumeStop) could be combined with physical barriers to sequester COPCs prior to groundwater discharge to the embayment. Reactive materials could be incorporated into hot-spot backfill along the embayment shoreline. Injectable organic carbon could also be used as a contingency measure.		X		X
Air-sparging (Section 8.13)	Install air-sparging wells below the water table and inject ambient air into the subsurface. Use air-sparging to increase dissolved oxygen concentrations in groundwater to promote degradation of aromatic hydrocarbons and potentially degrade vinyl chloride. Would be combined with SVE.	Most applicable to the Upper Aquifer groundwater zone where the fine-grained unit (aquitard) is missing. Would be combined with SVE.			X	
Soil Vapor Extraction (SVE) (Section 8.14)	Remove VOC vapors from subsurface and treat vapors. Would be combined with air-sparging.	By itself not viable for VOC removal because of high water table and most VOCs present in groundwater. Would be combined with air-sparging.			X	
Upgrade 2nd Ave. Storm Water Conveyance (Section 8.15)	The storm water pipeline appears sound but could leak in the future. Slip-fitting a liner into the existing pipeline or installing a new water tight pipeline would reduce the potential for impacted ground water infiltration into the conveyance. The work could also include installation of a tide gate.	Does not seem practical to relocate the pipeline. Pipeline replacement could be coordinated with cleanup of the former ditch alignment. Slip-filling a liner would require an analysis that the smaller diameter liner could handle peak storm water flows. Will be addressed as part of the peripheral area remedy as part of design. Does not affect overalll remedy selection.				
Monitored Natural Attenuation (MNA) (Section 8.16)	Monitor natural attenuation/degradation of VOCs and sequestration of PCBs to ensure compliance with CULs at point of compliance (where groundwater discharges to surface water).	Assumes sources have been controlled to an adequate extent (primarily NAPL in SA-MW1 area). Data indicate that PCBs are not migrating in groundwater to a significant degree and that VOCs are attenuating/degrading before groundwater discharge to surface water.	X	X	X	X
Institutional Controls (Section 8.17)	Use environmental covenants to reduce human health and terrestrial risks and ensure the long term viability of implemented remedial measures. Prevent use of groundwater for drinking water purposes.	Not adequate to meet cleanup levels in and of itself but will be implemented as part of any conceivable remedy.	X	X	X	X
Performance Monitoring (Section 8.18)	Assess long-term effectiveness of implemented remedial measures. Primarily will include performance groundwater monitoring and inspection/maintenance monitoring of constructed remedial components	Not adequate to meet cleanup levels in and of itself but will be implemented as part of any conceivable technically feasible and practical remedy. Would be combined with MNA	X	X	X	X

Notes: **X** - Carried forward to alternative development.

TABLE A9.1a - Remedial Soil Concentrations - ICS Upland - Alternative No. 1

COC	Conc. Units	Assumed CUL	No. of Samples (a)	Existing Conditons				After Apply Implementation				% Decline UCL95%
				Max. Conc.	UCL95%	% Spls > CUL	Spls. > 2xCUL	Max. Conc.	UCL95%	% Spls > CUL	Spls. > 2xCUL	
PCBs	ug/kg	10000 (b)	370	1768000	40038	15.4	38	1768000	40038	15.4	38	0.0%
Lead	mg/kg	1000(b)	331	11800	541	5.1	14	11800	541	5.1	14	0.0%
DRO+RRO	mg/kg	2000(b)	340	65000	6113	22.9	62	65000	6113	22.9	62	0.0%
Mercury	mg/kg	2	301	52	1.6	7	12	52	1.6	7	12	0.0%

Notes: (a) - Number of samples used in statistical analysis
(b) - Method A Industrial CUL
(c) - Mercury is not a significant groundwater COC. Based on Method A Industrial CUL.
CUL - Cleanup Level

-Less than CUL and MTCA Performance Criteria
-Greater than CUL and MTCA Performance Criteria

TABLE A9.1b - Estimated Cost ICS Upland Alternative No. 1

	Units	Unit Cost	Amounts	Estimate	Assumptions/Comment
Mobilization	LS	$ 50000.00	1	$50,000	incl. utility locate, survey
Decommission wells	well	$ 1000.00	4	$4,000	
Relocation of stormwater treatment	LS	$ 25000.00	1	$25,000	
South Sheet Pile Wall	SF	$ 80.00	23100	$1,848,000	Assume 550 linear feet to 42 feet deep
SA-MW1 Contaniment	SF	$ 80.00	1500	$120,000	Assume 150 linear feet to 10 feet deep
SA-MW1 LNAPL Revovery	LS	$ 20000.00	1	$20,000	Recovery well and system
Demolition					
ACM/Haz materials abatement	LS	$ 13000.00	1	$13,000	Boiler only - Quote from Dickson
Building structures	LS	$ 62800.00	1	$62,800	Quote from Dickson
Tanks footings (old SW treatment)	LS	$ 26000.00	1	$26,000	previous estimate
Concrete slab	SF	$ 6.00	3665	$21,990	In hot-spot areas
Shallow excavation (<4' deep)	CY	$ 10.00	0	$0	Areas P1, P8 and P39
Deeper excavation w/Trench Box (>4')	CY	$ 70.00	0	$0	Area SA-MW1. Includes trench box and steel plates
Water management	gal	$ 0.75	0	$0	Assumes <20,000 gallons (not include PCB treat)
Address "Void" - LP4	LS	$ 10000.00	0	$0	
Backfilling					
Import and place fill	ton	$ 38.00	0	$0	1.4 tons/CY
Concrete pavement - 6"	SY	$ 78.00	2100	$163,800	
Subtotal construction				$2,354,590	
Sales tax (10.10) on construction	%	10.10		$237,814	
Disposal (Subtitle C - TSCA)	ton	$ 380.00	0	$0	Incl. transport, taxes Waste Management
Disposal (Subtitle D)	ton	$ 95.00	0	$0	Incl. transport, taxes Waste Management
Subtotal				$2,592,404	
Design, oversight and reporting	%	15%		$388,861	Estimate 15% of construction costs
Operation/Monitoring	LS	$ 260000.00	1	$260,000	Assumes 30 years CAP inspections; ten years of semiannual monitoring for PCBs, HVOCs and TPH-G/BTEX
Subtotal				$3,241,264	
Contingency (20%)	%	20%		$648,253	
Estimated Total				**$3,889,517**	

TABLE A9.2a - Remedial Soil Concentrations - ICS Upland - Alternative No. 2

ICS/NW Cooperage Site
Seattle, Washington

COPC	Conc. Units	Assumed CUL	No. of Samples (a)	Existing Conditons								% Decline UCL95%
				Max. Conc.	UCL95%	% Spls > CUL	Spls. > 2xCUL	Max. Conc.	UCL95%	% Spls > CUL	Spls. > 2xCUL	
PCBs	ug/kg	10000 (b)	370	1768000	40038	15.4	38	209300	11390	13	29	71.6%
Lead	mg/kg	1000(b)	331	11800	541	5.1	14	11800	426	3.9	10	21.3%
DRO+RRO	mg/kg	2000(b)	340	65000	6113	22.9	62	53400	4955	20.9	55	18.9%
Mercury	mg/kg	2 (c)	301	52	1.6	7	12	27.8	1.0	6	10	37.5%

Notes: (a) - Number of samples used in statistical analysis
(b) - Method A Industrial CUL
(c) - Mercury is not a significant groundwater COC. Based on Method A Industrial CUL.
CUL - Cleanup Level

-Less than CUL and MTCA Performance Criteria
-Greater than CUL and MTCA Performance Criteria

TABLE A9.2b - Estimated Cost Upland Alternative 2

	Units	Unit Cost	Amounts	Estimate	Assumptions/Comment
Mobilization	LS	$ 50000.00	1	$50,000	incl. utility locate, survey
Decommission wells	well	$ 1000.00	4	$4,000	
Relocation of stormwater treatment	LS	$ 25000.00	1	$25,000	
South Sheet Pile Wall	SF	$ 80.00	23100	$1,848,000	Assume 550 linear feet to 42 feet deep
SA-MW1 Containment	SF	$ 80.00	0	$0	Assume 150 linear feet to 10 feet deep
SA-MW1 LNAPL Revovery	LS	$ 20000.00	1	$20,000	Recovery well and system
Demolition					
ACM/Haz materials abatement	LS	$ 13000.00	1	$13,000	Boiler only - Quote from Dickson
Building structures	LS	$ 62800.00	1	$62,800	Quote from Dickson
Tanks footings (old SW treatment)	LS	$ 26000.00	1	$26,000	previous estimate
Concrete slab	SF	$ 6.00	13500	$81,000	In hot-spot areas
Shallow excavation (<4' deep)	CY	$ 10.00	445	$4,450	Area SA-MW1
Deeper excavation w/Trench Box (>4')	CY	$ 70.00	445	$31,150	Area SA-MW1. Includes trench box and steel plates
Water management	gal	$ 0.75	0	$0	Assumes <20,000 gallons (not include PCB treat)
Address "Void" - LP4	LS	$ 10000.00	0	$0	
Backfilling					
Import and place fill	ton	$ 38.00	1335	$50,730	1.5 tons/CY
Planting	LS	$ 2500.00	1	$2,500	
Place concrete pavement - 6"	SY	$ 78.00	1500	$117,000	
Subtotal construction				$2,335,630	
Sales tax (10.1) on construction	%	10.10		$235,899	
Disposal (Subtitle C - TSCA)	ton	$ 380.00	450	$171,000	Incl. transport, taxes Waste Management
Disposal (Subtitle D)	ton	$ 95.00	885	$84,075	Incl. transport, taxes Waste Management
Subtotal				$2,826,604	
Design, oversight and reporting	%	15%		$423,991	Estimate 15% of construction costs
Operation/Monitoring	LS	$ 260000.00	1	$260,000	Assumes 30 years CAP inspections; ten years of semiannual monitoring for PCBs, HVOCs and TPH-G/BTEX
Subtotal				$3,510,594	
Contingency (20%)	%	20%		$702,119	
Estimated Total				**$4,212,713**	

TABLE A9.3a - Remedial Soil Concentrations - ICS Upland - Alternative No. 3

COPC	Conc. Units	Assumed CUL	No. of Samples (a)	Existing Conditons								% Decline UCL95%
				Max. Conc.	UCL95%	% Spls > CUL	Spls. > 2xCUL	Max. Conc.	UCL95%	% Spls > CUL	Spls. > 2xCUL	
PCBs	ug/kg	10000 (e)	370	1768000	40038	15.4	38	209300	7694	5.9	12	80.8%
Lead	mg/kg	1000(e)	331	11800	541	5.1	14	5070	231	2.4	6	57.3%
DRO+RRO	mg/kg	2000(e)	340	65000	6113	22.9	62	37500	2822	11.5	26	53.8%
Mercury	mg/kg	100(h)	124	52	1.6	7	12	27.8	1.0	5	10	37.5%

Notes: (a) - Number of samples used in statistical analysis
(b) - Method A Industrial CUL
(c) - Mercury is not a significant groundwater COC. Based on Method A Industrial CUL.
CUL - Cleanup Level

-Less than CUL and MTCA Performance Criteria
-Greater than CUL and MTCA Performance Criteria

TABLE A9.3b - Estimated Cost Upland Alternative 3

	Units	Unit Cost	Amounts	Estimate	Assumptions/Comment
Mobilization	LS	$ 50000.00	1	$50,000	incl. utility locate, survey
Decommission wells	well	$ 1000.00	4	$4,000	
Relocation of stormwater treatment	LS	$ 25000.00	1	$25,000	
South Sheet Pile Wall	SF	$ 80.00	0	$0	Assume 550 linear feet to 42 feet deep
SA-MW1 Containiment	SF	$ 80.00	0	$0	Assume 150 linear feet to 10 feet deep
SA-MW1 LNAPL Revovery	LS	$ 20000.00	0	$0	Recovery well and system
Demolition					
ACM/Haz materials abatement	LS	$ 13000.00	1	$13,000	Boiler only - Quote from Dickson
Building structures	LS	$ 62800.00	1	$62,800	Quote from Dickson
Tanks footings (old SW treatment)	LS	$ 26000.00	1	$26,000	previous estimate
Concrete slab	SF	$ 6.00	18000	$108,000	In excavation areas
Shallow excavation	CY	$ 10.00	2650	$26,500	Excavation Areas - Not including deeper SA-MW1
Deeper excavation w/Trench Box (>4')	CY	$ 70.00	400	$28,000	Portions area SA-MW1, MW-Ju. Includes trench box and steel plates
Water management	gal	$ 0.75	0	$0	Assumes <20,000 gallons (not include PCB treat)
Address "Void" - LP4	LS	$ 10000.00	0	$0	
Backfilling					
Import and place fill	ton	$ 38.00	4600	$174,800	1.5 tons/CY
Planting	LS	$ 10000.00	1	$10,000	12,000 square feet
Restore concrete pavement - 6"	SY	$ 78.00	1500	$117,000	
Subtotal construction				$645,100	
Sales tax (10.10) on construction	%	10.10		$65,155	
Disposal (Subtitle C - TSCA)	ton	$ 380.00	1125	$427,500	Incl. transport, taxes Waste Management
Disposal (Subtitle D)	ton	$ 95.00	3525	$334,875	Incl. transport, taxes Waste Management
Subtotal				$1,472,630	
Design, oversight and reporting	%	15%		$220,895	Estimate 15% of construction costs
Operation/Monitoring	LS	$ 260000.00	1	$260,000	Assumes 30 years CAP inspections; ten years of semiannual monitoring for PCBs, HVOCs and TPH-G/BTEX
Subtotal				$1,953,525	
Contingency (20%)	%	20%		$390,705	
Estimated Total				**$2,344,230**	

TABLE A9.4a - Remedial Soil Concentrations - ICS Upland - Alternative No. 3 + No. 4

COPC	Conc. Units	Assumed CUL	No. of Samples (a)	Existing Conditons								% Decline UCL95%
				Max. Conc.	UCL95%	% Spls > CUL	Spls. > 2xCUL	Max. Conc.	UCL95%	% Spls > CUL	Spls. > 2xCUL	
PCBs	ug/kg	10000 (b)	370	1768000	40038	15.4	38	17000	1388	2.2	0	96.5%
Lead	mg/kg	1000(b)	331	11800	541	5.1	14	2410	91.5	0.6	1	83.1%
DRO+RRO	mg/kg	2000(b)	340	65000	6113	22.9	62	32500	1564	9.1	19	74.4%
Mercury	mg/kg	2(c)	124	52	1.6	7	12	13.9	0.47	3	2	70.6%

Notes:
(a) - Number of samples used in statistical analysis
(b) - Method A Industrial CUL
(c) - Mercury is not a significant groundwater COC. Based on Method A Industrial CUL.
CUL - Cleanup Level

-Less than CUL and MTCA Performance Criteria
-Greater than CUL and MTCA Performance Criteria

TABLE 9.4b - Estimated Cost Alternative 4 - Lagoon (incremental to Alternative 3)

	Units	Unit Cost	Amounts	Estimate	Assumptions/Comment
Mobilization	LS	$ 50000.00	0	$0	Assumes upland mob. w/ shoreline
Decommission wells	well	$ 1000.00	4	$4,000	
Demolition					
Concrete slab	SF	$ 6.00	7300	$43,800	Existing paving
Shallow excavation (<3' deep)	CY	$ 10.00	800	$8,000	Exc. and stockpile
Deeper excavation w/Trench Box	CY	$ 70.00	1760	$123,200	Includes trench box and steel plates
Water management	gal	$ 0.75	0	$0	
Address "Void" - LP4	LS	$ 13000.00	1	$13,000	
Backfilling					
Import/place fill	ton	$ 38.00	2640	$100,320	1.5 tons/CY
Place stockpiled fill	CY	$ 20.50	800	$16,400	
Restore concrete pavement - 6"	SY	$ 74.00	850	$62,900	Would include small unpaved area
Subtotal construction				$371,620	
Sales tax (10.10) on construction	%	10.10		$37,534	
Disposal (Subtitle C - TSCA)	ton	$ 380.00	915	$347,700	Incl. transport, taxes Waste Management
Disposal (Subtitle D)	ton	$ 95.00	840	$79,800	Incl. transport, taxes Waste Management
Subtotal				$836,654	
Design, oversight and reporting	%	15%		$125,498	Estimate 15% of construction costs
Operation/Monitoring	LS	$ $260,000	0	$0	Assumes 30 years CAP inspections; ten years of semiannual monitoring for PCBs, HVOCs and TPH-G/BTEX
Subtotal				$962,152	
Contingency (20%)	%	20%		$192,430	
Estimated Total				**$1,154,582**	

ALTERNATIVE ICS-ED1 - MNA

ITEM	Units	Unit Cost	Amounts	COST
Install two new wells	EA	$7,500	2	$15,000
ESTIMATED COST				**$15,000**

ALTERNATIVE ICS-ED2 - IN-SITU GW SPARGING AND VAPOR EXTRACTION TREATMENT

ITEM	Units	Unit Cost	Amounts	COST
Soil Vapor Extraction				
Assumptions:				
Two horizontal lines spaced 15' apart (100' length each)				
12 Vertical sparge wells on 15' spacing (screened 27-30')				
Design	LS	$17,250	1	$17,250
Equipment	LS	$34,500	1	$34,500
horizontal wells (2)	EA	$28,750	2	$57,500
vertical well (12)	EA	$3,450	12	$41,400
condensate carbon	LS	$920	1	$920
Install equipment/compound	LS	$23,000	1	$23,000
Connect power	LS	$3,450	1	$3,450
Purchase two 1000 lb activated carbon units	EA	$11,500	1	$11,500
Permitting (PSCAA)	LS	$5,750	1	$5,750
DOF Installation labor	LS	$11,500	1	$11,500
DOF Start-up labor	LS	$11,500	1	$11,500
Install two new wells	EA	$7,500	2	$15,000
ESTIMATED INSTALLATION COST				**$233,270**
Operation and Maintenance				
Assumptions:				
1000 lbs per month average carbon consumption				
Three Year Operation				
Carbon replacement/disposal	LBS	$1.73	36000	$62,100
Monthly maintenance	Month	1,150	36	$12,000
Electrical power	Month	345	36	$3,600
Reporting	EA	3,450	3	$10,350
ESTIMATED THREE YEAR O&M COST				**$77,700**
ESTIMATED TOTAL COST				**$310,970**

ISCO GROUNDWATER TREATMENT

ITEM	Units	Unit Cost	Amounts	COST
Assumptions:				
Using Sodium Persulfate or equivalent				
Pilot study limited to vicinity of MW-8				
18 grid locations on 15' centers				
Pilot Study and Additional Characterization	LS	17250	1	$25,000
Oxidant product (2 rounds)	EA	46000	2	$92,000
Drilling & injection (2 rounds)	DAY	4025	18	$72,450
DOF QA/QC labor (2 rounds)	EA	17250	2	$34,500
Install two new wells	EA	$7,500	2	$15,000
Reporting	EA	$3,450	2	$6,900
ESTIMATED COST				**$245,850**

ISB GROUNDWATER TREATMENT

ITEM	Units	Unit Cost	Amounts	COST
Assumptions:				
Using Regenesis ORC-X or equivalent				
10 grid locations on 20' centers (assumes dispersion over time)				
HRC product (2 rounds)	LBS	$9	5000	$46,000
Drilling & injection (2 rounds)	DAY	4025	6	$24,150
DOF QA/QC labor (2 rounds)	EA	17250	2	$34,500
Install two new wells	EA	$7,500	2	$15,000
Reporting	EA	$3,450	2	$6,900
ESTIMATED COST				**$126,550**

ED Area
ASSUMPTIONS
45' x 90' area
saturated zone 10-30' deep
Fairly uniform fine to medium sand

ISCO - In-Situ Chemical Oxidation
ISB - In-Situ Enhanced Aerobic Biodegradation

TABLE A10.1 - Remedial Alternative Rankings

TABLE A10.1a - Embayment Alternatives

Disproportionate Cost Criteria	Embayment Alternative		
	EB-1 (2' Sed. Removal)	EB-2 (3' Sed. Removal)	EB-3 (2' to 5' Sed. Removal)
Overall Protectiveness	1	2	3
Permanence	1	2	3
Long-Term Effectiveness	1	2	3
Short-Term Risk Management	3	2	1
Implementability	3	2	1
Consider of Public Concerns	1	2	3
Total Benefit Score	10	12	14
Total Estimated Cost (millions)	$11.2	$12.1	$12.7
Benefit/Cost Ratio	0.89	0.99	1.10

Notes: 1 = Lowest Relative Ranking, 3=Highest Relative Ranking; Benefit/Cost Ratio = Cost (in millions of dollars)/Total Benefit Score (e.g. EB-3 - 14/$12.7=1.10)

TABLE A10.1b - Upland Alternatives

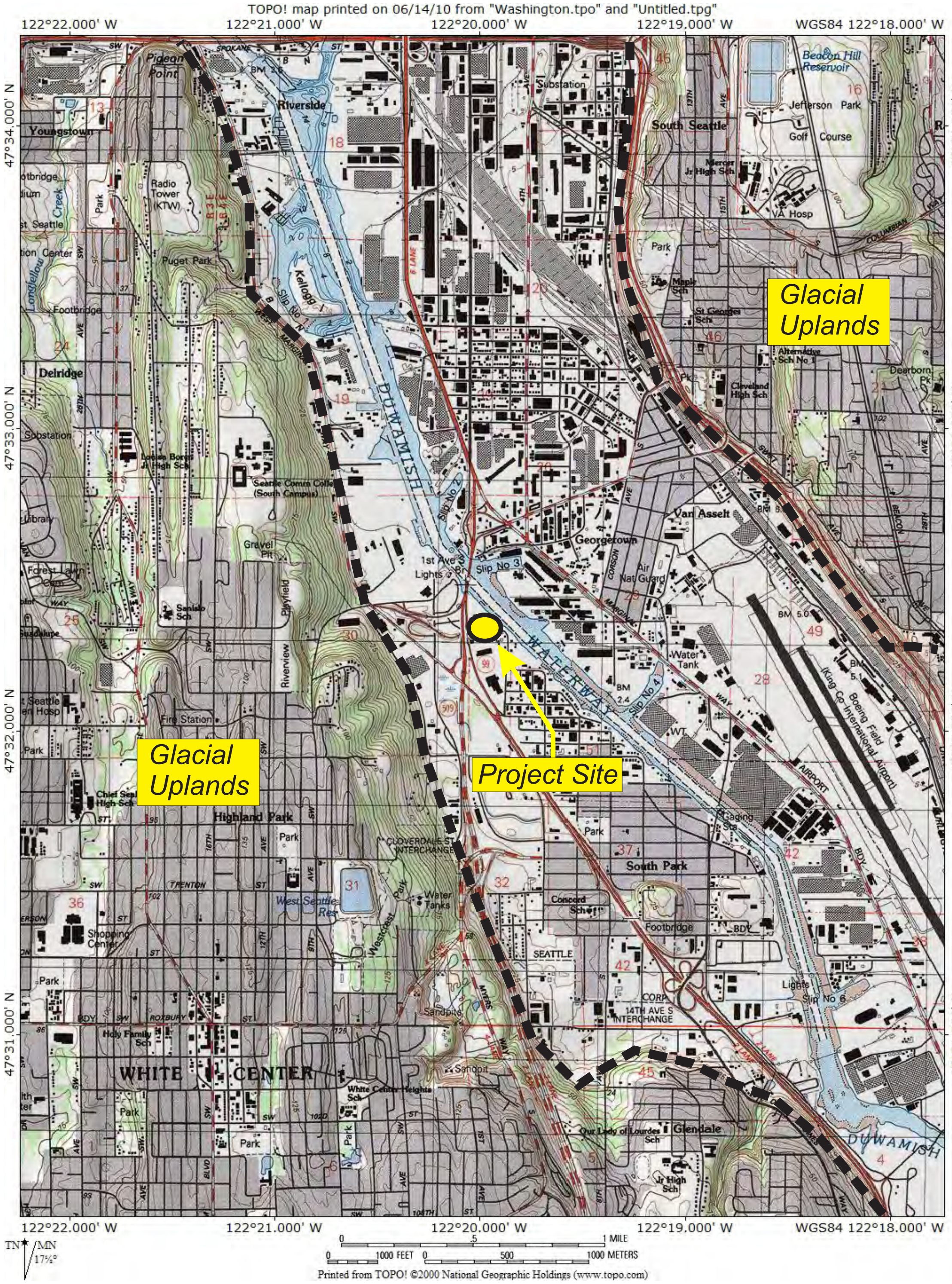
Disproportionate Cost Criteria	Upland Alternatives			
	UP-1 (S. Wall/NAPL Well)	UP-2 (S. Wall/Exc. NAPL)	UP-3 (Cut S. Slope/Exc. NAPL)	UP-3 +4 (UP3 + Exc. Settling Basin)
Overall Protectiveness	1	2	2	3
Permanence	1	2	2	3
Long-Term Effectiveness	1	1	2	3
Short-Term Risk Management	3	2	2	1
Implementability	1	1	3	2
Consider of Public Concerns	1	2	2	3
Total Benefit Score	8	10	13	15
Total Estimated Cost (millions)	$3.9	$4.2	$2.3	$3.5
Benefit/Cost Ratio	2.05	2.38	5.65	4.29

Notes: 1 = Lowest Relative Ranking, 3=Highest Relative Ranking; Benefit/Cost Ratio = Cost (in millions of dollars)/Total Benefit Score (e.g. UP-3+4 - 15/$3.5=4.29)

TABLE A10.1c - East Drum Building Area Alternatives

Disproportionate Cost Criteria	East Drum Building Area Alternatives			
	ED-1 (MNA)	ED-2 (Sparging/SVE)	ED-3a (ISCO)	ED-3b (ISB)
Overall Protectiveness	3	3	3	3
Permanence	3	3	3	3
Long-Term Effectiveness	3	3	3	3
Short-Term Risk Management	3	3	2	3
Implementability	3	1	2	2
Consider of Public Concerns	2	2	2	2
Total Benefit Score	17	15	15	16
Total Estimated Cost (millions)	\$0.02	\$0.31	\$0.25	\$0.13
Benefit/Cost Ratio	850	48	60	123

Notes: 1 = Lowest Relative Ranking, 3=Highest Relative Ranking; Benefit/Cost Ratio = Cost (in millions of dollars)/Total Benefit Score (e.g. ED-1 - 17/\$0.02=850); SVE - Soil Vapor Extraction; ISCO - In Situ Chemical Oxidation; ISB - In Situ Enhanced Aerobic Biodegradation.



N

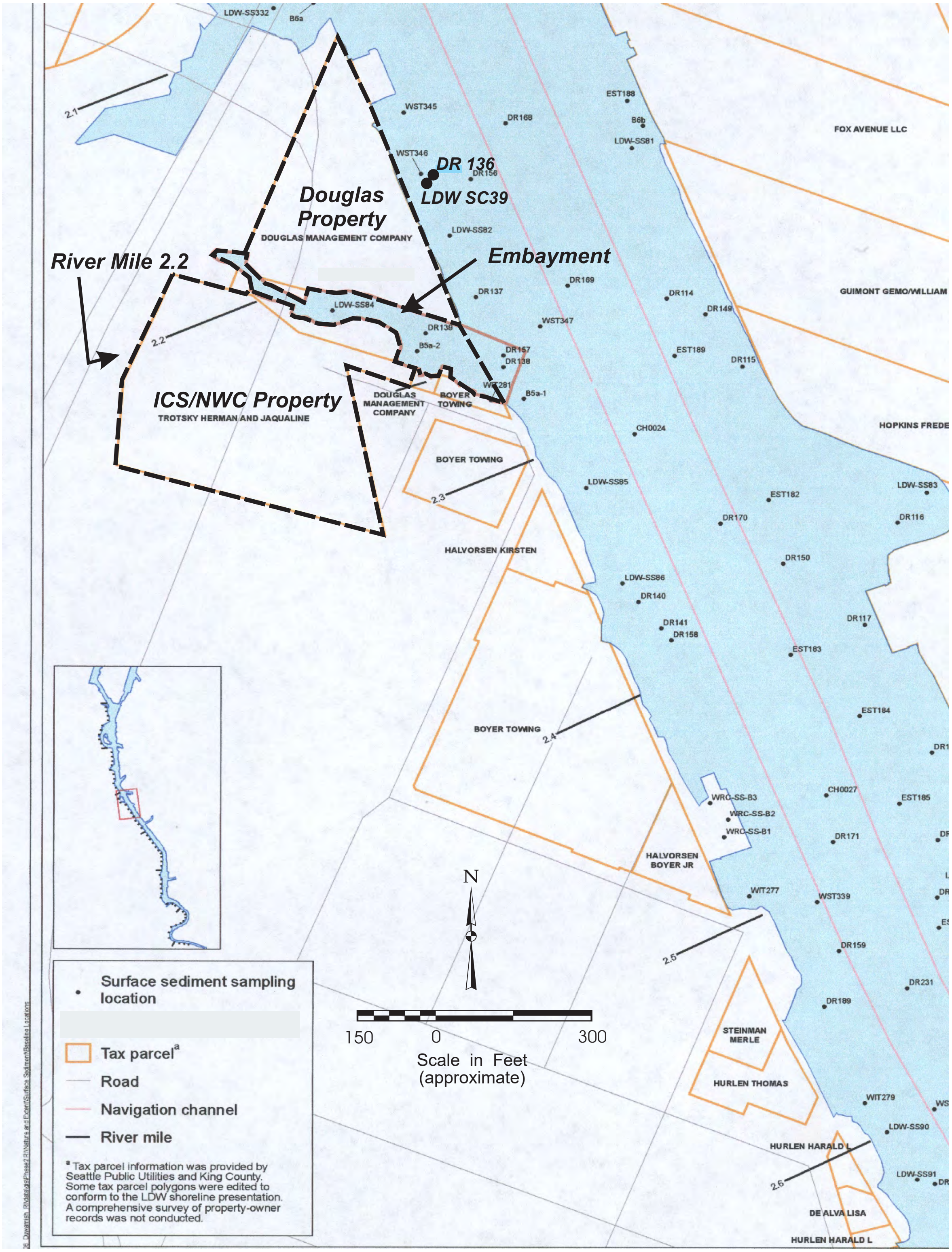
ICS/NW Cooperage Site

Vicinity Map

SUM-008-00 (ICS) *June 2010*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 1-1



Note: Base Windward Environmental Draft RI Map 4-4e

ICS/NW Cooperage Site

Project Site Area and Lower Duwamish Waterway

SUM-008-00 (ICS) ***Sept. 2014***

FIGURE 1-2

Ref: Map Local.cdr

Dalton, Olmsted & Fuglevand, Inc.

Property Boundary

Embayment (Remedial) Area

ICS Upland (Remedial) Area

Image: Google Maps Pro
Date: 05-22-17

N

0 120
Scale in Feet

Ref: 2018 Properties FSrev.cdr

ICS/NW Cooperage Site
Seattle, Washington

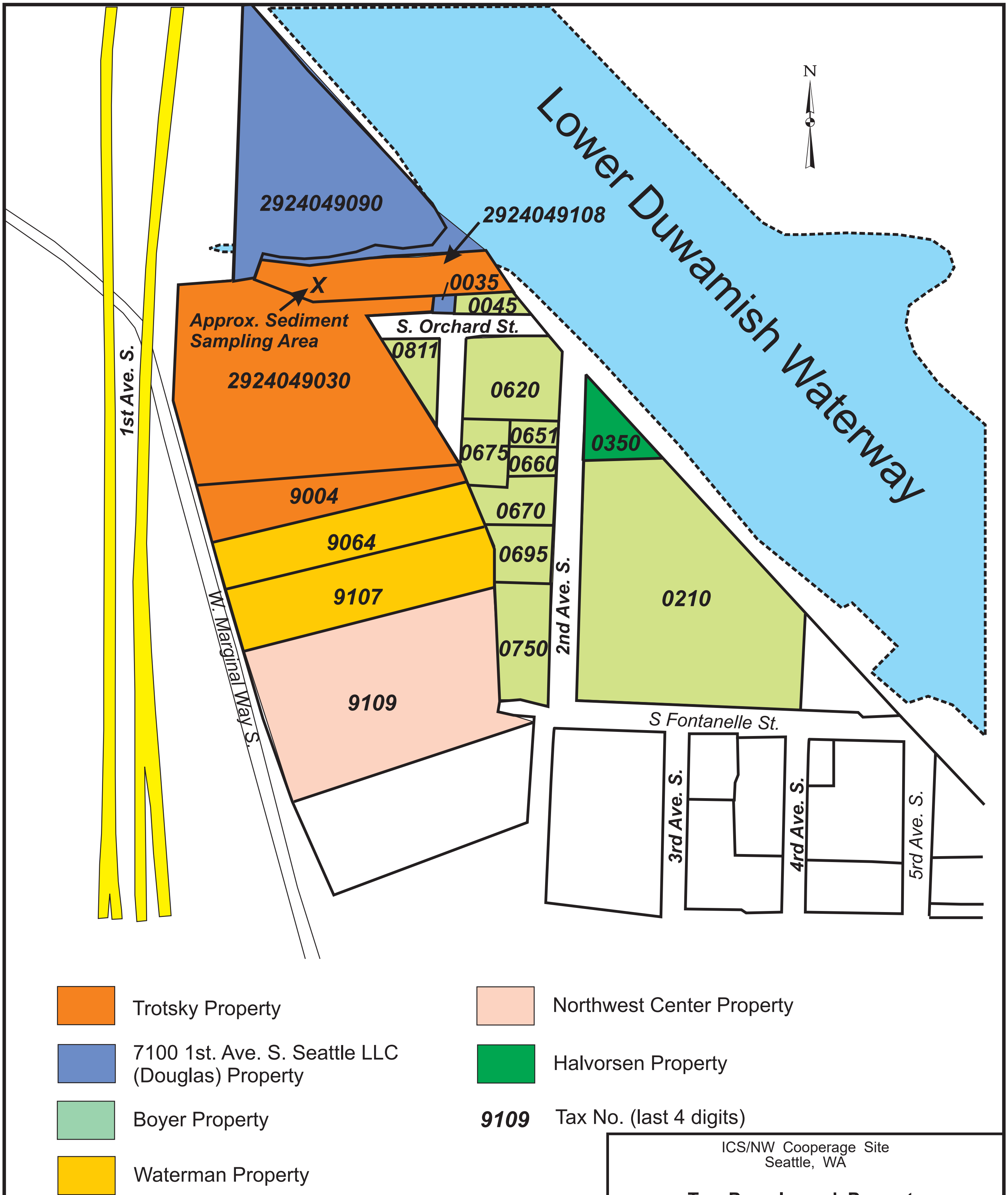
DALTON OLMSTED FUGLEVAND

Property Lines and Remedial Areas

FIGURE
1-3

March 6, 2018

PLOT TIME: 2/23/2018 8:40 AM MOD TIME: 2/23/2018 12:10 PM USER: Lee Barras DWG: D:\Projects\ICS-NW Cooperage\Figures\2018-02\2018-02-23 ICS MW2CDR.dwg



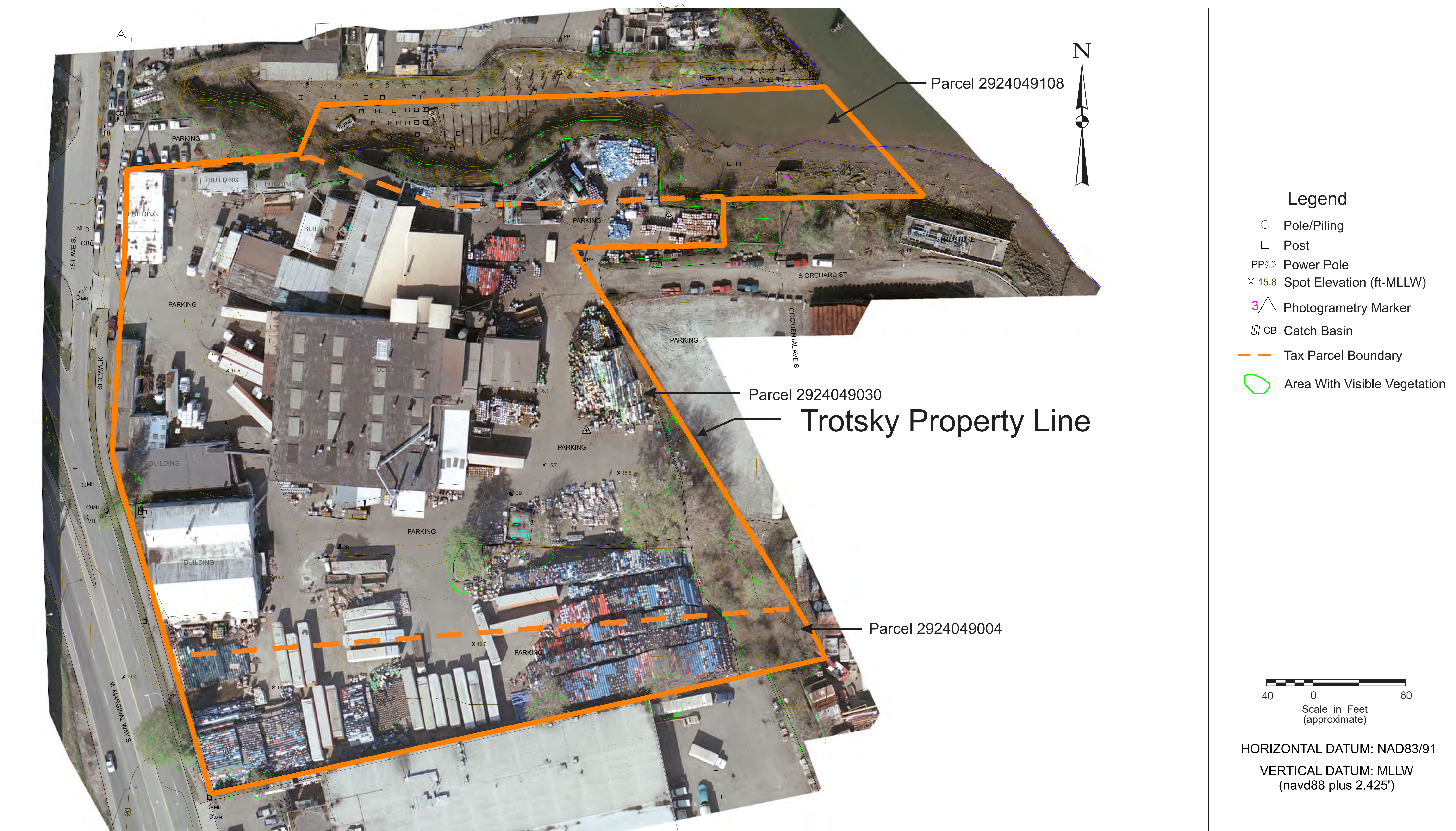
Ref: Tax Parcels revFS.cdr

ICS/NW Cooperage Site
Seattle, WA

Tax Parcels and Property Ownership

SUM-008-00 **FIGURE 1-4** May 2010

Dalton, Olmsted & Fuglevand, Inc.



Notes:
1) Property Survey by Continental Survey Co. (12-15-09)
2) Topography by David C. Smith Associates (flown 3-18-10 @ 1412 PDT)

Ref: ICS-NW Cooperage Photo Topo.cdr

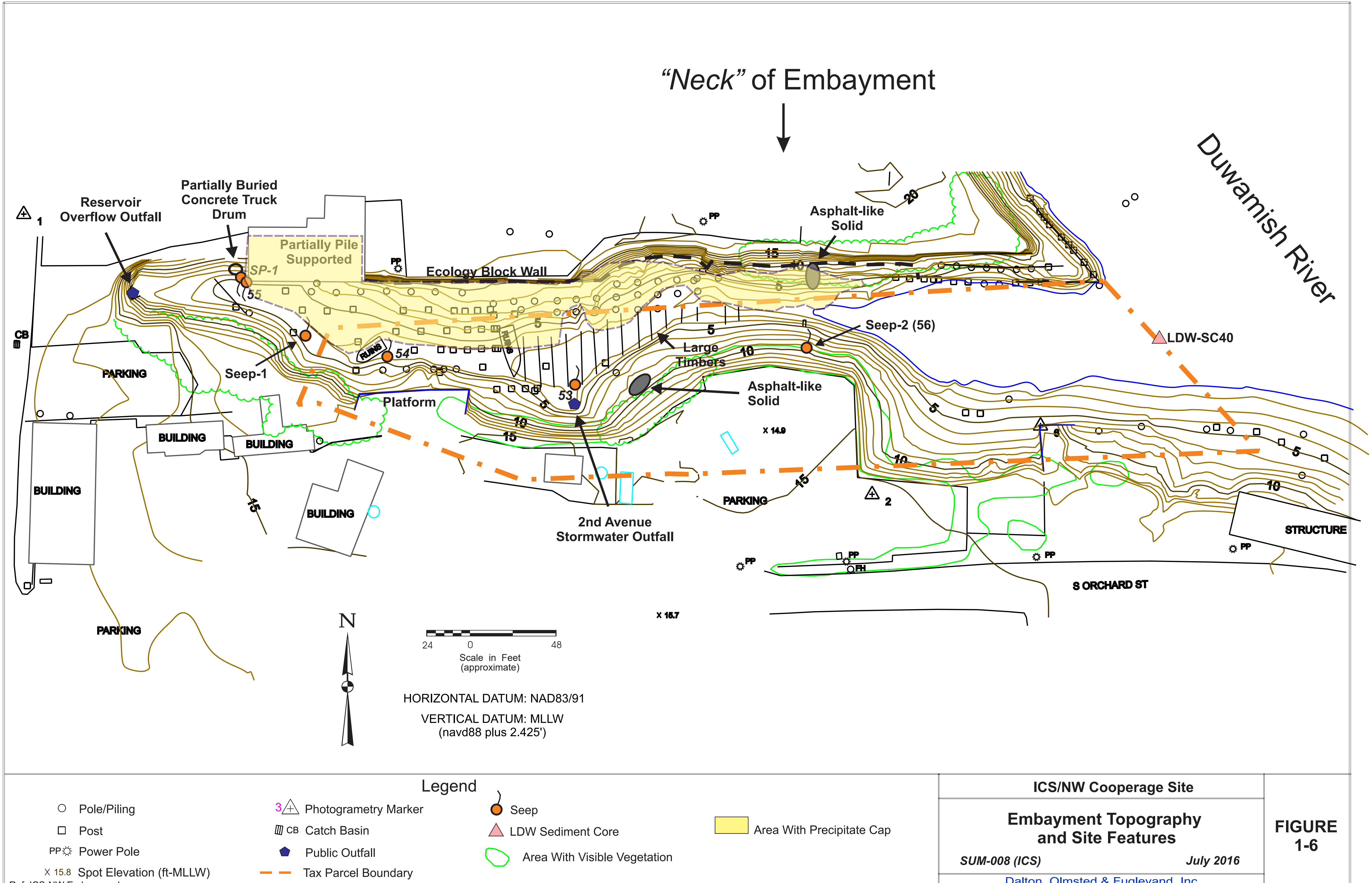
ICS/NW Cooperage Site

Air Photograph - March 18, 2010

SUM-008-00 (ICS) *June 2010*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 1-5



ICS/NW Cooperage Site

Embayment Topography and Site Features

SUM-008 (ICS) *July 2016*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 1-6

Notes:

1) All site paving consists of concrete, with many joints, hairline fractures, overlays and patches.
2) Perimeter of paved area is surrounded by 6-inch concrete curbing, except as noted in driveway areas.
3) Areas of pavement damage with multiple fractures/alligatoring shown.

Ref: ICS Paving 8-2016 revFS.cdr

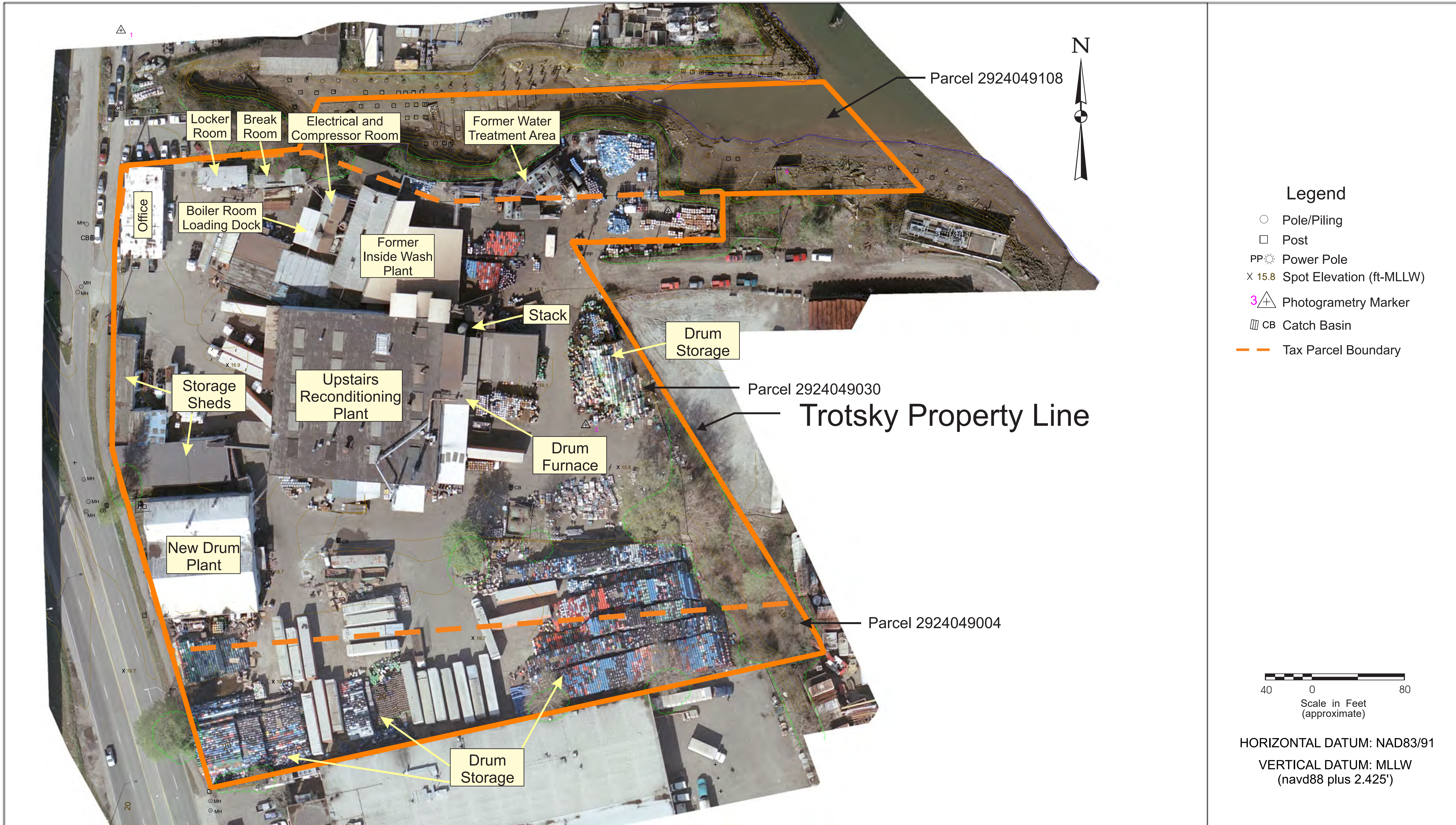
ICS/NW Cooperage Site

Extent of Paving

SUM-008 (ICS) Dec. 2019

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 1-7



Notes:

1) Property Survey by Continental Survey Co. (12-15-09)
2) Topography by David C. Smith Associates (flown 3-18-10 @ 1412 PDT)

Ref: ICS-NW Cooperage Photo rev FS.cdr

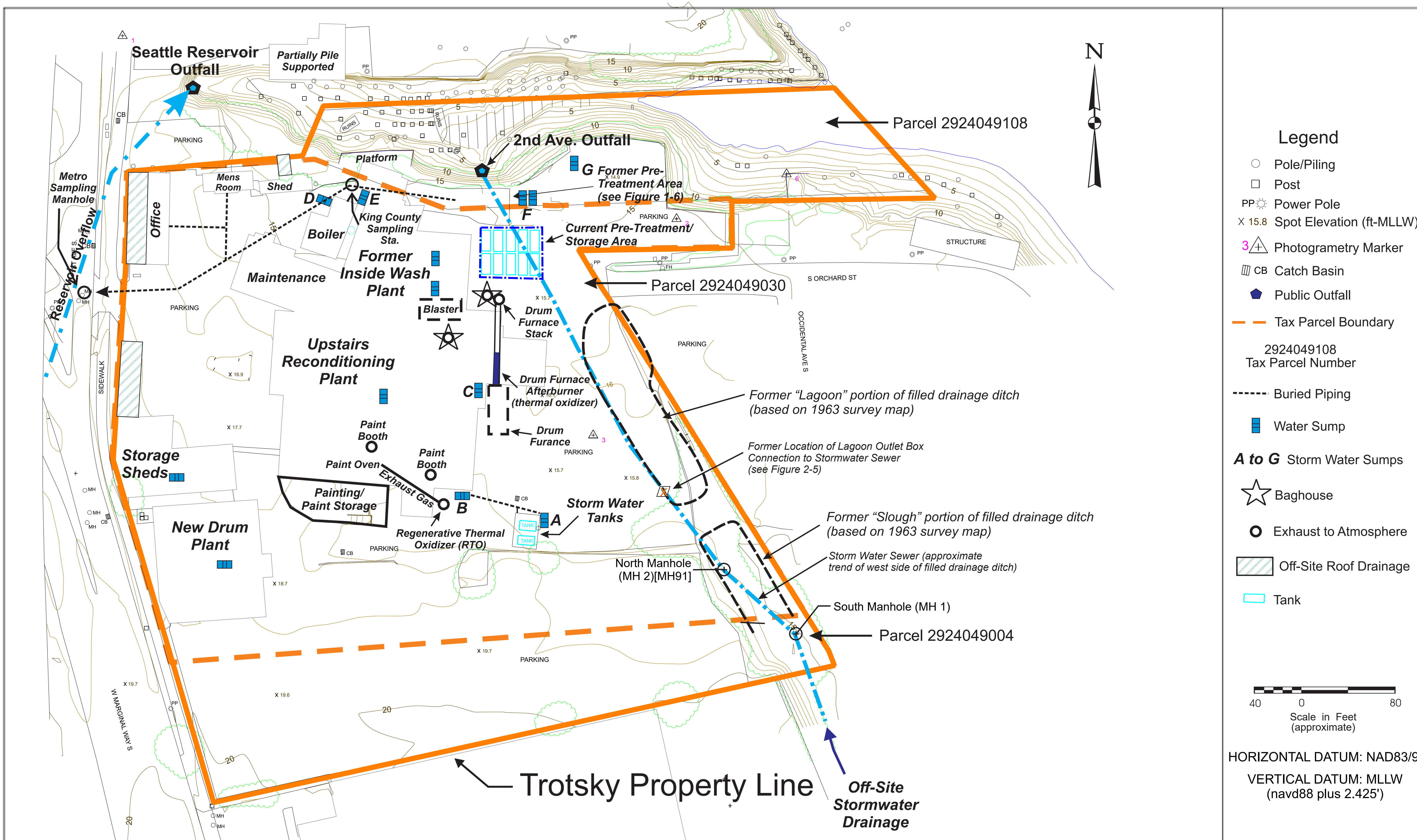
ICS/NW Cooperage Site

Site Layout on Photobase

SUM-008-00 (ICS) *Dec. 2019*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 1-8a



Notes:

1) Property Survey by Continental Survey Co. (12-15-09)
2) Topography by David C. Smith Associates (Flown 3-18-10)
3) Buried pipe, Metro sampling points, and sump locations have not been surveyed
4) All sump connections are above ground except near stormwater tanks

Ref: ICS-NW Cooperage Working Base rev1FS.cdr

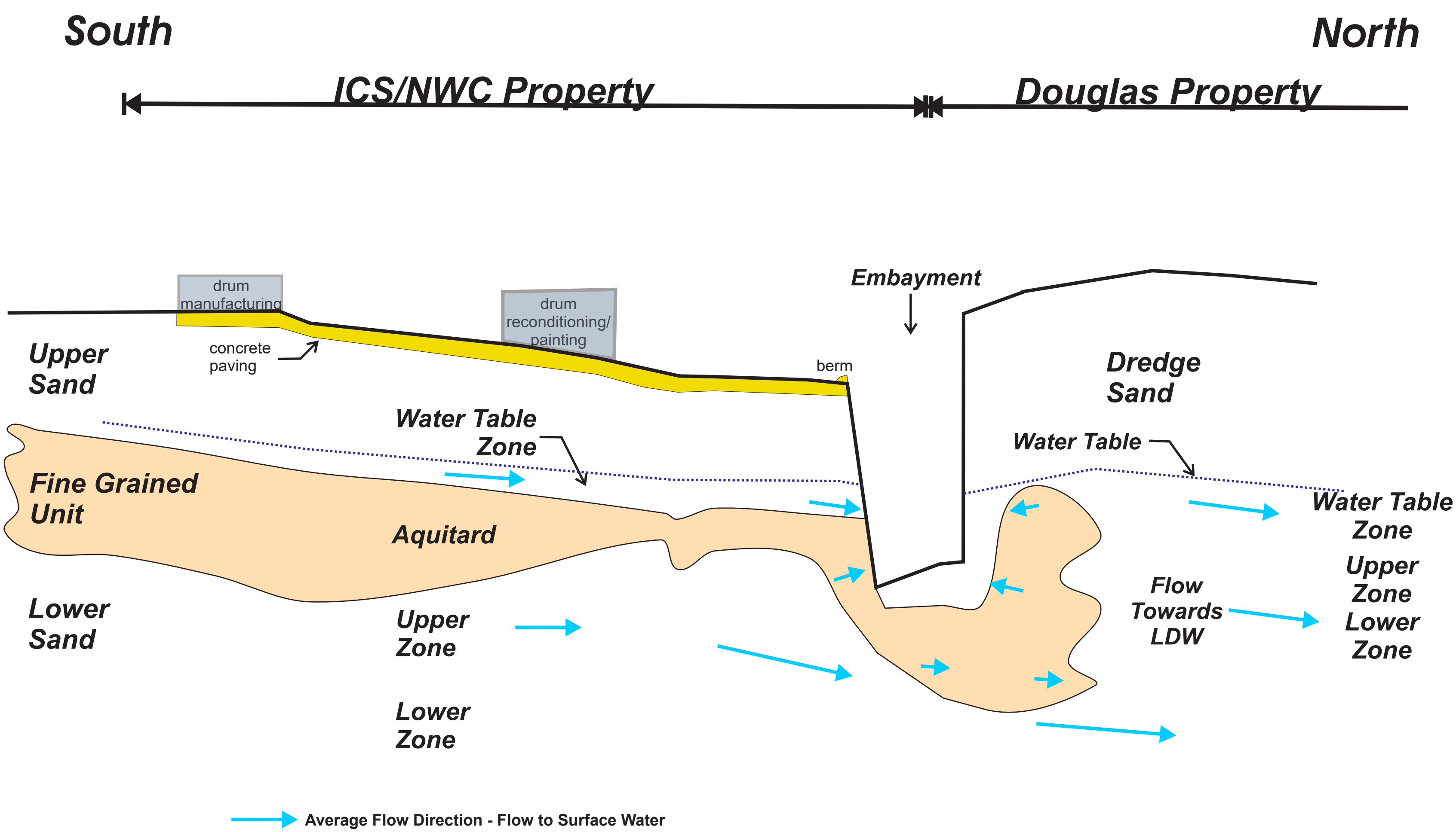
ICS/NW Cooperage Site

Site Layout and Topography

SUM-008 (ICS) ***Dec. 2019***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 1-8b



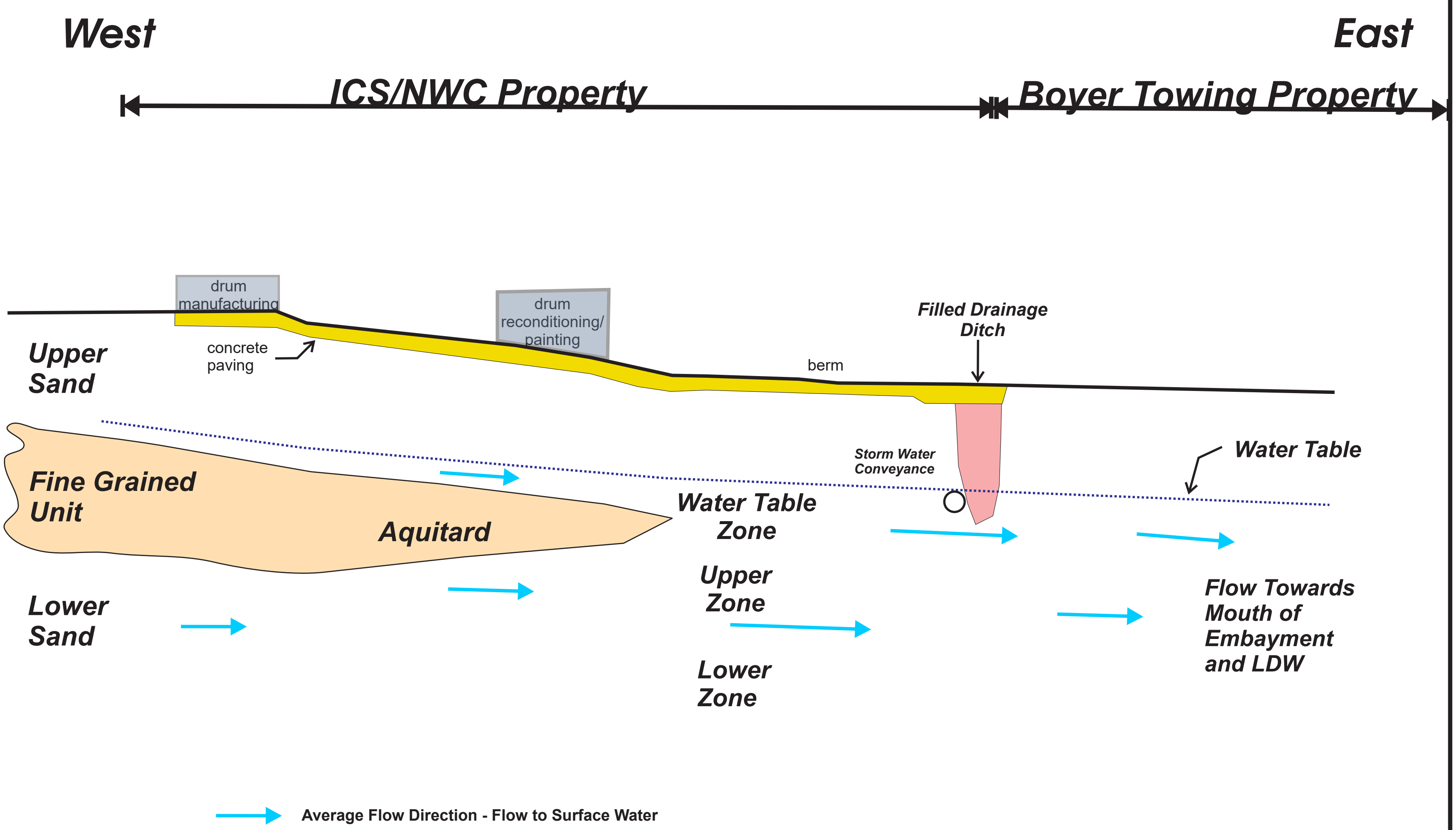
ICS/NW Cooperage Site
Seattle, Washington

Generalized Geology and Hydrogeologic Units - Upper End of Embayment

SUM-008-00 **FIGURE 2-1a** June 2021

Dalton, Olmsted & Fuglevand, Inc.

Ref: Subsurface Conditions FSrev.cdr



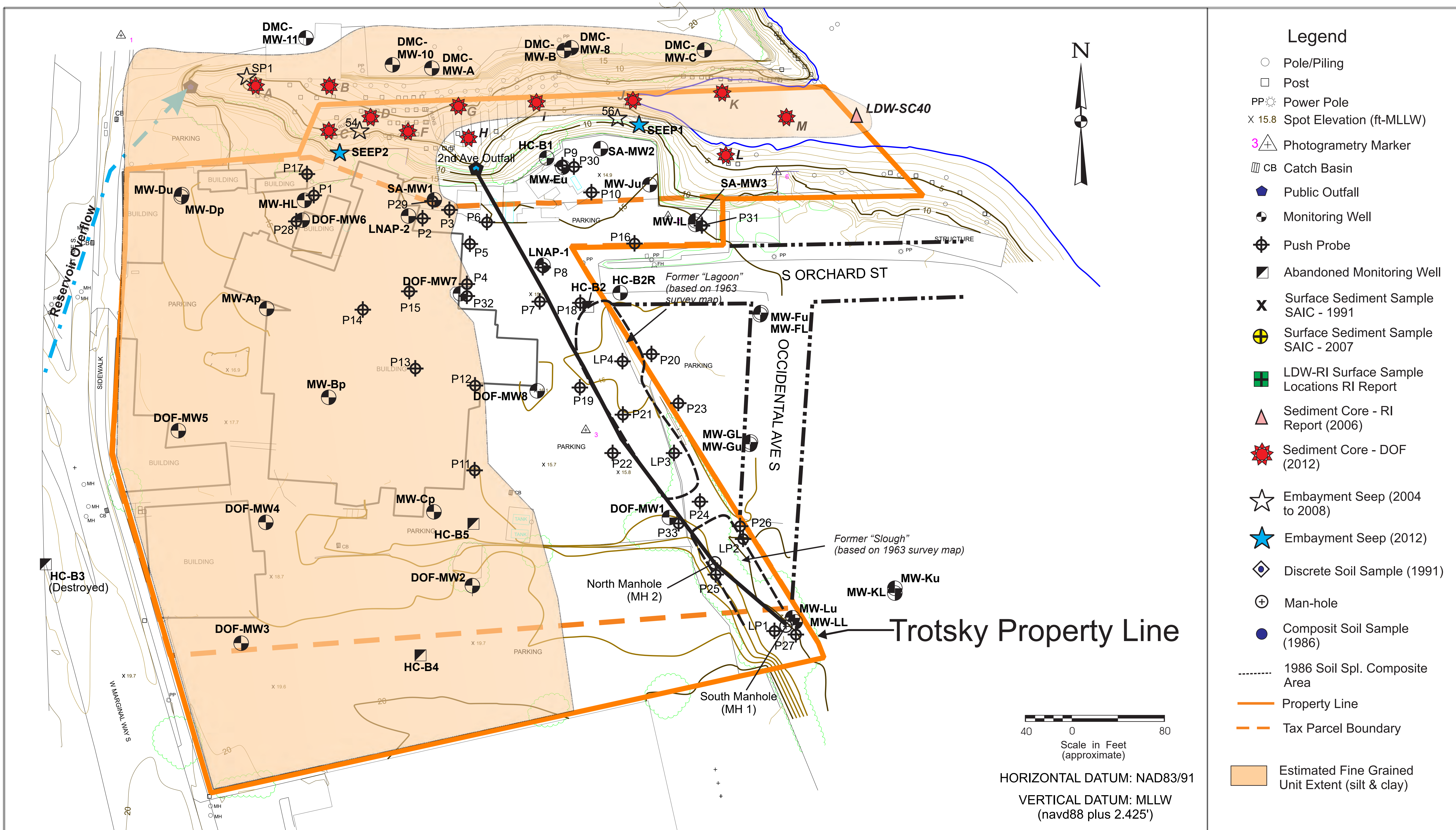
ICS/NW Cooperage Site
Seattle, Washington

Generalized Geology and Hydrogeologic Units - Towards Embayment Mouth and LDW

SUM-008-00 **FIGURE 2-1b** Dec. 2019

Dalton, Olmsted & Fuglevand, Inc.

Ref: Subsurface Conditions FSrev.cdr



Notes:

1) Property Survey by Continental Survey Co. (12-15-09)
2) Topography by David C. Smith Associates (flown 3-18-10 @ 1412 PDT)

Ref: Extent of Aquitard A FS.cdr

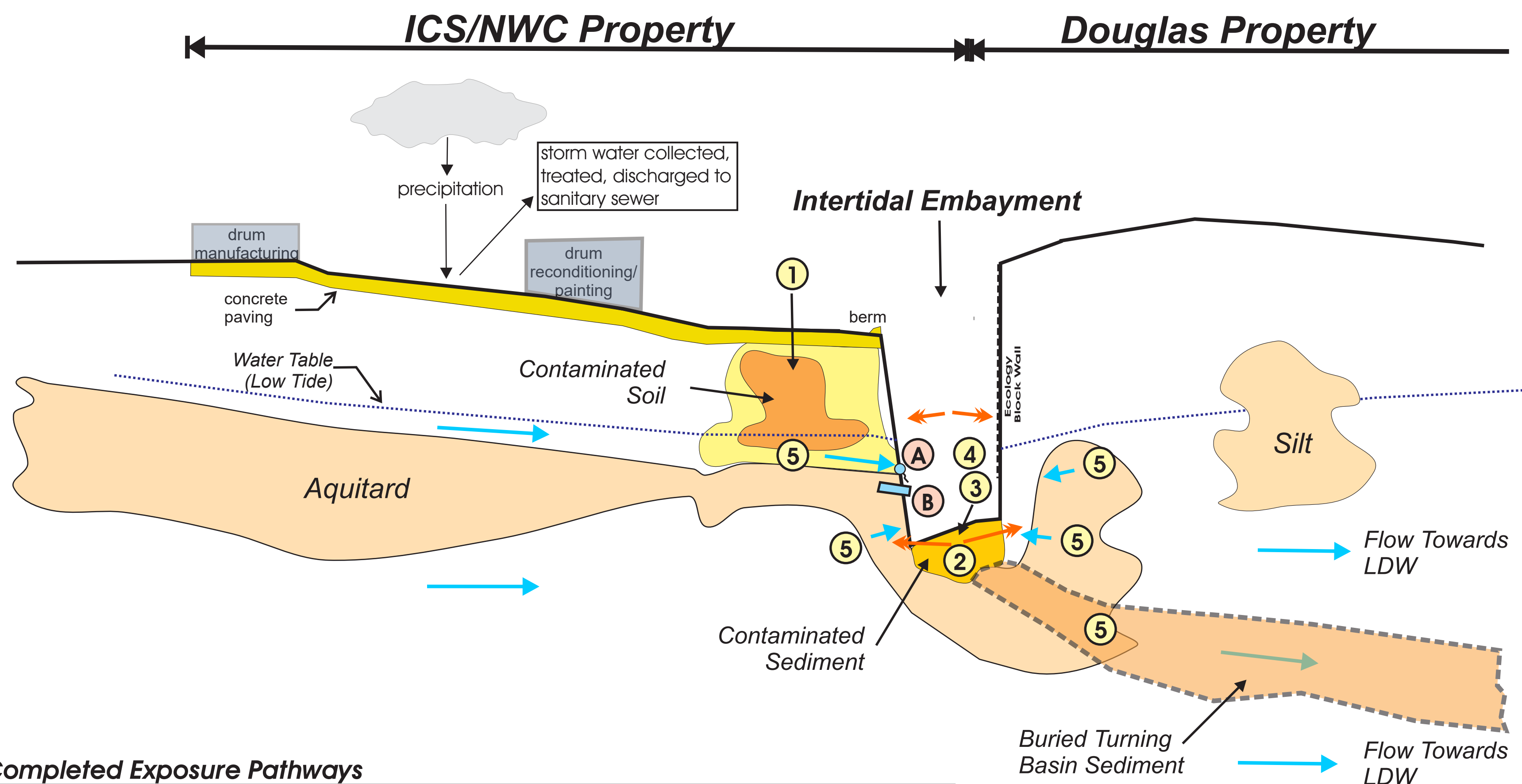
ICS/NW Cooperage Site

Extent of Fine Grained Unit (Aquitard)

SUM-008-00 (ICS) ***Mar. 2018***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 2-2



Completed Exposure Pathways

	Pathway	Receptors	Possible Exposure
1	Direct Contact* Soil/Groundwater	Utility workers/wildlife	Excavation/burrowing
2	Direct Contact* Sediment	Aquatic organisms	Organisms living in sediment matrix
3	Direct Contact* Sediment	Visitors/wildlife	Beach play; shellfish harvesting and foraging (inc. wildlife); consumption of aquatic organisms
4	Direct Contact* Surface Water**	Marine life/visitors	Fin fish during higher tides; visitor recreation; Human consumption of fin fish
5	Soil Leaching/Groundwater to Surface Water and Sediment	Same as 2, 3, 4	Same as 2, 3, 4

Low Tide Flow Direction - Flow to Surface Water

High Tide Flow Direction - Flow Reversal into Uplands

* Direct contact - dermal contact and incidental ingestion

** Surface water affected by groundwater discharges

A Groundwater Seepage at Low Tide; Possible NAPL seepage (SA-MW1 Area); Bank Soil/Sediment Erosion

B Storm Water Discharge - 2nd. Ave. Outfall (drainage area to south)

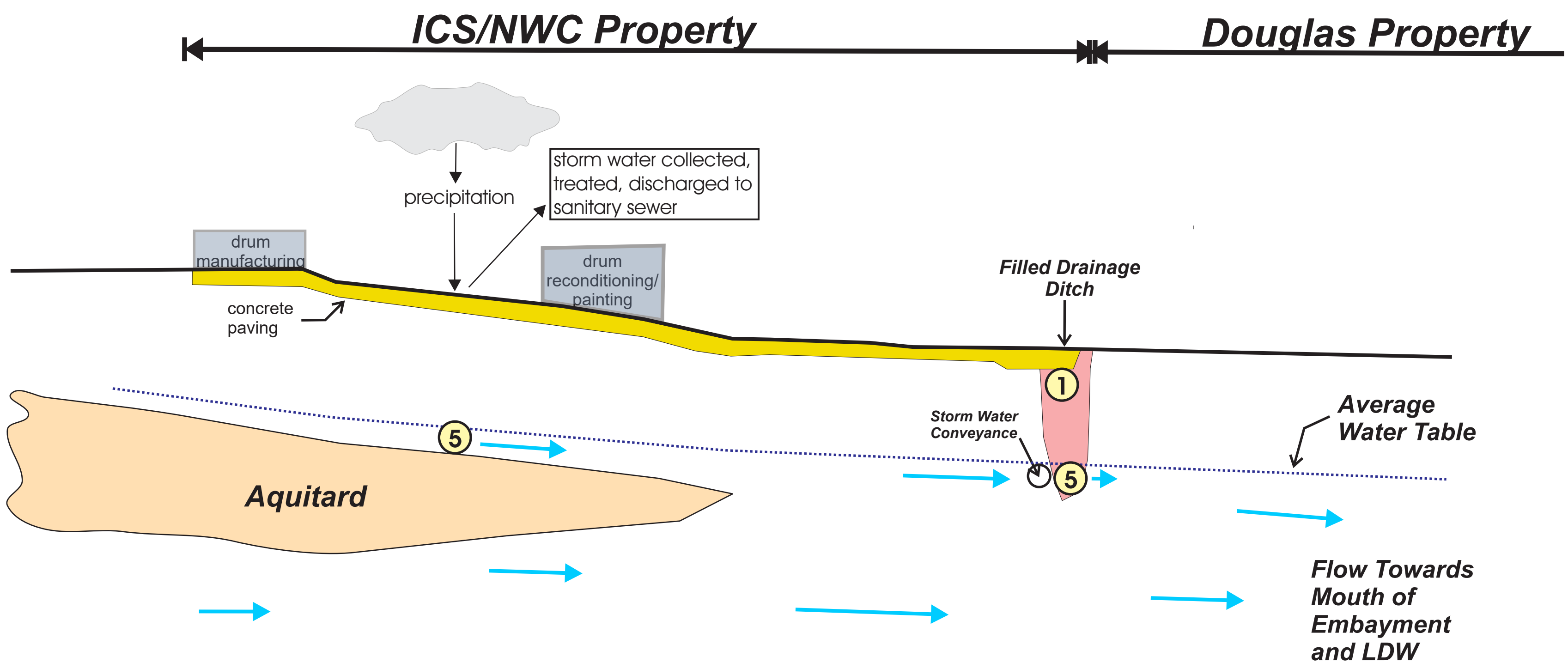
Ref: Conceptual Pathways FS rev.cdr

ICS/NW Cooperage Site
Seattle, Washington

Conceptual Site Model
Upper End of Embayment

SUM-008-00 **FIGURE 2-3a** June 2021

Dalton, Olmsted & Fuglevand, Inc.



Completed Exposure Pathways

	Pathway	Receptors	Possible Exposure
1	Direct Contact* Soil/Groundwater	Utility workers/wildlife	Excavation/burrowing
2	Direct Contact* Sediment	Aquatic organisms	Organisms living in sediment matrix
3	Direct Contact* Sediment	Visitors/wildlife	Beach play; shellfish harvesting and foraging (inc. wildlife); Consumption of aquatic organisms
4	Direct Contact* Surface Water**	Marine life/visitors	Fin fish during higher tides; visitor recreation; consumption of fin fish
5	Soil Leaching/Groundwater to Surface Water/Sediment	Same as 2, 3, 4	Same as 2, 3, 4

→ Average Flow Direction - Flow to Surface Water

A Groundwater Seepage at Low Tide; Possible NAPL seepage (SA-MW1 Area); Bank Soil/Sediment Erosion

B Storm Water Discharge - 2nd. Ave. Outfall (drainage area to south)

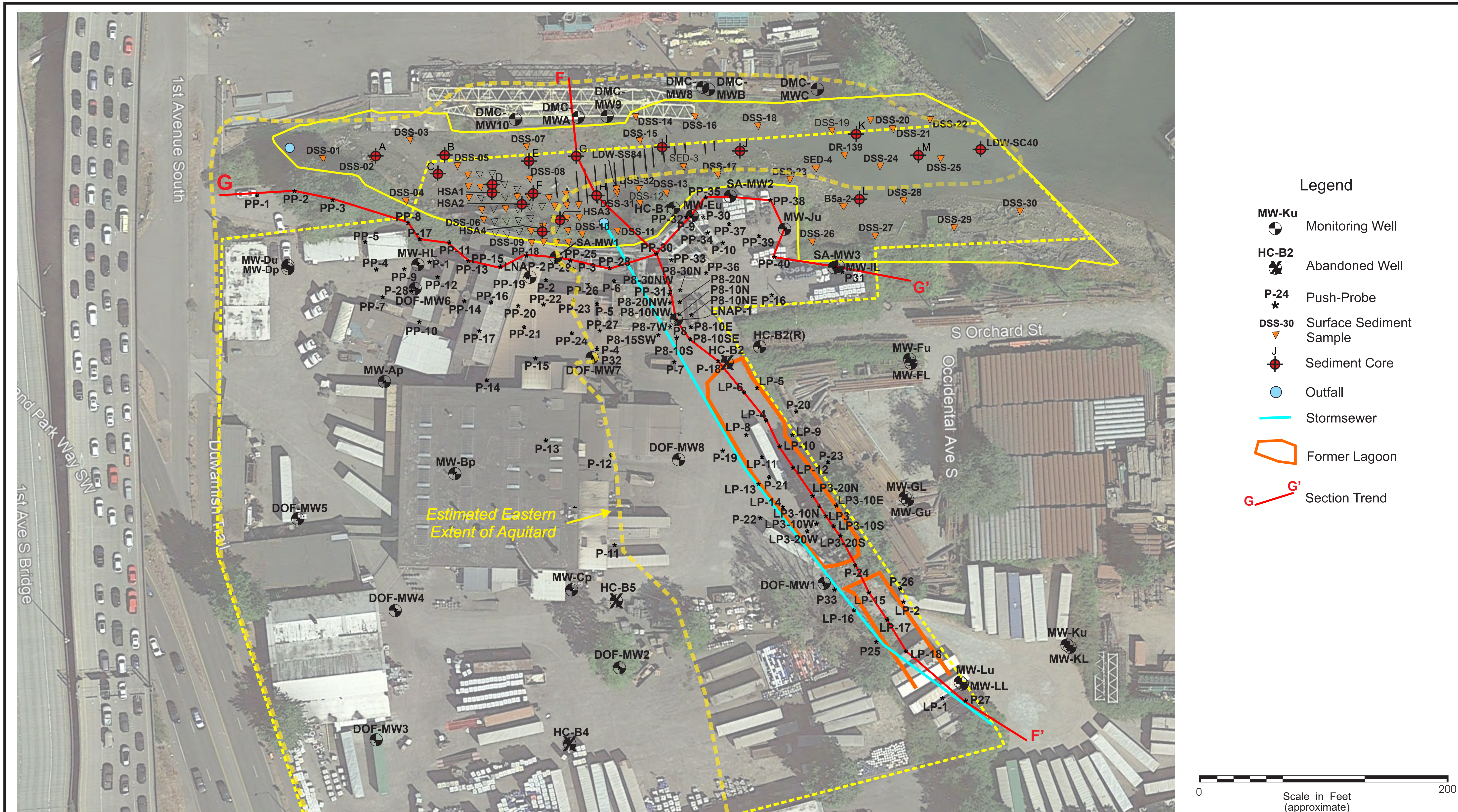
* Direct contact - dermal contact and ingestion
** Surface water affected by groundwater discharges

Ref: Conceptual Pathways FS rev.cdr

ICS/NW Cooperage Site
Seattle, Washington

Conceptual Site Model
Towards Embayment Mouth and LDW

SUM-008-00 **FIGURE 2-3b** June 2021
Dalton, Olmsted & Fuglevand, Inc.



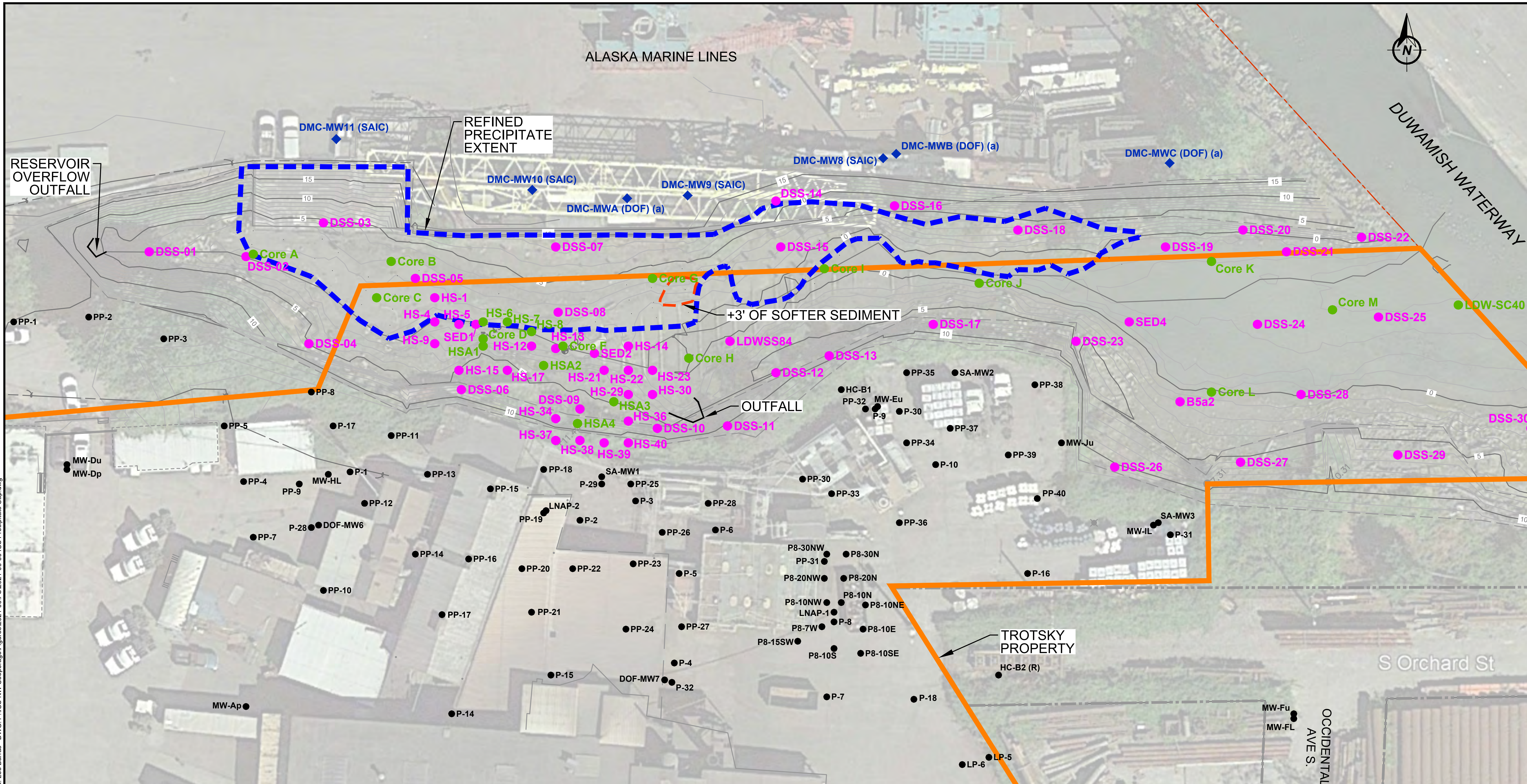
Ref: Spl LocrevLoc.cdr

ICS/NW Cooperage
Seattle, Washington

Sample Location Map

SUM-008-03 FS **FIGURE 4-1a** June 2021

Dalton, Olmsted & Fuglevand, Inc.



0 40
Scale in Feet

NOTES

1. Topographic and feature survey performed by Bush, Roed & Hitchings, Inc. - July 2018
2. Horizontal Datum: NAD 83/91 Washington State Plane Coordinates, North Zone (US feet).
3. Vertical Datum: NAVD88 (feet). Difference from NAVD 88 to MLLW = 2.39'
4. Background image source: Google Earth Pro 2020. Use for visual reference only.

LEGEND

	Refined Extent of Precipitate Cap
	+3' of Softer Sediment
DSS-11	Surface Sediment Sample Location & ID
Core I	Sediment Core Location & ID
DMC-MWB (x)	Well Location & ID
PP-27	Push-Probe Location & ID
	Trotsky Property Boundary

ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

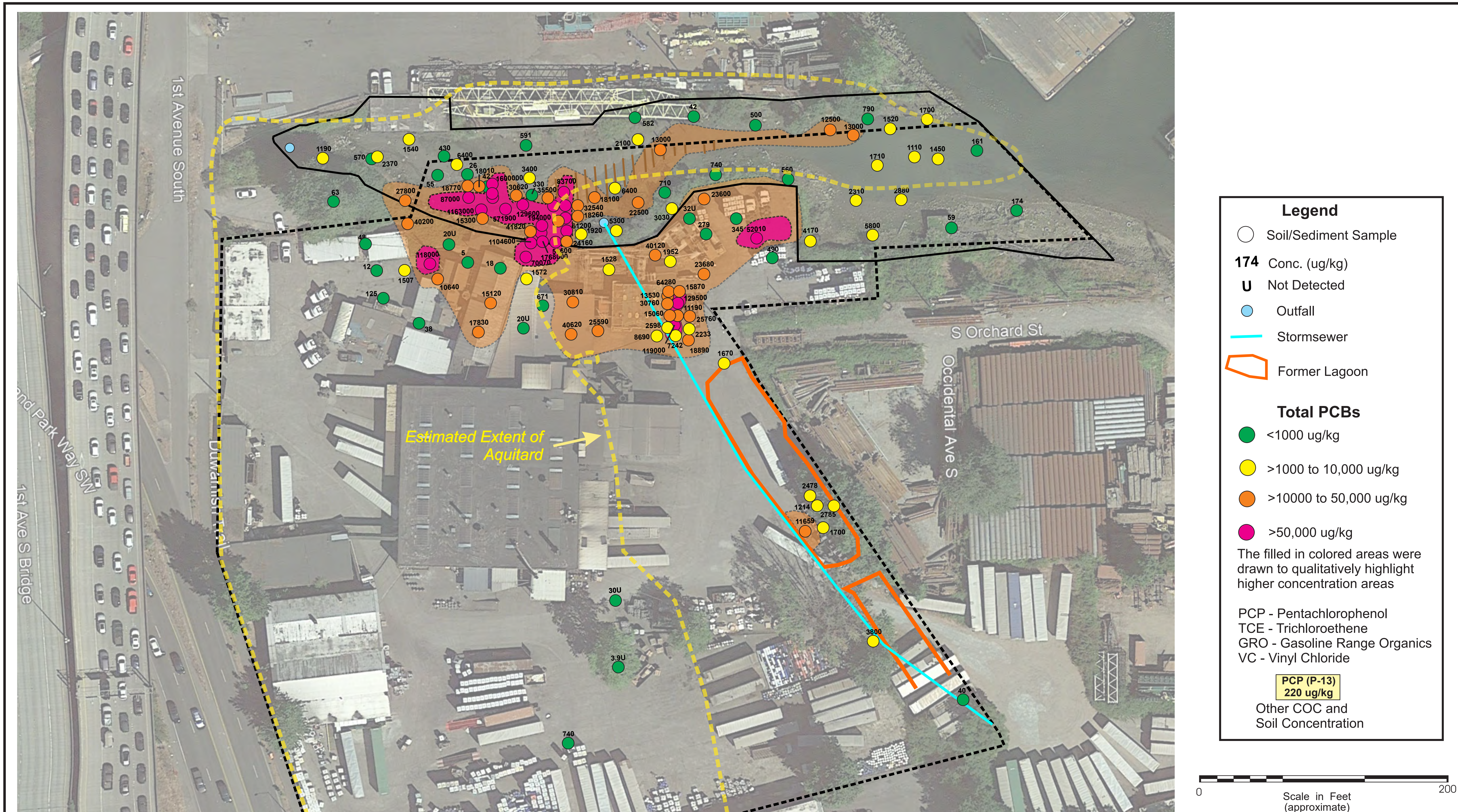
REFINED EXTENT OF PRECIPITATE CAP WITH SAMPLING LOCATIONS

DOF DALTON OLMSTED FUGLEVAND

FIGURE
4-1b

SUM-008-03FS 06/30/2021

PLOT TIME: 6/30/2021 8:46 AM MOD TIME: 6/30/2021 8:45 AM USER: Lee Barras DWG: P:\ICS-NW Cooperage\Figures\2021-06\FS\2021-06-30 ICS Precipitate Cap.dwg



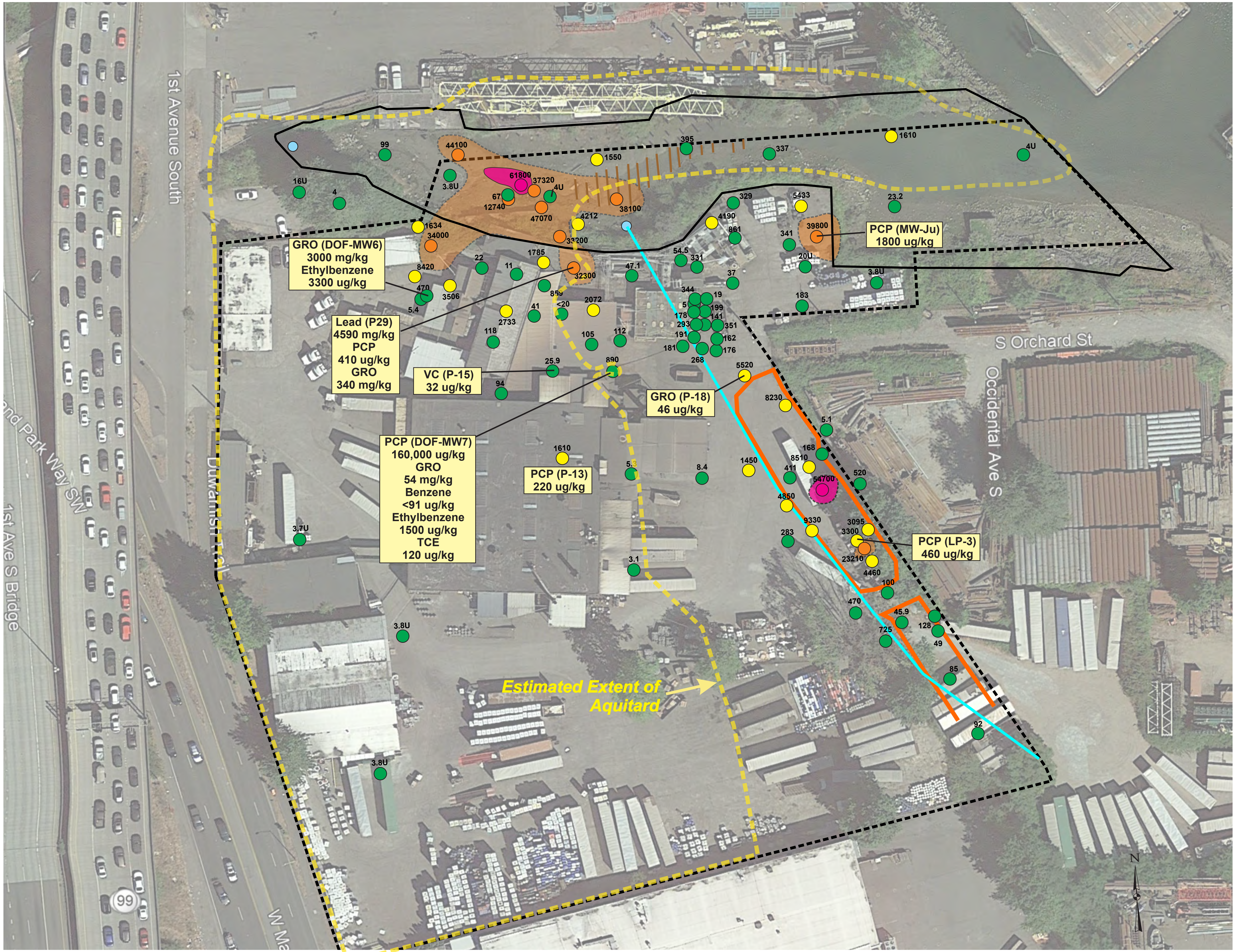
Ref: 0 to 3.0 feet soil conc PCB TPH.cdr

ICS/NW Cooperage Site
Seattle, Washington

PCB and COC Conc. in Soil and PCB Conc. in Sediment (Approx. 0 to 3.0 Feet)

SUM-008-03FS **FIGURE 4-2a** Feb. 2022

Dalton, Olmsted & Fuglevand, Inc.



Ref: 3 to 5 feet soil conc PCB TPH.cdr

Legend

- Soil/Sediment Sample
- **174** Conc. (ug/kg)
- **U** Not Detected
- Outfall
- Stormsewer
- Former Lagoon

Total PCBs

- <1000 ug/kg
- >1000 to 10,000 ug/kg
- >10000 to 50,000 ug/kg
- >50,000 ug/kg

The filled in colored areas were drawn to qualitatively highlight higher concentration areas

PCP - Pentachlorophenol
TCE - Trichloroethene
GRO - Gasoline Range Organics
VC - Vinyl Chloride

PCP (P-13)
220 ug/kg
Other COC and Soil Concentration

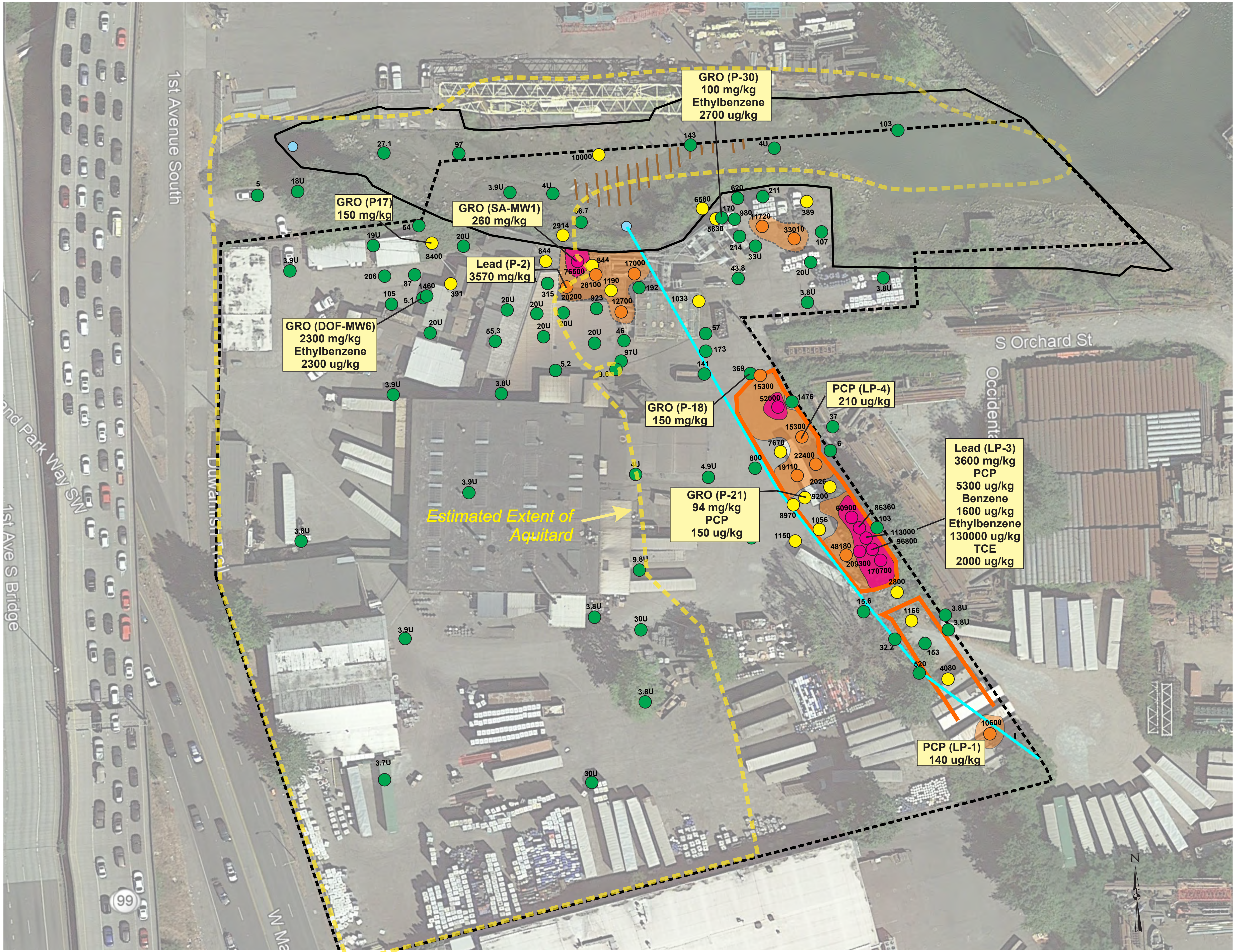
0 Scale in Feet (approximate) 200

ICS/NW Cooperage Site
Seattle, Washington

PCB and COC Conc. in Soil and PCB Conc. in Sediment (Approx. 3 to 5 Feet)

SUM-008-03FS **FIGURE 4-2b** Feb. 2022

Dalton, Olmsted & Fuglevand, Inc.



Legend

- Soil/Sediment Sample
- **174** Conc. (ug/kg)
- **U** Not Detected
- Outfall
- Stormsewer
- Former Lagoon

Total PCBs

- <1000 ug/kg
- >1000 to 10,000 ug/kg
- >10000 to 50,000 ug/kg
- >50,000 ug/kg

The filled in colored areas were drawn to qualitatively highlight higher concentration areas

PCP - Pentachlorophenol
TCE - Trichloroethene
GRO - Gasoline Range Organics
VC - Vinyl Chloride

PCP (P-13)
220 ug/kg
Other COC and Soil Concentration

0 200
Scale in Feet
(approximate)

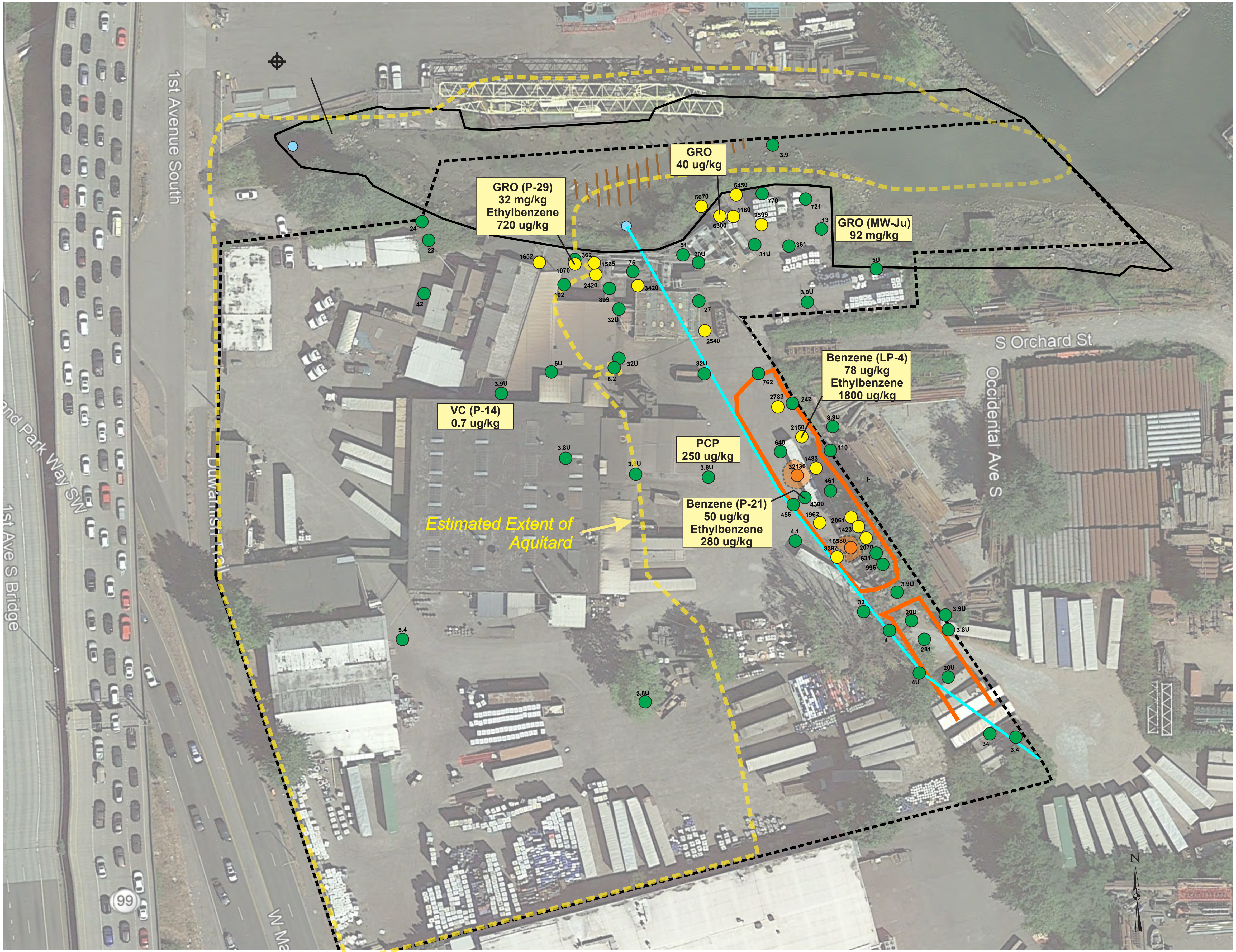
ICS/NW Cooperage Site
Seattle, Washington

PCB and COC Conc. in Soil and PCB Conc. in Sediment (Approx. 5 to 10 Feet)

SUM-008-03FS **FIGURE 4-2c** Feb. 2022

Dalton, Olmsted & Fuglevand, Inc.

Ref: 5 to 10 feet soil conc PCB TPH.cdr



Legend

Soil/Sediment Sample

174 Conc. (ug/kg)

U Not Detected

Outfall

Stormsewer

Former Lagoon

Total PCBs

<1000 ug/kg

>1000 to 10,000 ug/kg

>10000 to 50,000 ug/kg

>50,000 ug/kg

The filled in colored areas were drawn to qualitatively highlight higher concentration areas

PCP - Pentachlorophenol
TCE - Trichloroethene
GRO - Gasoline Range Organics
VC - Vinyl Chloride

PCP (P-13)
220 ug/kg
Other COC and Soil Concentration

0 200
Scale in Feet
(approximate)

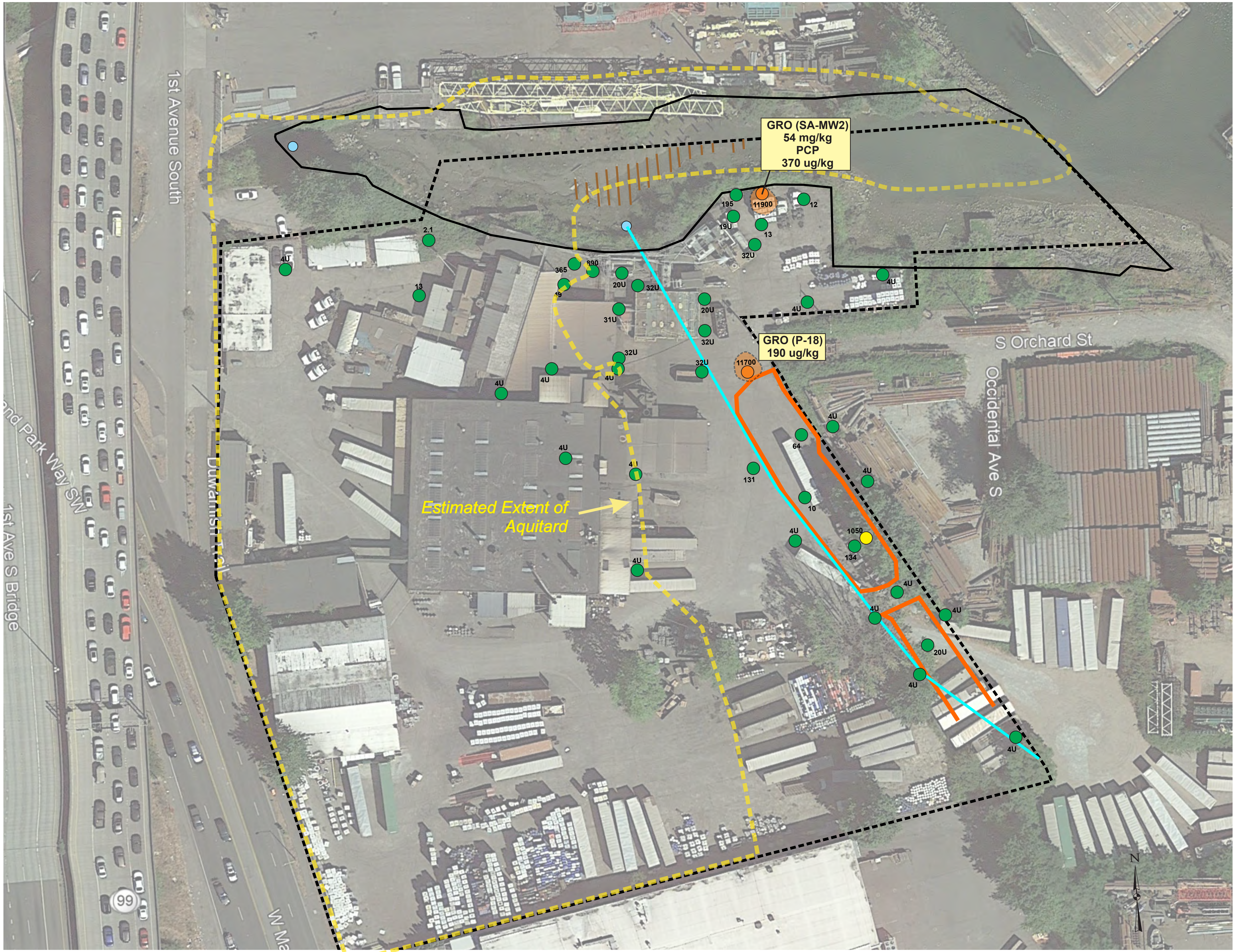
ICS/NW Cooperage Site
Seattle, Washington

PCB and COC Conc. in Soil and Sediment and PCB Conc. in Sediment (Approx. 10 to 15 Feet)

SUM-008-03FS **FIGURE 4-2d** Feb. 2022

Dalton, Olmsted & Fuglevand, Inc.

Ref: 10 to 15 feet soil conc PCB TPH.cdr



Legend

Soil/Sediment Sample

174 Conc. (ug/kg)

U Not Detected

Outfall

Stormsewer

Former Lagoon

Total PCBs

<1000 ug/kg

>1000 to 10,000 ug/kg

>10000 to 50,000 ug/kg

>50,000 ug/kg

The filled in colored areas were drawn to qualitatively highlight higher concentration areas

PCP - Pentachlorophenol
TCE - Trichloroethene
GRO - Gasoline Range Organics
VC - Vinyl Chloride

PCP (P-13)
220 ug/kg
Other COC and Soil Concentration

0 Scale in Feet (approximate) 200

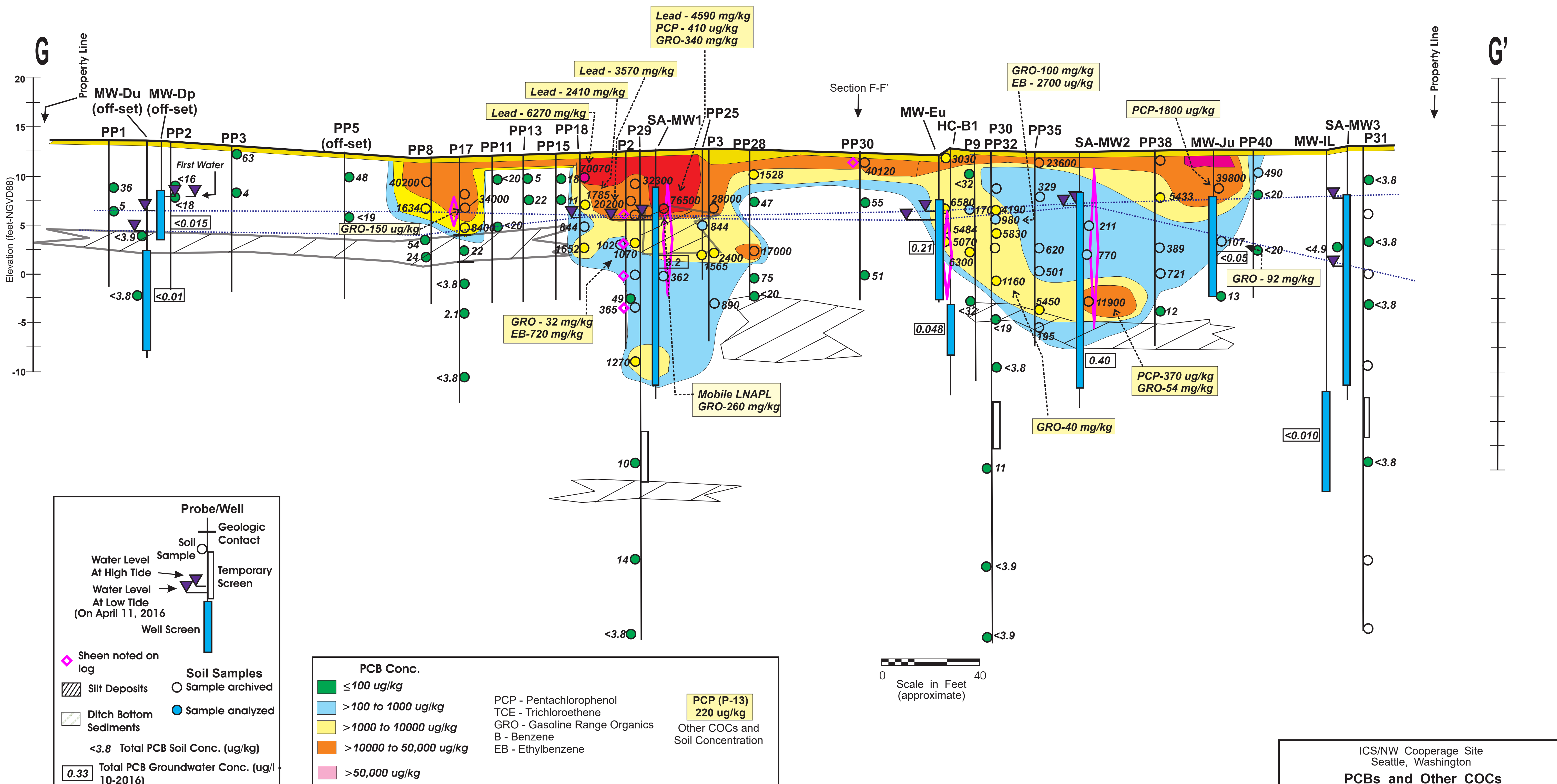
ICS/NW Cooperage Site
Seattle, Washington

PCB and COC Conc. in Soil and Sediment and PCB in Sediment (Approx. 15 to 20 Feet)

SUM-008-03FS **FIGURE 4-2e** Feb. 2022

Dalton, Olmsted & Fuglevand, Inc.

Ref: 15 to 20 feet soil conc PCB TPH.cdr



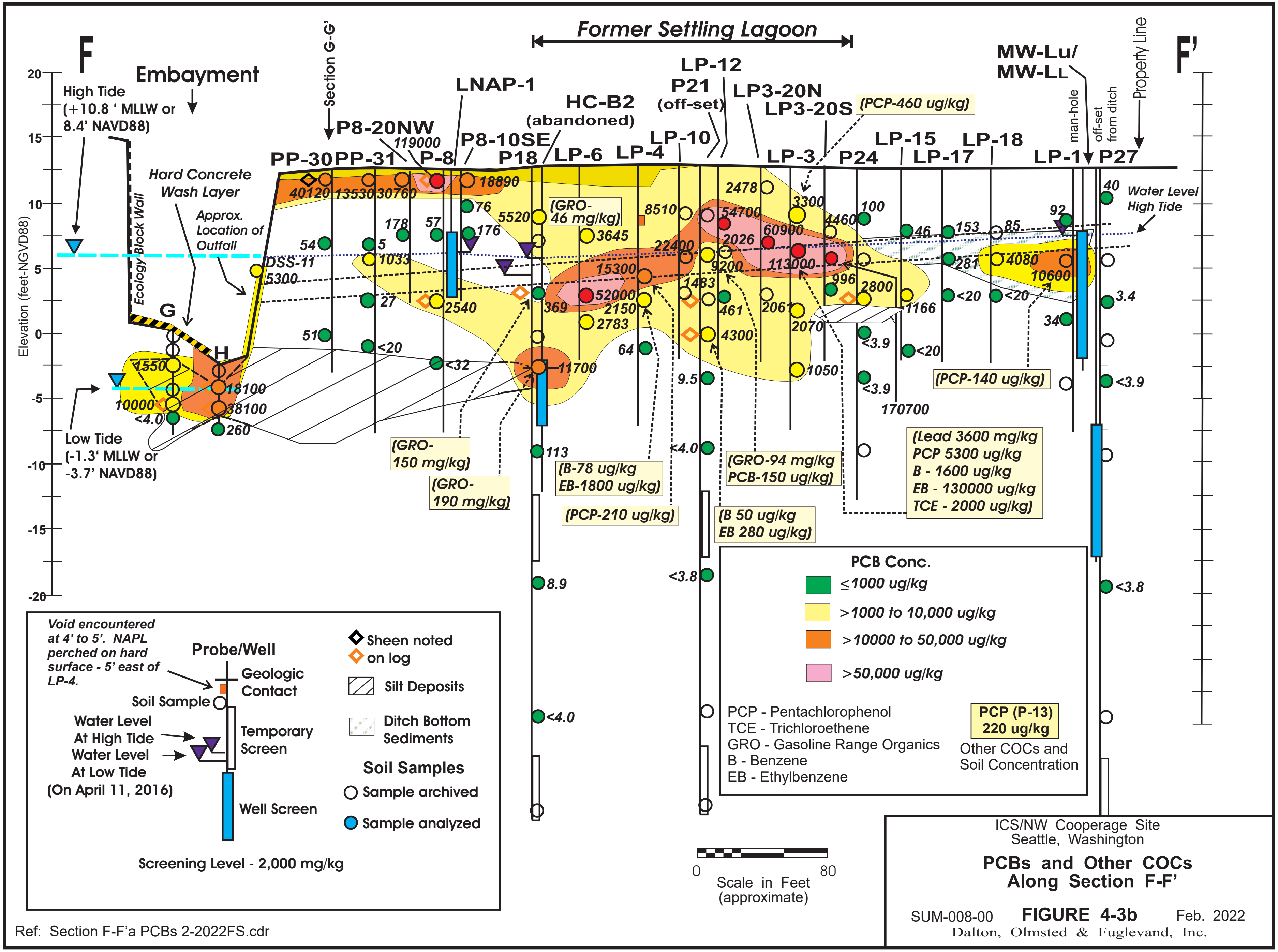
ICS/NW Cooperage Site
Seattle, Washington

PCBs and Other COCs Along Section G-G'

SUM-008-00 **FIGURE 4-3a** Feb. 2022

Dalton, Olmsted & Fuglevand, Inc.

Ref: Section G-G'2-2022 PCBs Strech FS.cdr

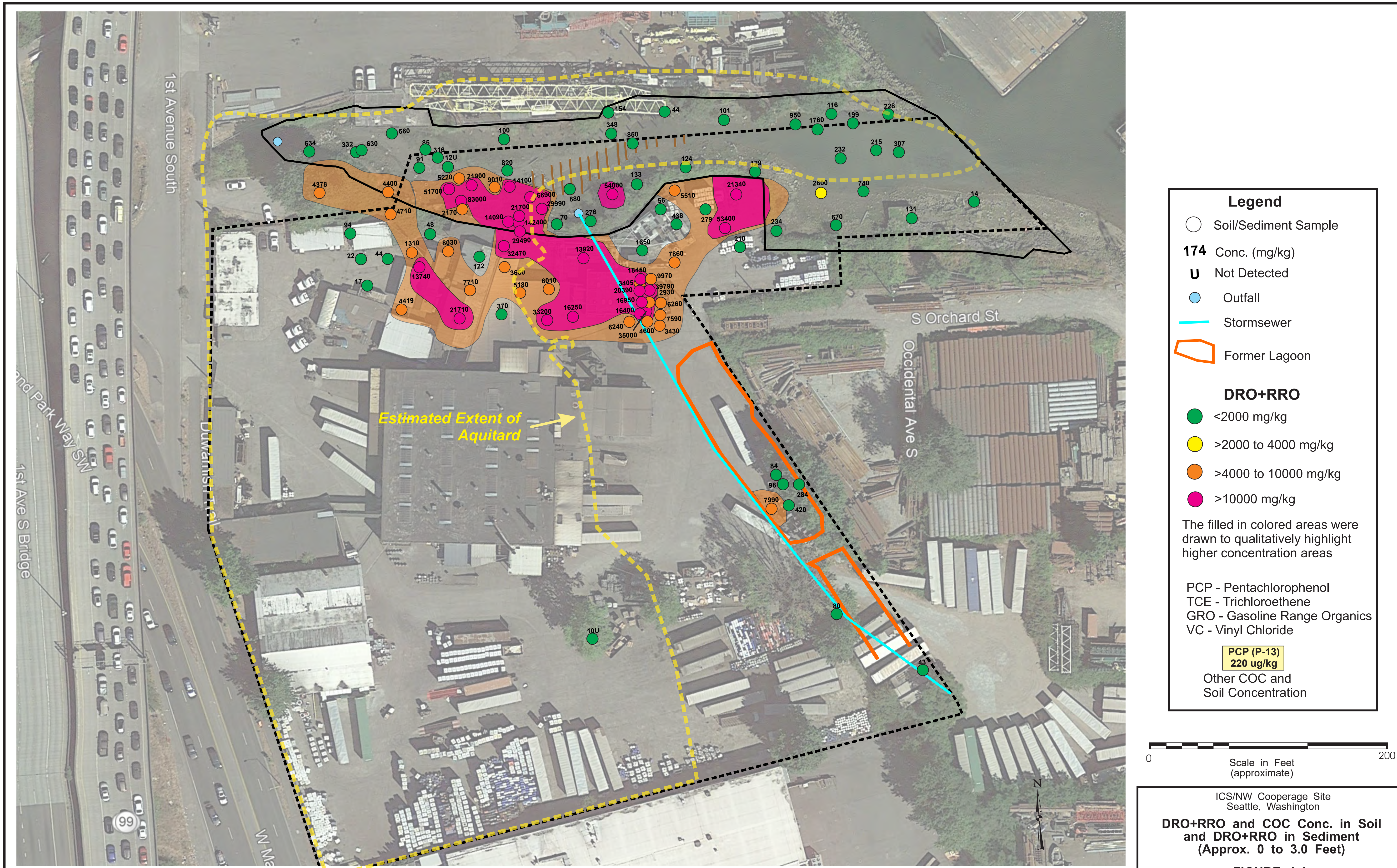


ICS/NW Cooperage Site
Seattle, Washington

PCBs and Other COCs Along Section F-F'

SUM-008-00 **FIGURE 4-3b** Feb. 2022

Dalton, Olmsted & Fuglevand, Inc.



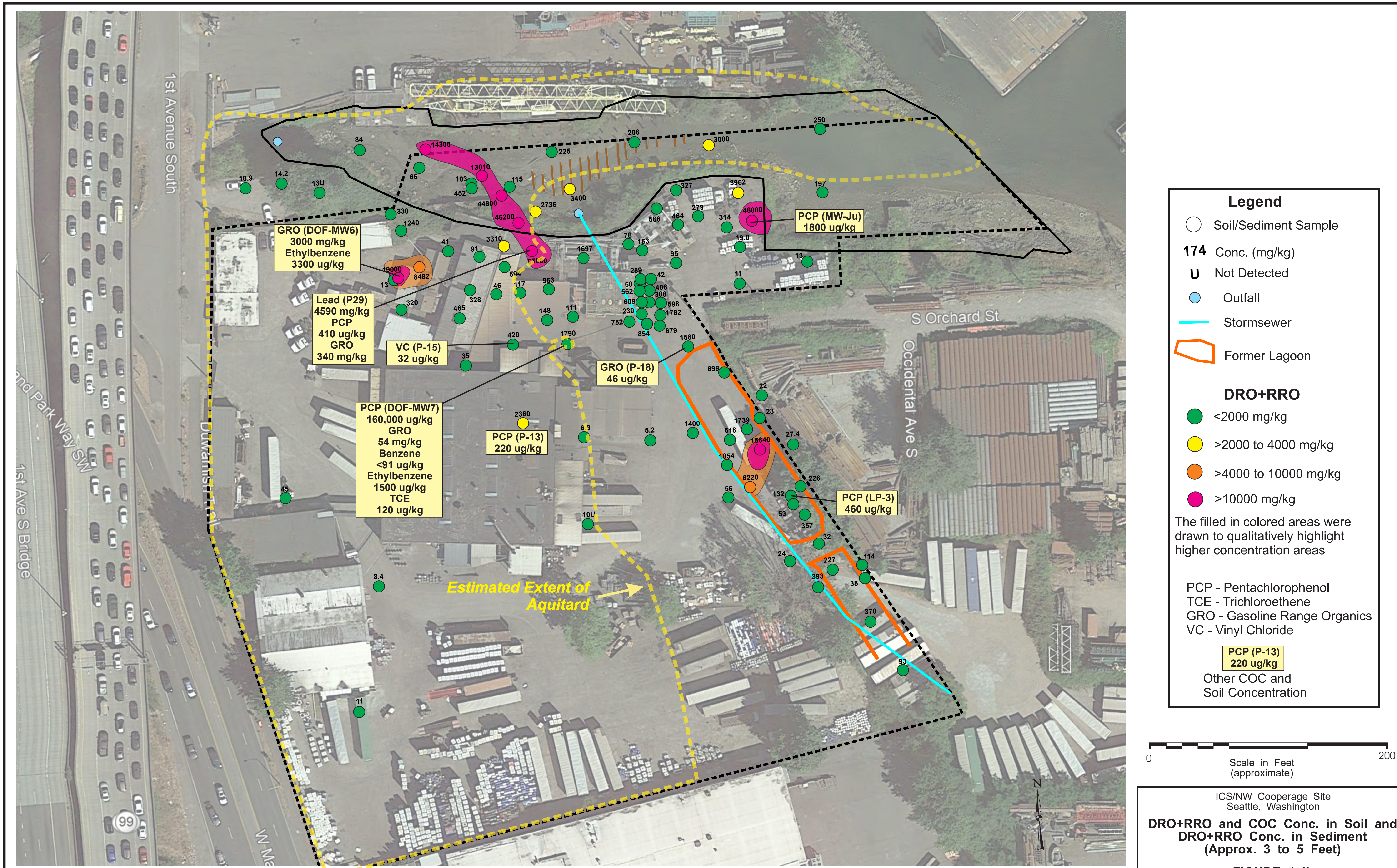
ICS/NW Cooperage Site
Seattle, Washington

DRO+RRO and COC Conc. in Soil and DRO+RRO in Sediment (Approx. 0 to 3.0 Feet)

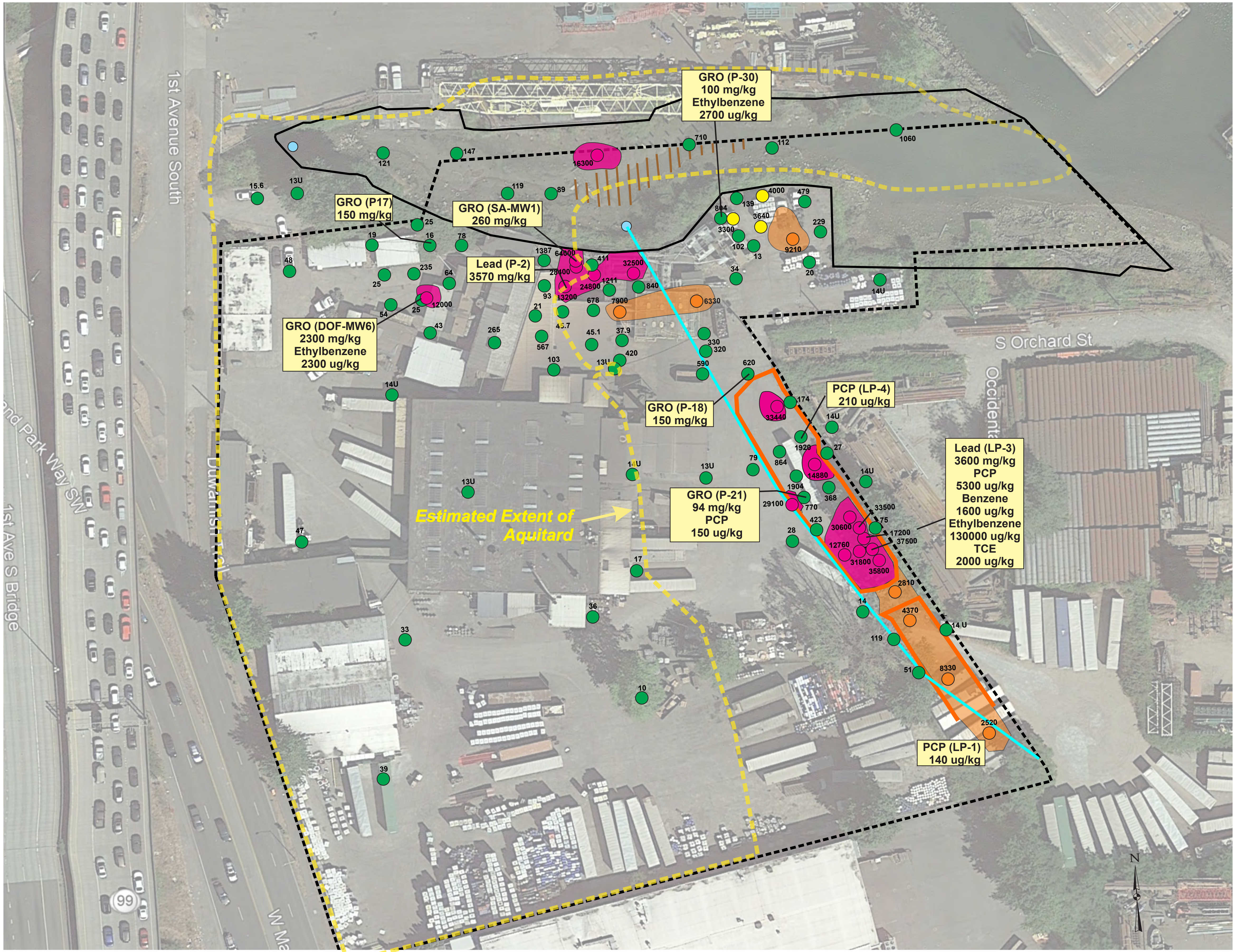
SUM-008-03FS **FIGURE 4-4a** Feb. 2022

Dalton, Olmsted & Fuglevand, Inc.

Ref: 0 to 3.0 feet soil conc PCB TPH.cdr



Ref: 3 to 5 feet soil conc PCB TPH.cdr



Ref: 5 to 10 feet soil conc PCB TPH.cdr

Legend

- Soil/Sediment Sample
- **174** Conc. (mg/kg)
- **U** Not Detected
- Outfall
- Stormsewer
- Former Lagoon

DRO+RRO

- <2000 mg/kg
- >2000 to 4000 mg/kg
- >4000 to 10000 mg/kg
- >10000 mg/kg

The filled in colored areas were drawn to qualitatively highlight higher concentration areas

PCP - Pentachlorophenol
TCE - Trichloroethene
GRO - Gasoline Range Organics
VC - Vinyl Chloride

PCP (P-13)
220 ug/kg
Other COC and Soil Concentration

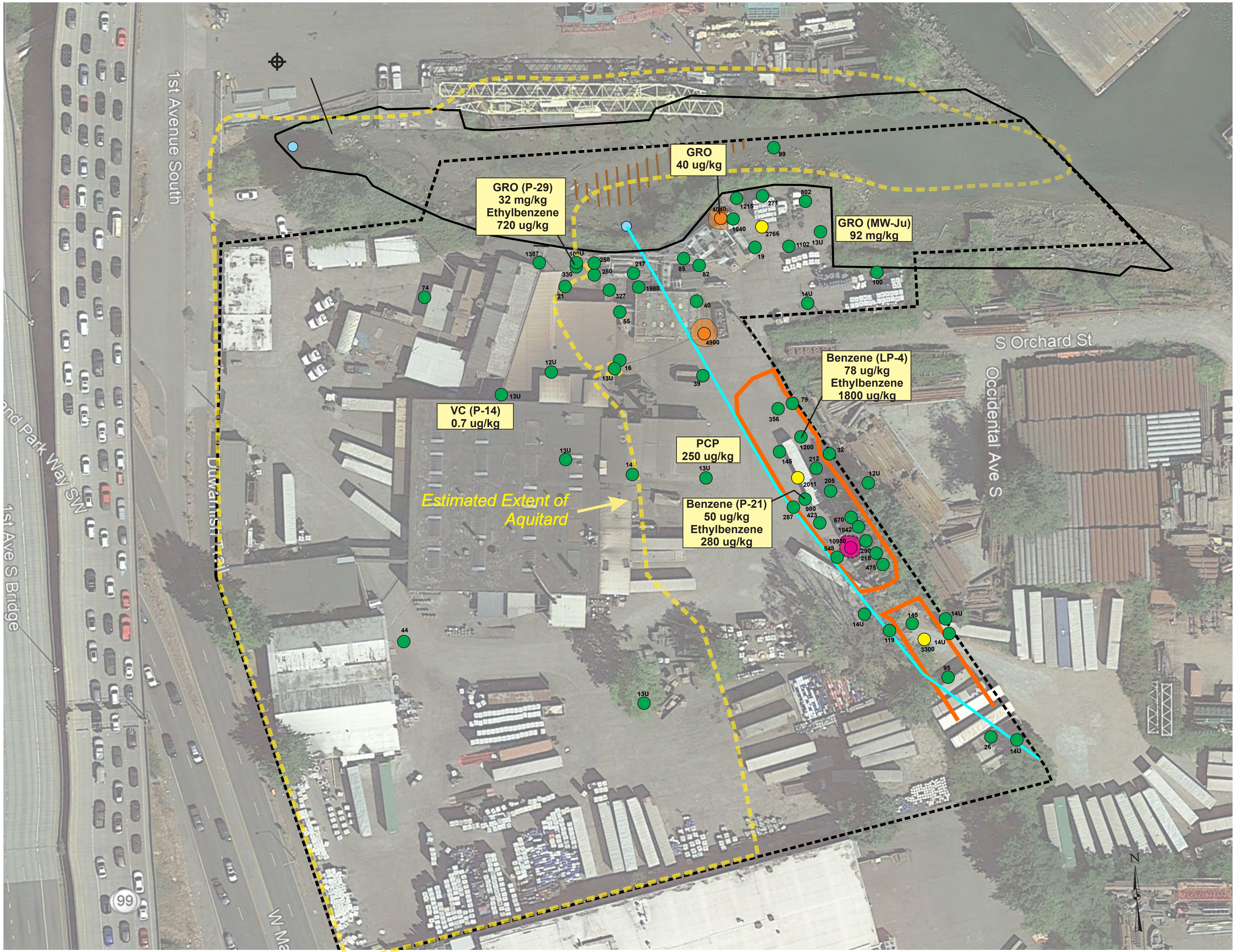
0 — 200
Scale in Feet (approximate)

N

ICS/NW Cooperage Site
Seattle, Washington

DRO+RRO and COC Conc. in Soil and DRO+RRO in Sediment (Approx. 5 to 10 Feet)

SUM-008-03FS **FIGURE 4-4c** Feb. 2022
Dalton, Olmsted & Fuglevand, Inc.



Legend

Soil/Sediment Sample

174 Conc. (mg/kg)

U Not Detected

Outfall

Stormsewer

Former Lagoon

DRO+RRO

<2000 mg/kg

>2000 to 4000 mg/kg

>4000 to 10000 mg/kg

>10000 mg/kg

The filled in colored areas were drawn to qualitatively highlight higher concentration areas

PCP - Pentachlorophenol
TCE - Trichloroethene
GRO - Gasoline Range Organics
VC - Vinyl Chloride

PCP (P-13)
220 ug/kg
Other COC and
Soil Concentration

0 200
Scale in Feet
(approximate)

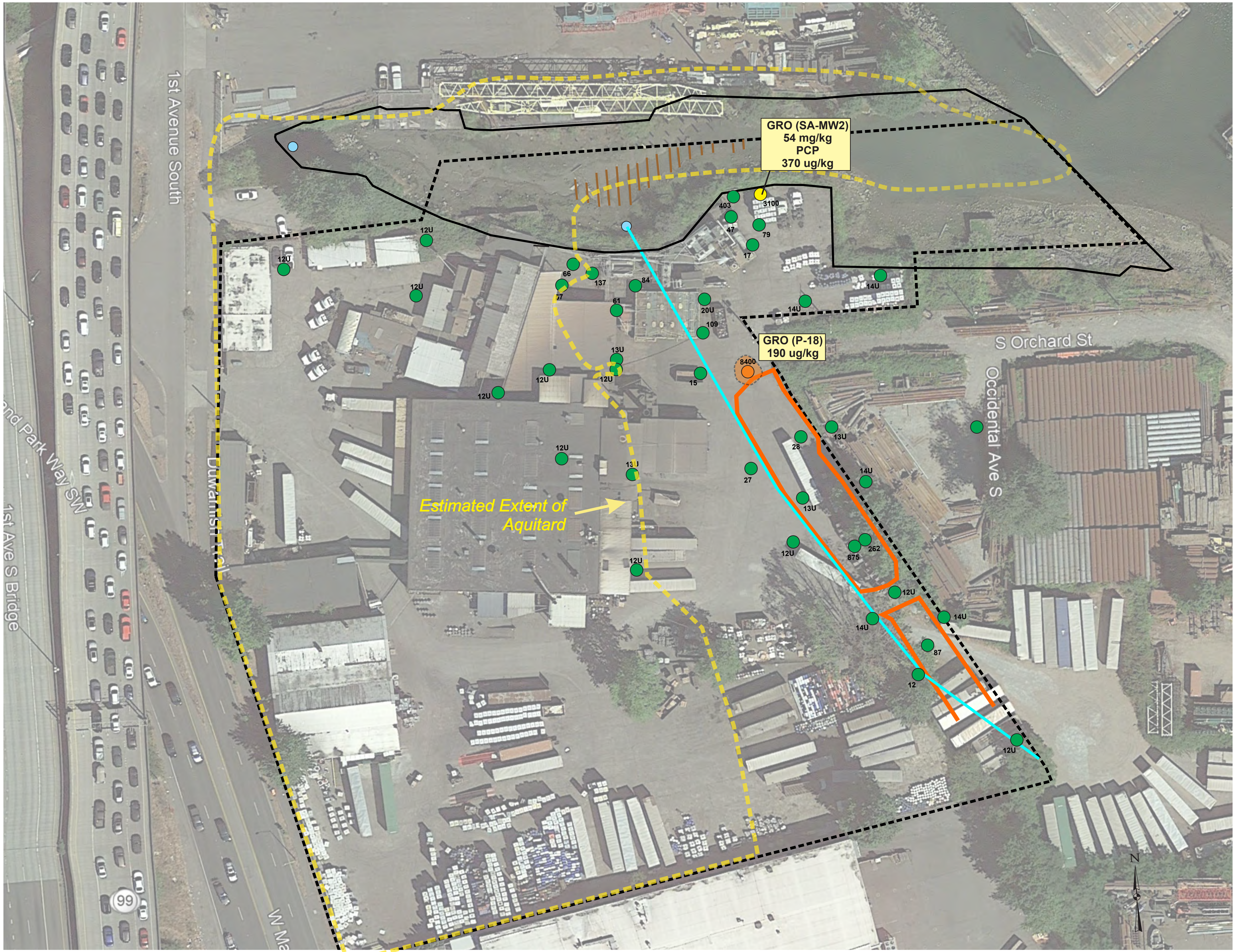
Ref: 10 to 15 feet soil conc PCB TPH.cdr

ICS/NW Cooperage Site
Seattle, Washington

DRO+RRO and COC Conc. in Soil and Sediment and PCB Conc. in Sediment (Approx. 10 to 15 Feet)

SUM-008-03FS **FIGURE 4-4d** Feb. 2022

Dalton, Olmsted & Fuglevand, Inc.



Legend

- ○ Soil/Sediment Sample
- **174** Conc. (mg/kg)
- **U** Not Detected
- Outfall
- Stormsewer
- Former Lagoon

DRO+RRO

- <2000 mg/kg
- >2000 to 4000 mg/kg
- >4000 to 10000 mg/kg
- >10000 mg/kg

The filled in colored areas were drawn to qualitatively highlight higher concentration areas

PCP - Pentachlorophenol
TCE - Trichloroethene
GRO - Gasoline Range Organics
VC - Vinyl Chloride

PCP (P-13)
220 ug/kg
Other COC and Soil Concentration

0 — 200
Scale in Feet
(approximate)

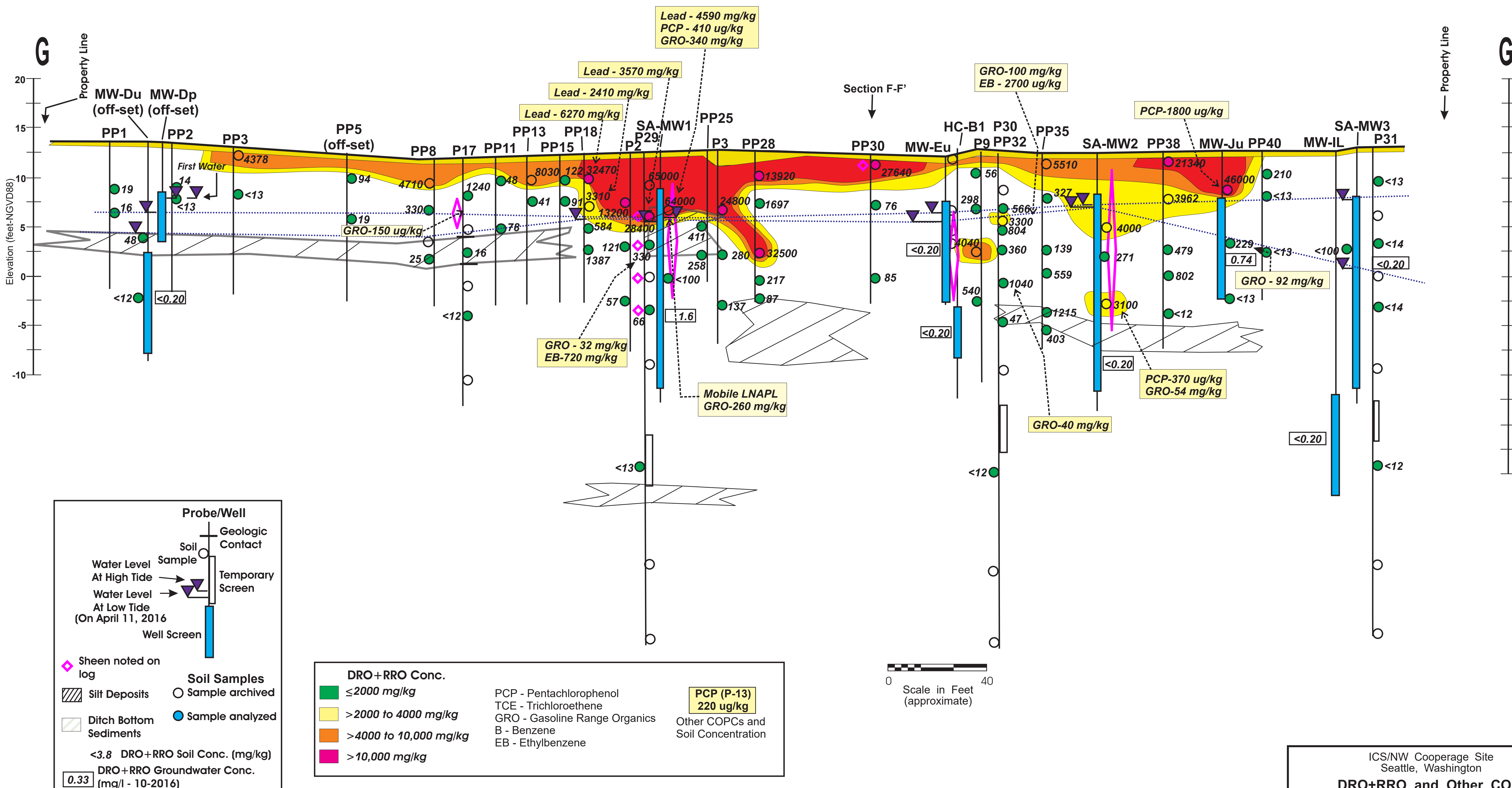
ICS/NW Cooperage Site
Seattle, Washington

DRO+RRO and COC Conc. in Soil and Sediment and PCB in Sediment (Approx. 15 to 20 Feet)

SUM-008-03FS **FIGURE 4-4e** Feb. 2022

Dalton, Olmsted & Fuglevand, Inc.

Ref: 15 to 20 feet soil conc PCB TPH.cdr



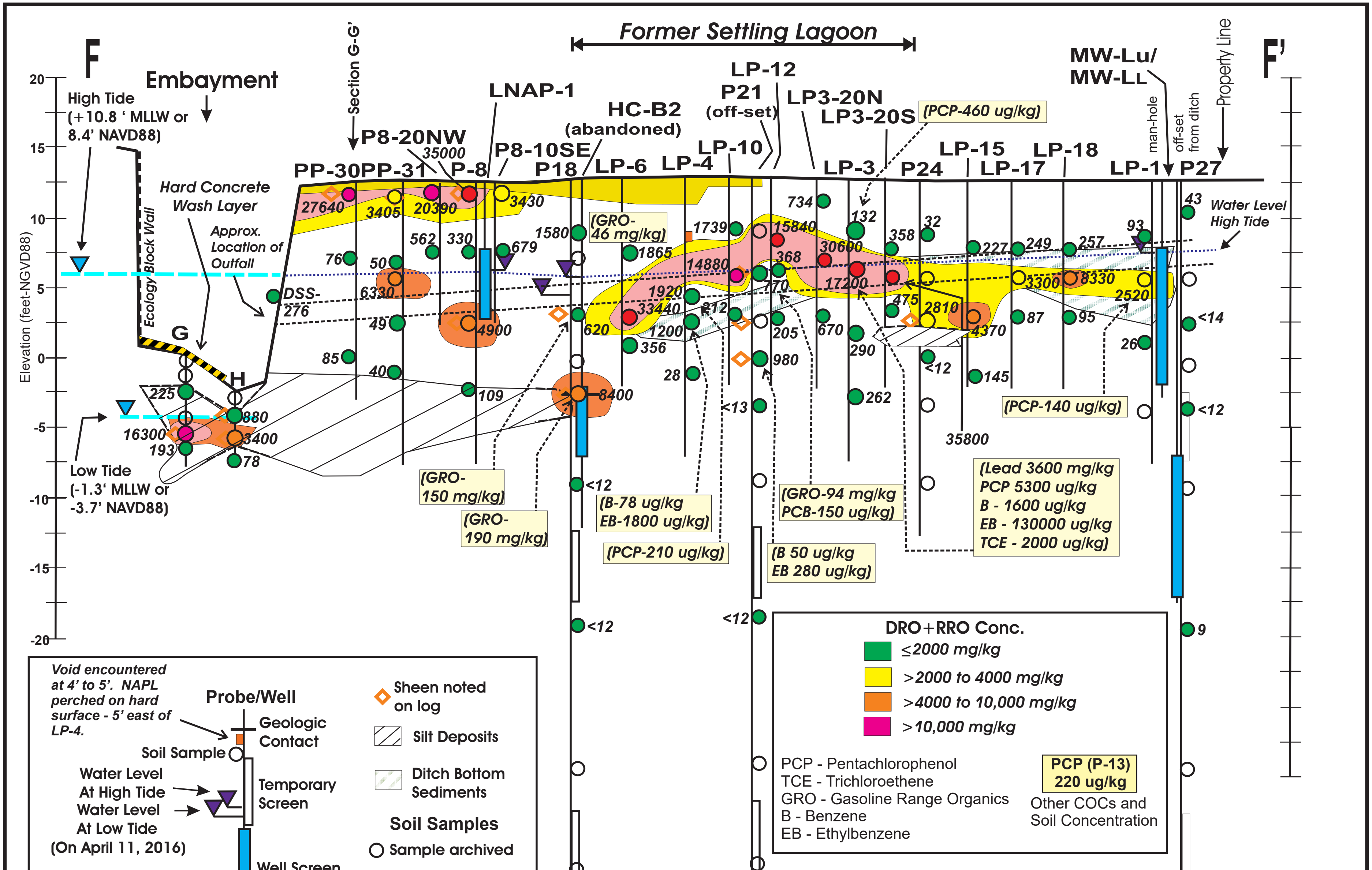
ICS/NW Cooperage Site
Seattle, Washington

DRO+RRO and Other COCs Along Section G-G'

SUM-008-00 **FIGURE 4-5a** Feb. 2022

Dalton, Olmsted & Fuglevand, Inc.

Ref: Section G-G'2-2022 DRORRO Strech FS.cdr



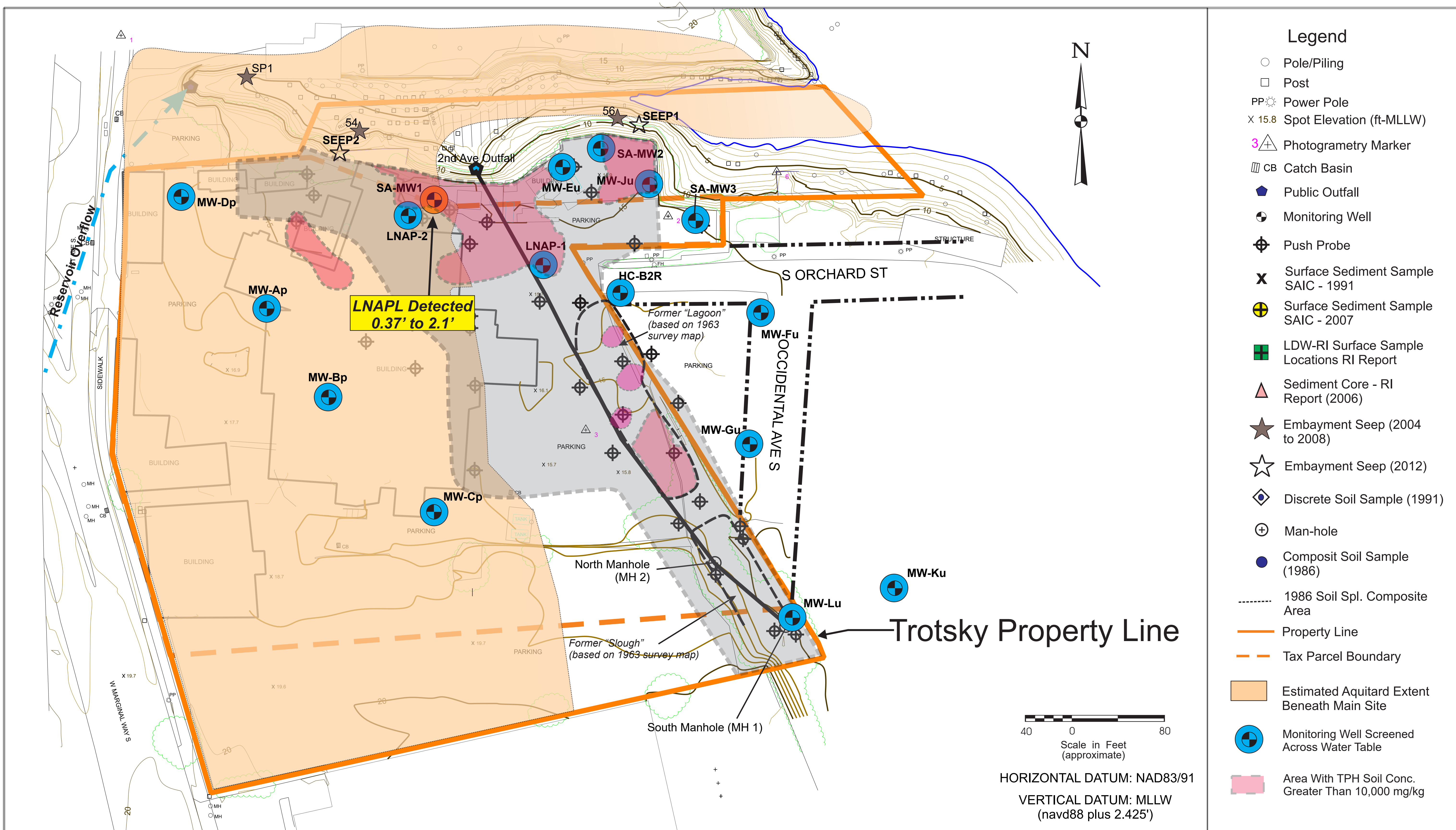
ICS/NW Cooperage Site
Seattle, Washington

DRO/RRO and Other COCs Along Section F-F'

SUM-008-00 **FIGURE 4-5b** Feb. 2022

Dalton, Olmsted & Fuglevand, Inc.

Ref: Section F-F'a Dx 2-2022FS.cdr



Notes:

1) Property Survey by Continental Survey Co. (12-15-09)
2) Topography by David C. Smith Associates (flown 3-18-10 @ 1412 PDT)

Feasibility Study Focus Area - ICS Upland Property

ICS/NW Cooperage Site

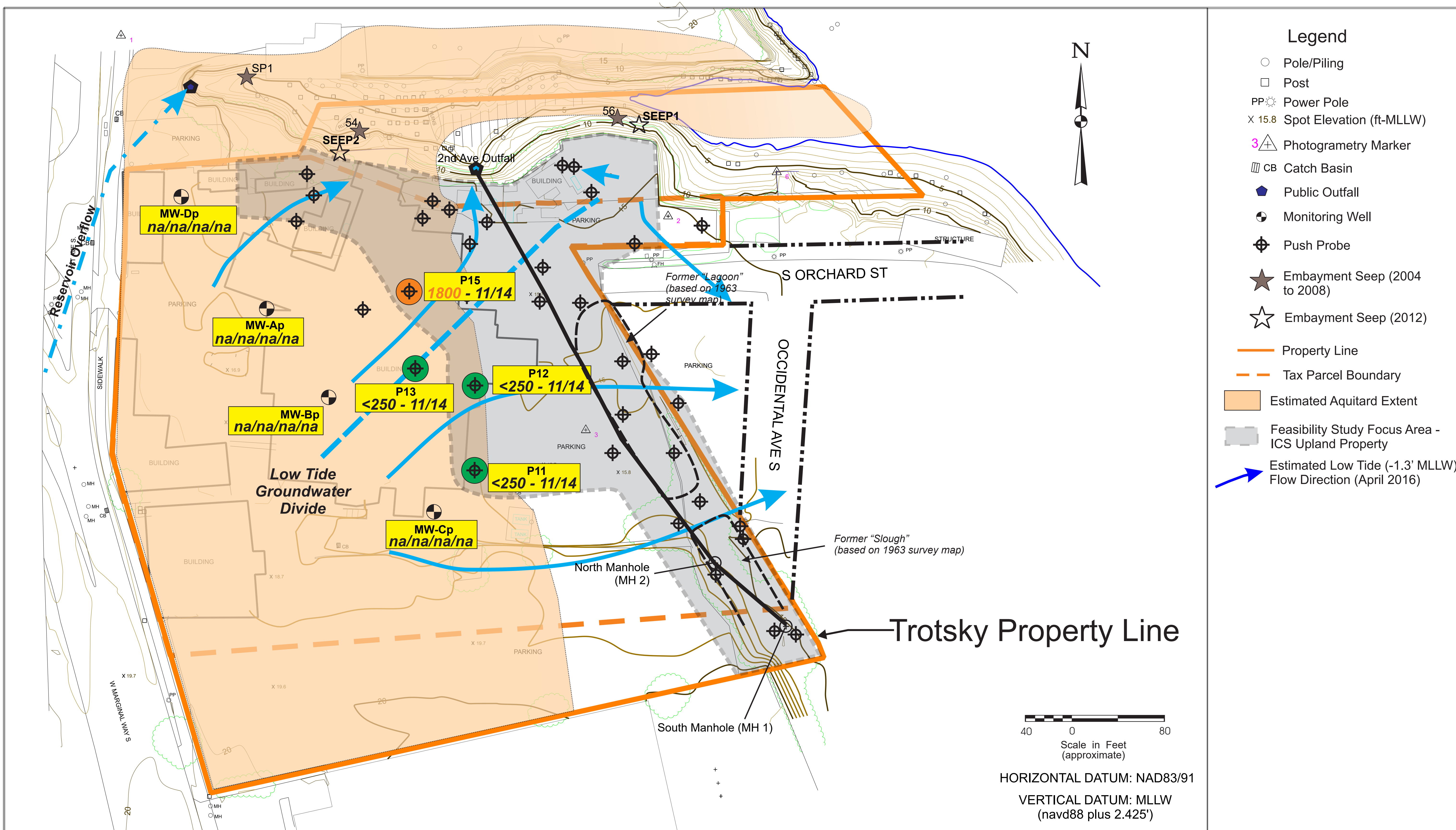
Wells Screened Across Water Table To Monitor for LNAPL

SUM-008-00 (ICS) ***Jan. 2020***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-6

Ref: NAPL Well NetworkrevFS.cdr



Concentration ≤ Screening Level (SL= 800 ug/l)

Concentration > Screening Level (SL= 800 ug/l)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available

Ref: GROGW Plot R1-R3revFS.cdr

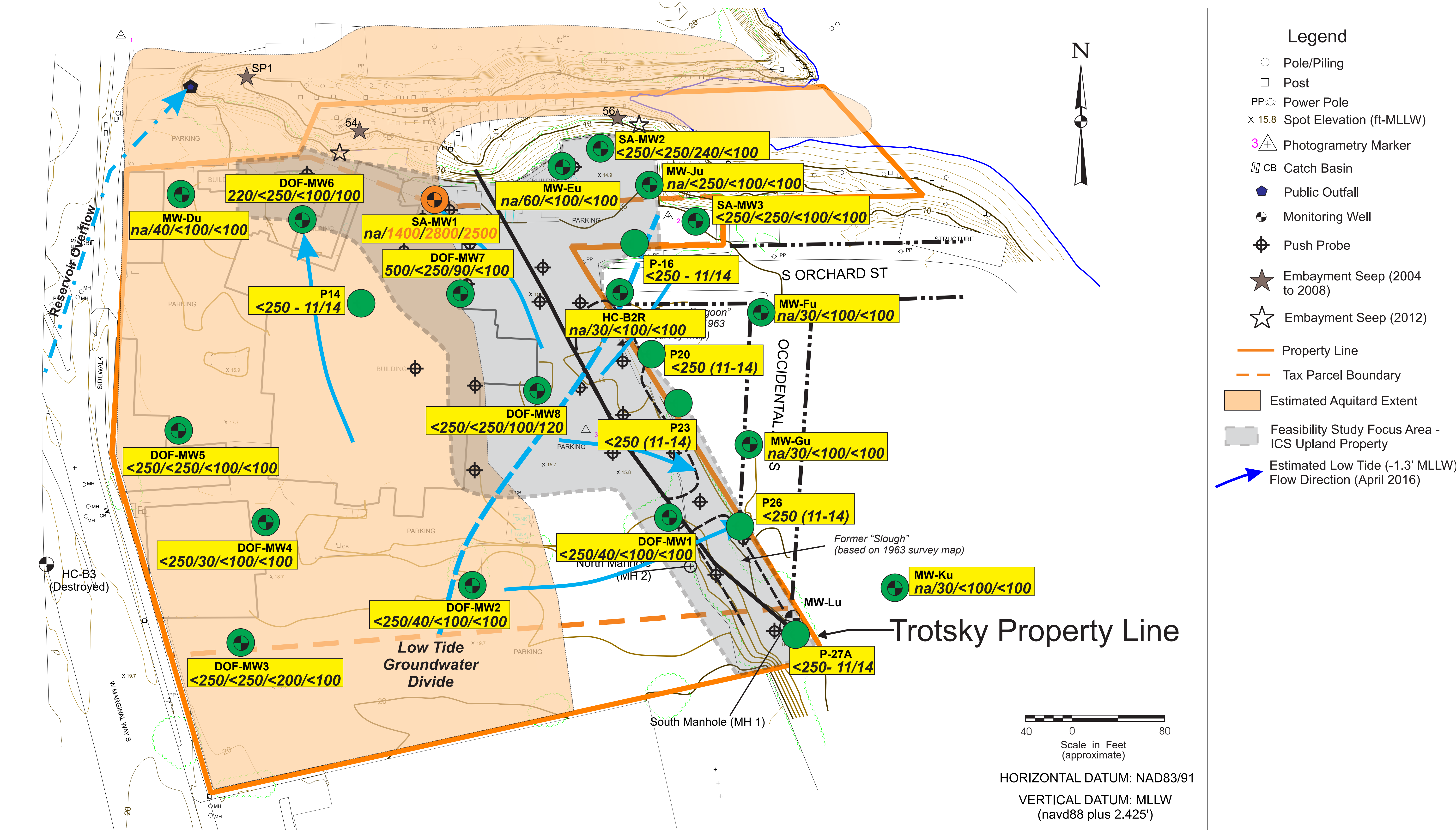
ICS/NW Cooperage Site

GRO Concentrations Water Table Zone Above Aquitard

SUM-008-00 (ICS) ***Jan. 2020***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-7a



Concentration ≤ Screening Level (SL= 800 ug/l)

Concentration > Screening Level (SL= 800 ug/l)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available

Ref: GRO GW Plot R1-R3revFS.cdr

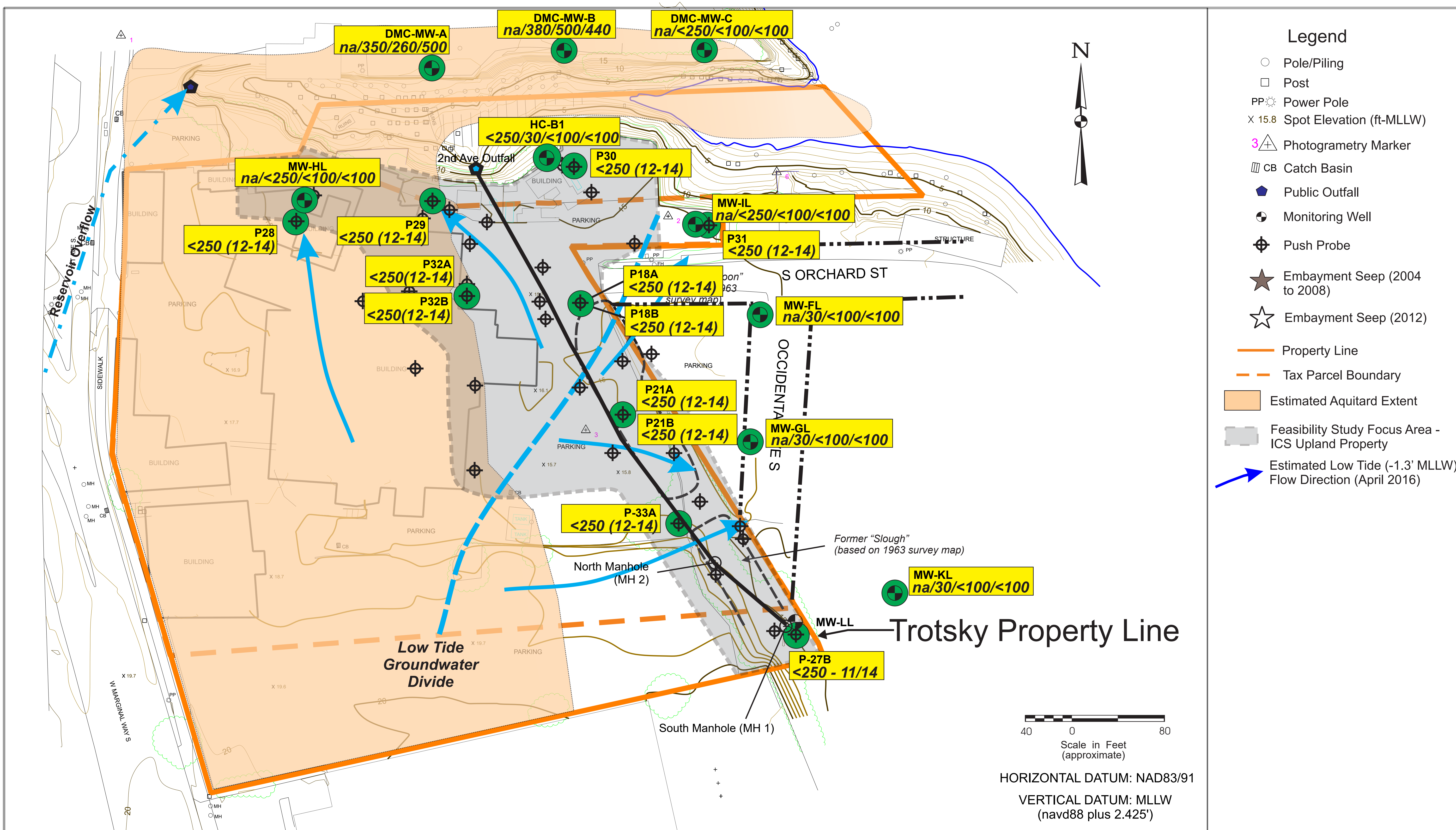
ICS/NW Cooperage Site

GRO Concentrations Upper Zone

SUM-008-00 (ICS) *Jan. 2020*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-7b



Concentration ≤ Screening Level (SL= 800 ug/l)

Concentration > Screening Level (SL= 800 ug/l)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available

Ref: GRO GW Plot R1-R3revFS.cdr

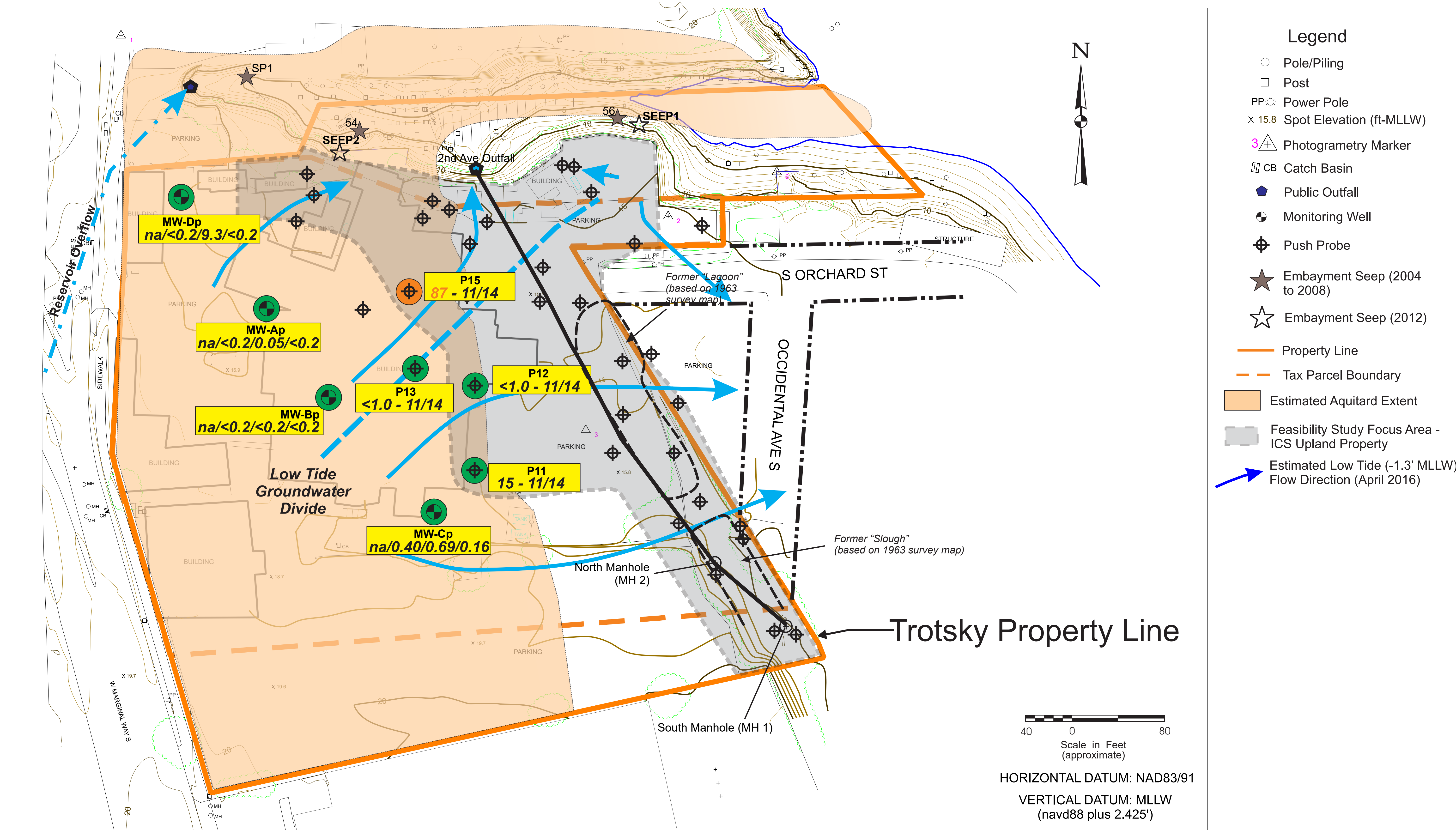
ICS/NW Cooperage Site

GRO Concentrations Lower Zone

SUM-008-00 (ICS) ***Jan. 2020***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-7c



Concentration ≤ Screening Level (SL= 21 ug/l)

Concentration > Screening Level (SL= 21 ug/l)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available

Ref: Ethylbenzene GW Plot R1-R3revFS.cdr

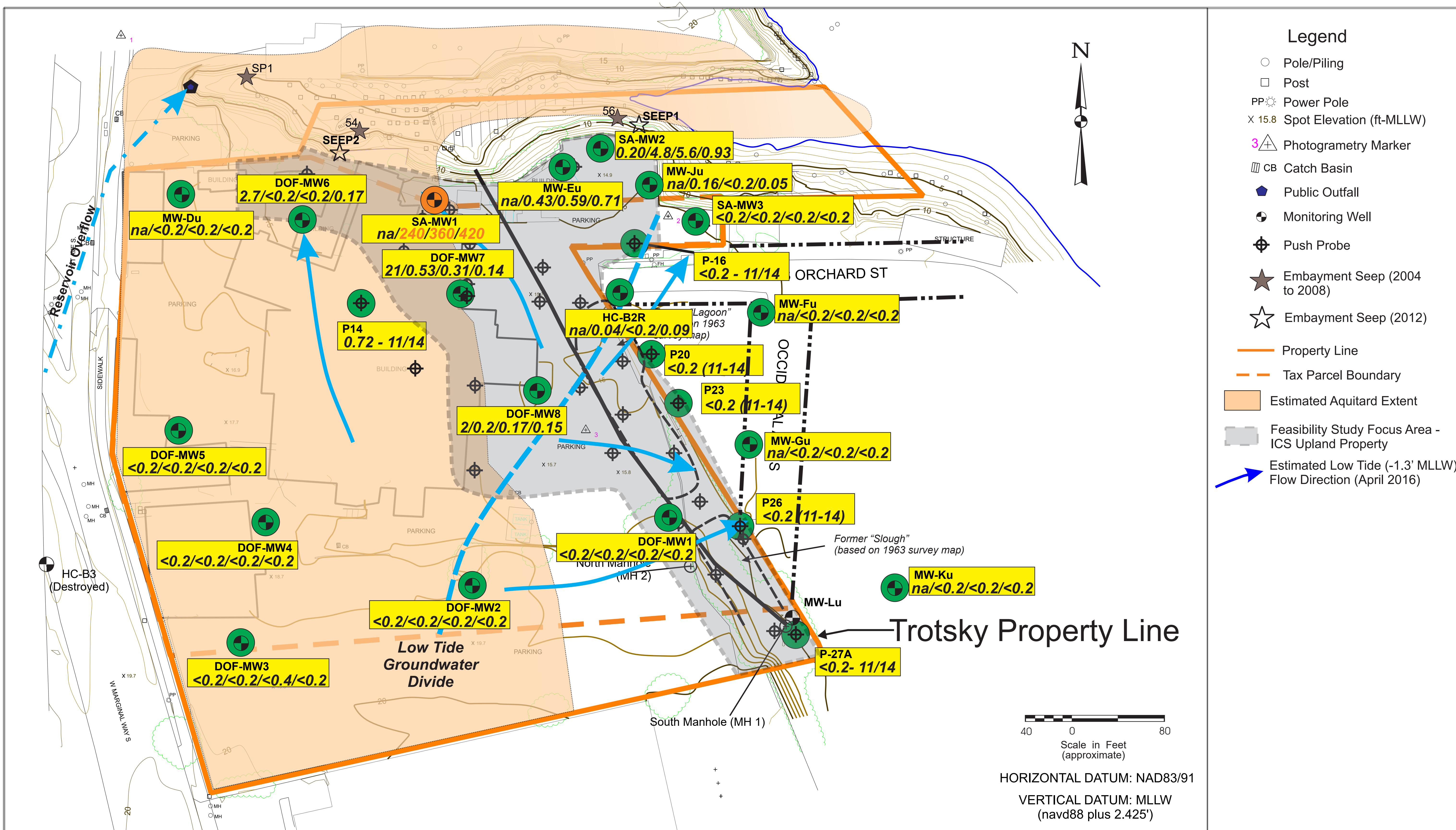
ICS/NW Cooperage Site

Ethylbenzene Concentrations Water Table Zone Above Aquitard

SUM-008-00 (ICS) ***Jan. 2020***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-8a



Concentration ≤ Screening Level (SL= 21 ug/l)

Concentration > Screening Level (SL= 21 ug/l)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available

Ref: Ethylbenzene GW Plot R1-R3revFS.cdr

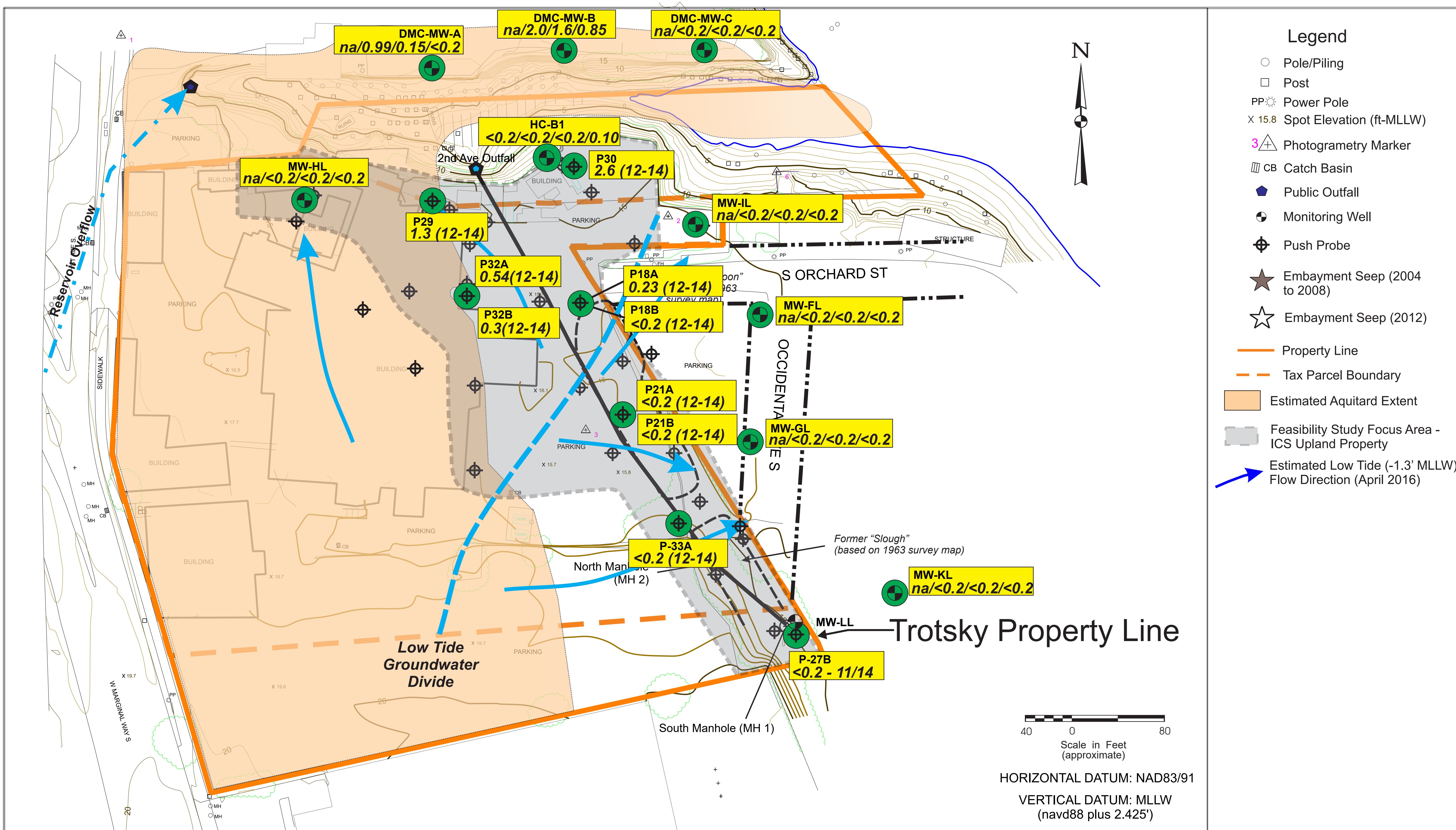
ICS/NW Cooperage Site

Ethylbenzene Concentrations Upper Zone

SUM-008-00 (ICS) *Jan. 2020*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-8b



Concentration ≤ Screening Level (SL= 21 ug/l)

Concentration > Screening Level (SL= 21 ug/l)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available

Ref: Ethylbenzene GW Plot R1-R3revFS.cdr

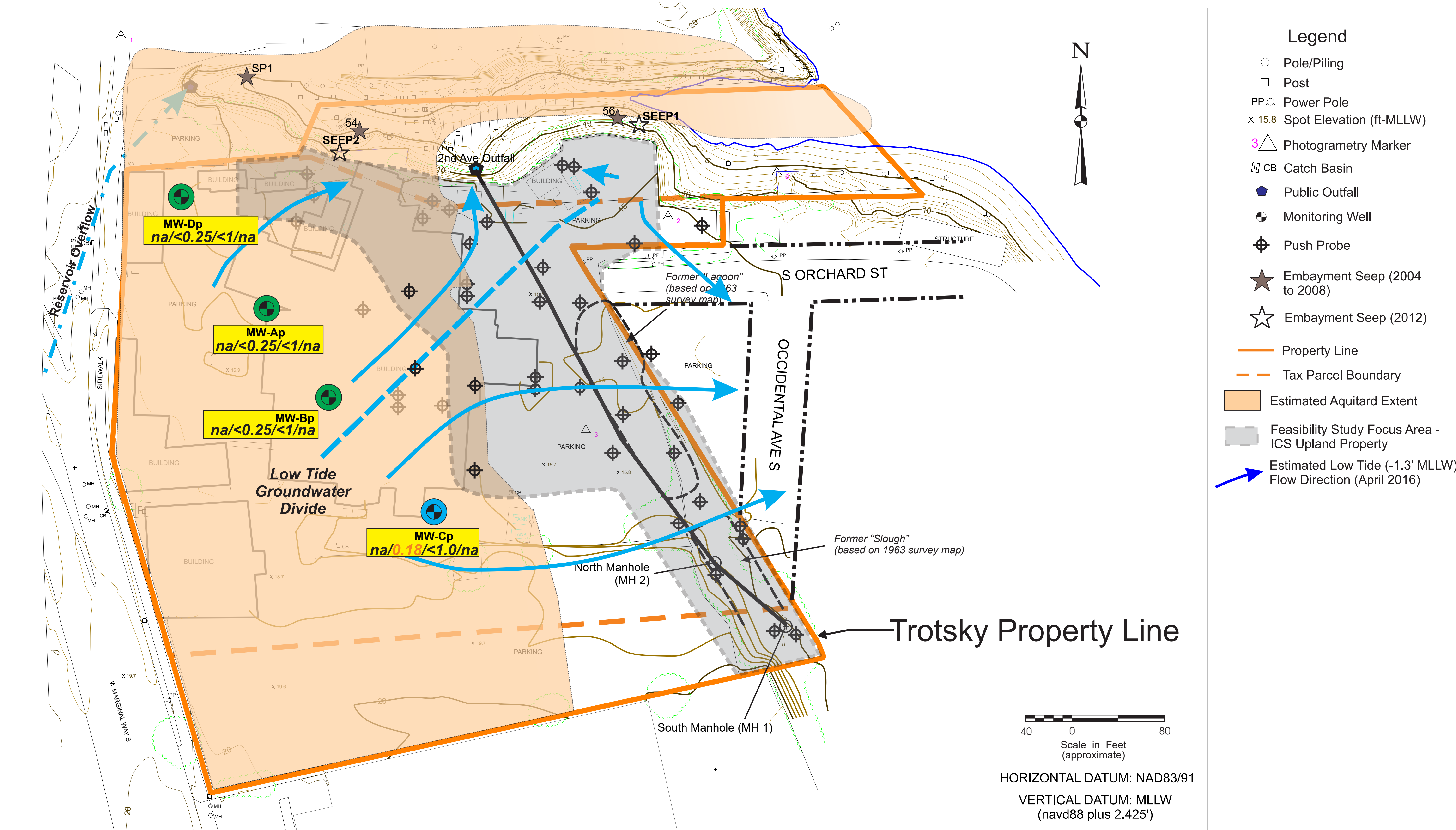
ICS/NW Cooperage Site

Ethylbenzene Concentrations Lower Zone

SUM-008-00 (ICS) ***Jan. 2020***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-8c



Concentration ≤ Screening Level (SL= 0.002 ug/l - PQL=0.025 ug/l)

Concentration > Screening Level (SL= 0.002 ug/l- PQL=0.025 ug/l)

Intermittent Detection > Screening Level (SL= 0.002 ug/l- PQL=0.025 ug/l)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available

Ref: PCP GW Plot R1-R3revFS.cdr

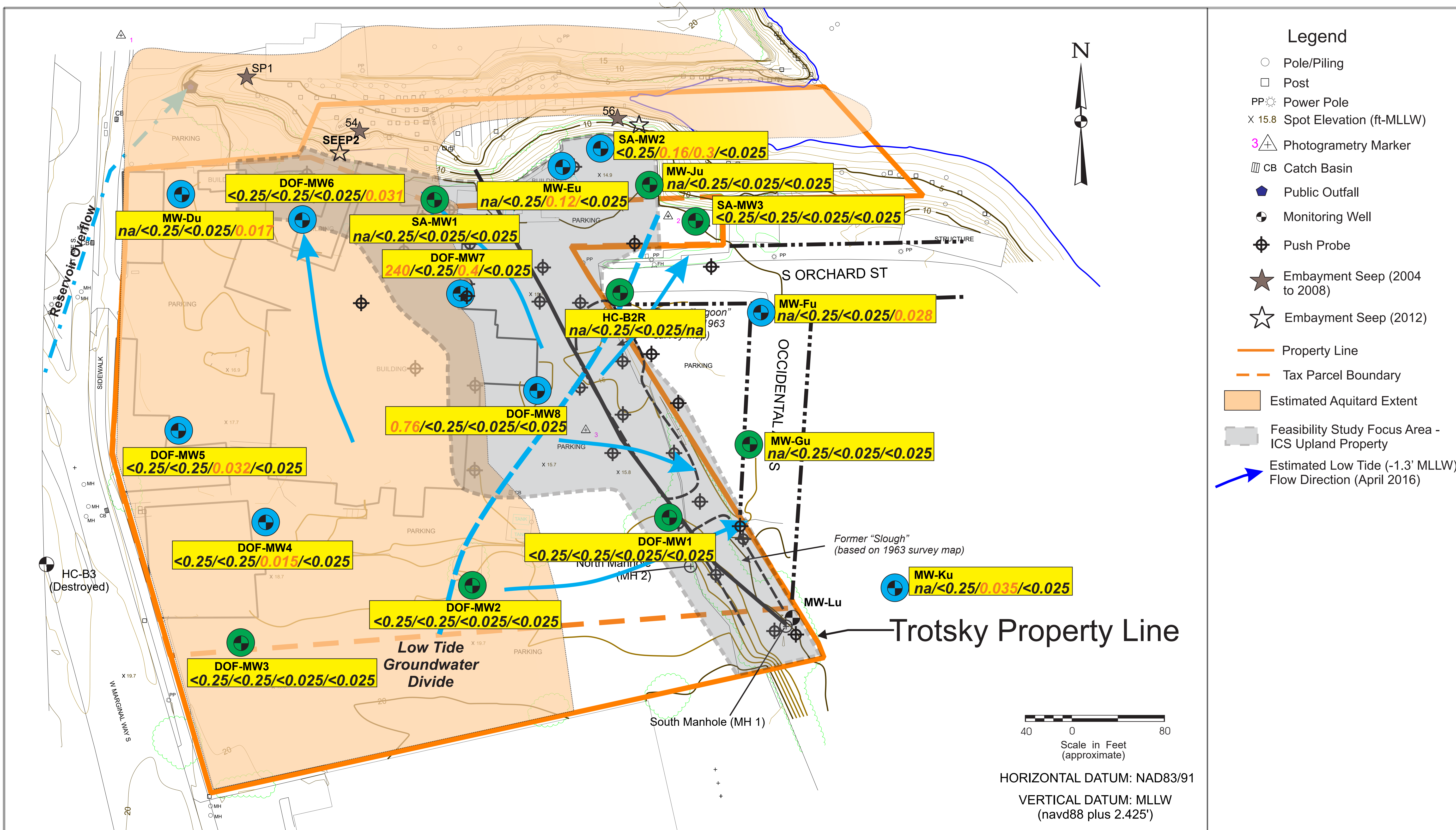
ICS/NW Cooperage Site

Pentachlorophenol Concentrations Water Table Zone Above Aquitard

SUM-008-00 (ICS) ***Jan. 2020***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-9a



Concentration ≤ Screening Level (SL= 0.002 ug/l - PQL=0.025 ug/l) 2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

Concentration > Screening Level (SL= 0.002 ug/l- PQL=0.025 ug/l) *na* - Not Available

Intermittent Detection > Screening Level (SL= 0.002 ug/l- PQL=0.025 ug/l)

Ref: PCP GW Plot R1-R3revFS.cdr

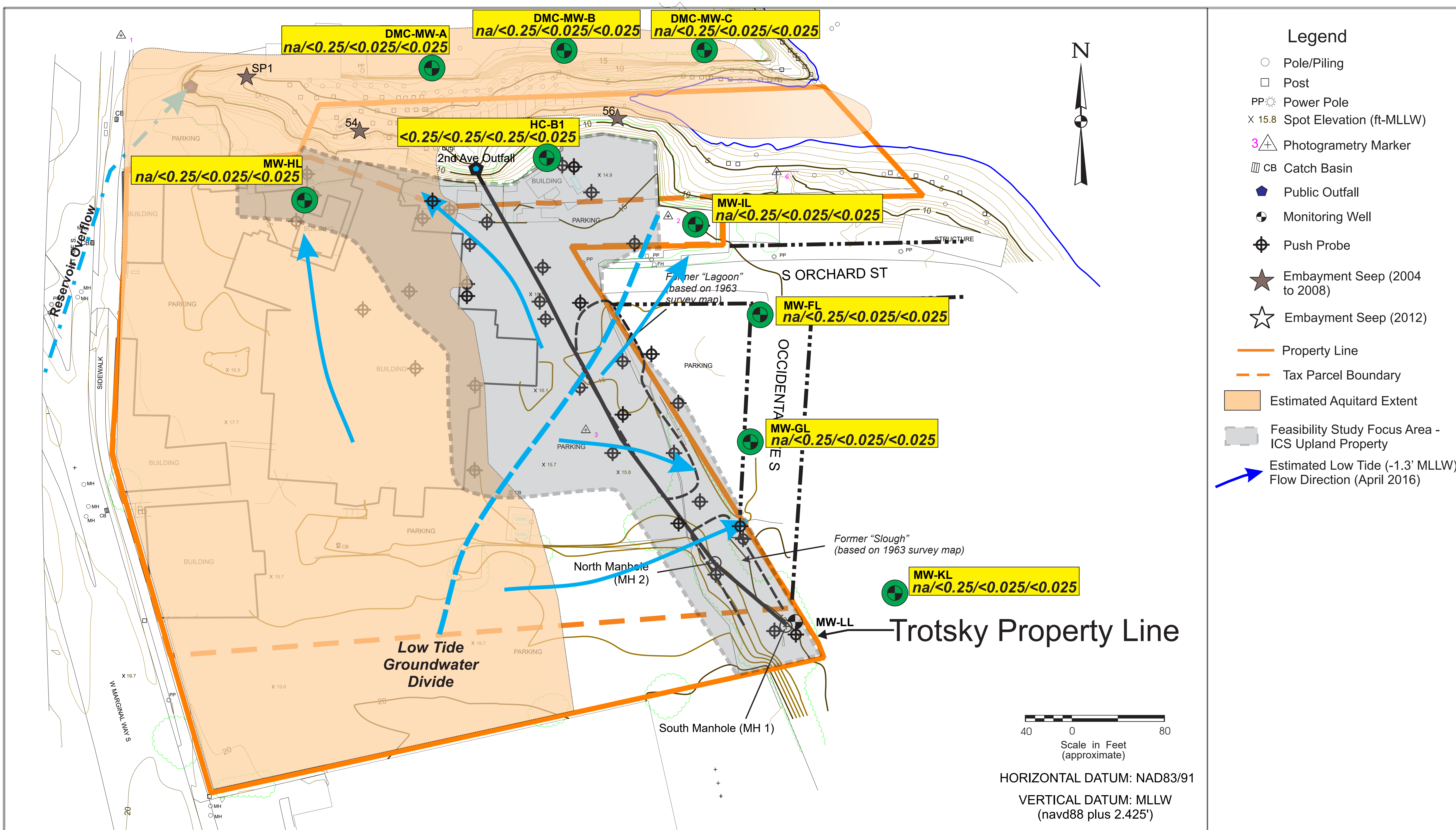
ICS/NW Cooperage Site

Pentachlorophenol Concentrations Upper Zone

SUM-008-00 (ICS) ***Jan. 2020***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-9b



Concentration ≤ Screening Level (SL= 0.002 ug/l - PQL=0.025 ug/l)

Concentration > Screening Level (SL= 0.002 ug/l- PQL=0.025 ug/l)

Intermittent Detection > Screening Level (SL= 0.002 ug/l- PQL=0.025 ug/l)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available

Ref: PCP GW Plot R1-R3revFS.cdr

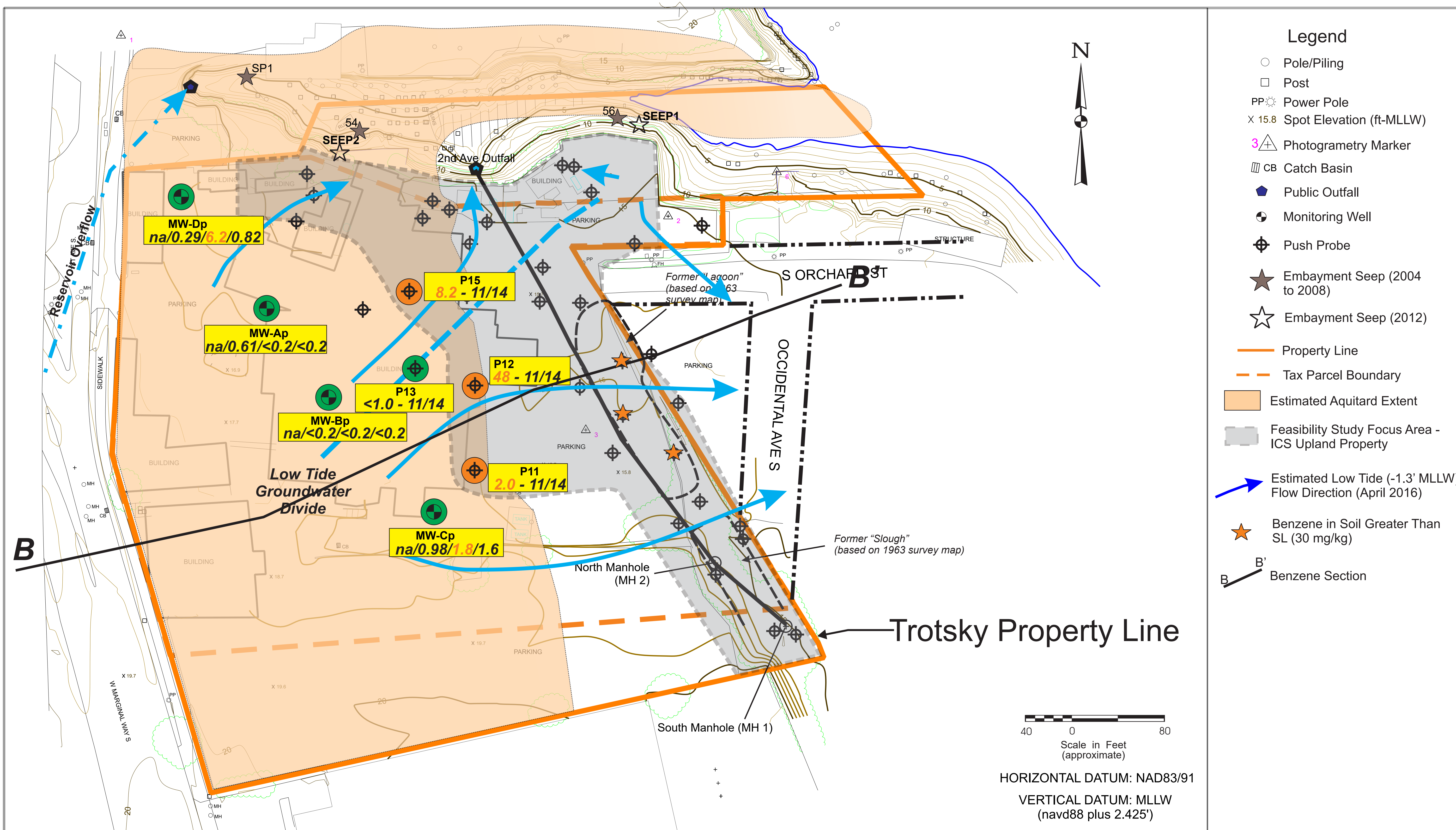
ICS/NW Cooperage Site

Pentachlorophenol Concentrations Lower Zone

SUM-008-00 (ICS) ***Jan. 2020***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-9c



Concentration ≤ Screening Level (SL= 1.6* ug/l)

Concentration > Screening Level (SL= 1.6* ug/l)

2.0/5.3/6.0/0.61 Concentration - ug/l (11-12/11-15/3-16/10-16)

na - Not Available; * Surface Water

Ref: Benzene GW Plot R1-R3revFSrev.cdr

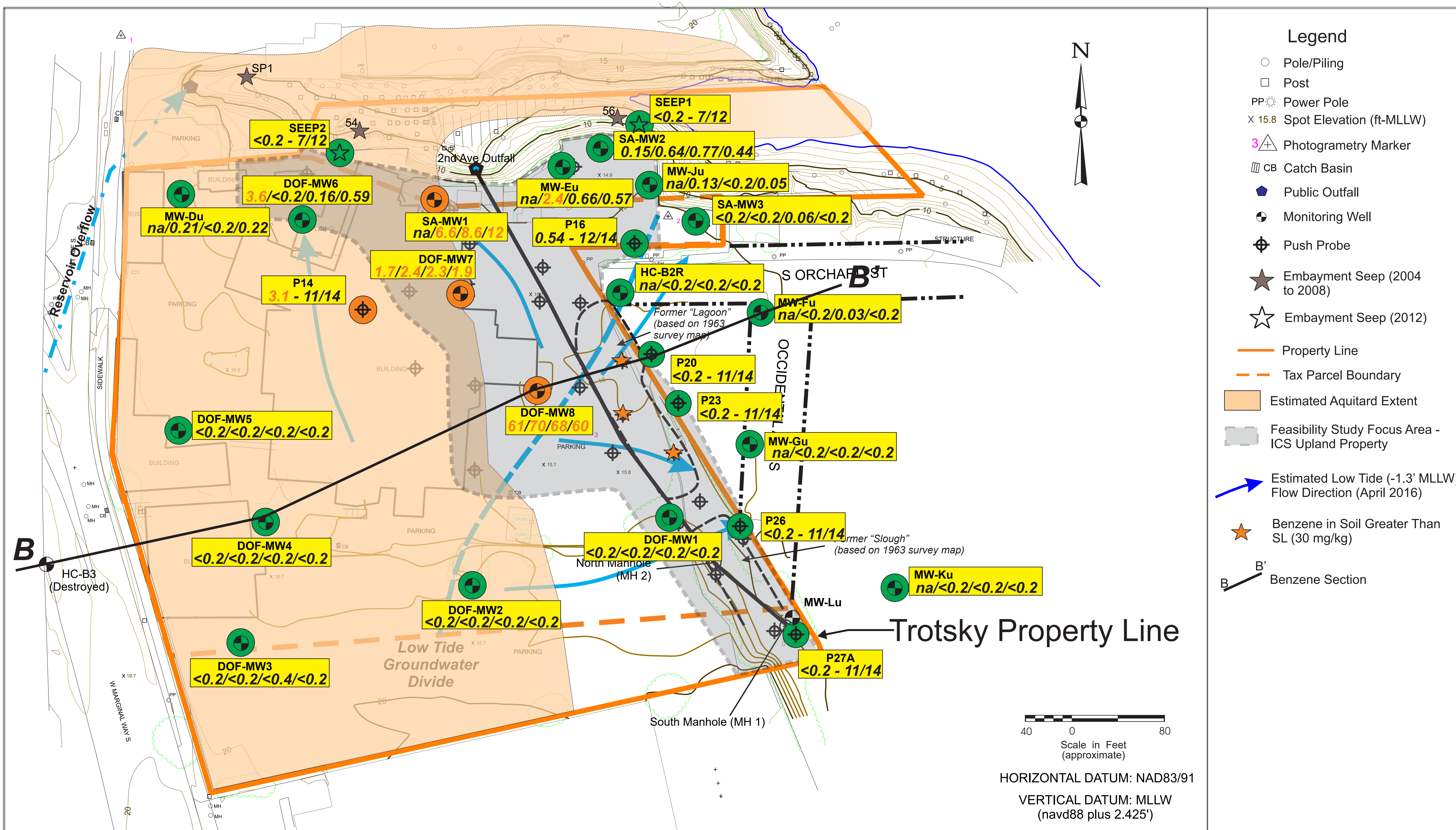
ICS/NW Cooperage Site

Benzene Concentrations in Water Table Zone Above Aquitard

SUM-008-00 (ICS) ***Jan. 2020***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-10a



Concentration ≤ Screening Level (SL= 1.6* ug/l)

Concentration > Screening Level (SL= 1.6* ug/l)

2.0/5.3/6.0/0.61 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available; * Surface Water

Ref: Benzene GW Plot R1-R3revFSrev.cdr

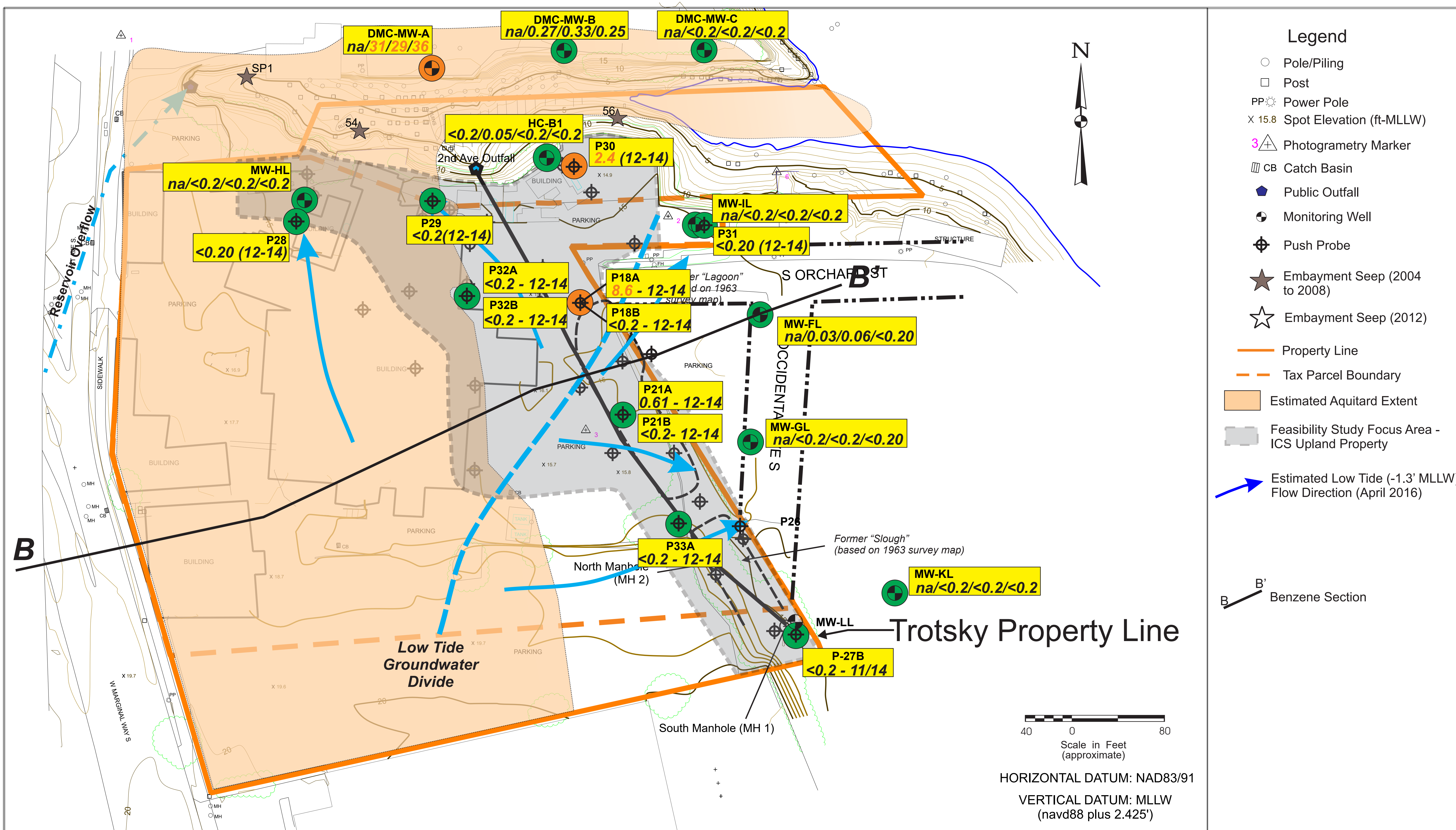
ICS/NW Cooperage Site

Benzene Concentrations in Upper Zone

SUM-008-00 (ICS) *Jan. 2020*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-10b



Concentration ≤ Screening Level (SL= 1.6* ug/l)

Concentration > Screening Level (SL= 1.6* ug/l)

2.0/5.3/6.0/0.61 Concentration - ug/l (11-12/11-15/3-16/10-16)

na - Not Available; * Surface Water

Ref: Benzene GW Plot R1-R3revFSrev.cdr

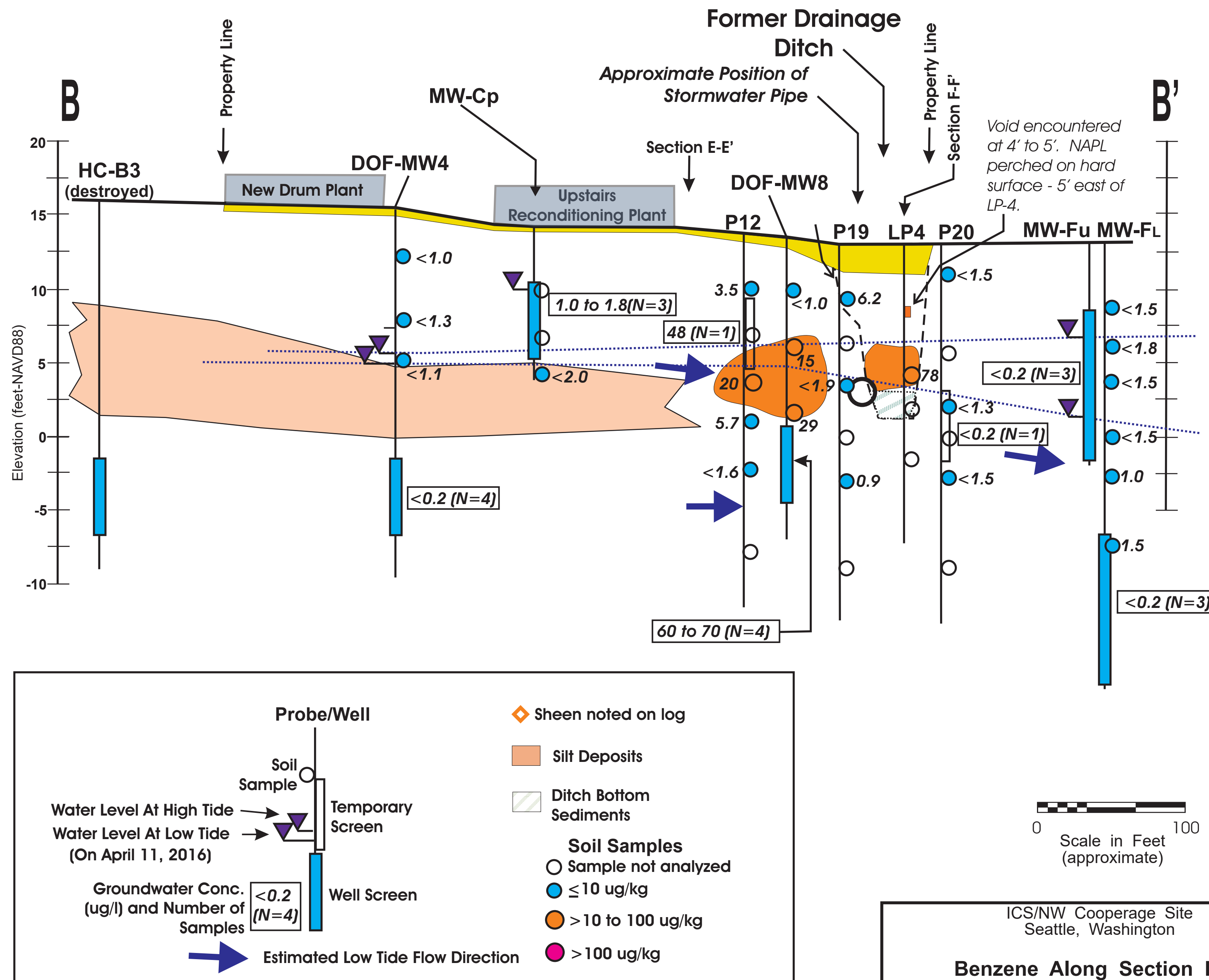
ICS/NW Cooperage Site

Benzene Concentrations in Lower Zone

SUM-008-00 (ICS) ***Jan. 2020***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-10c



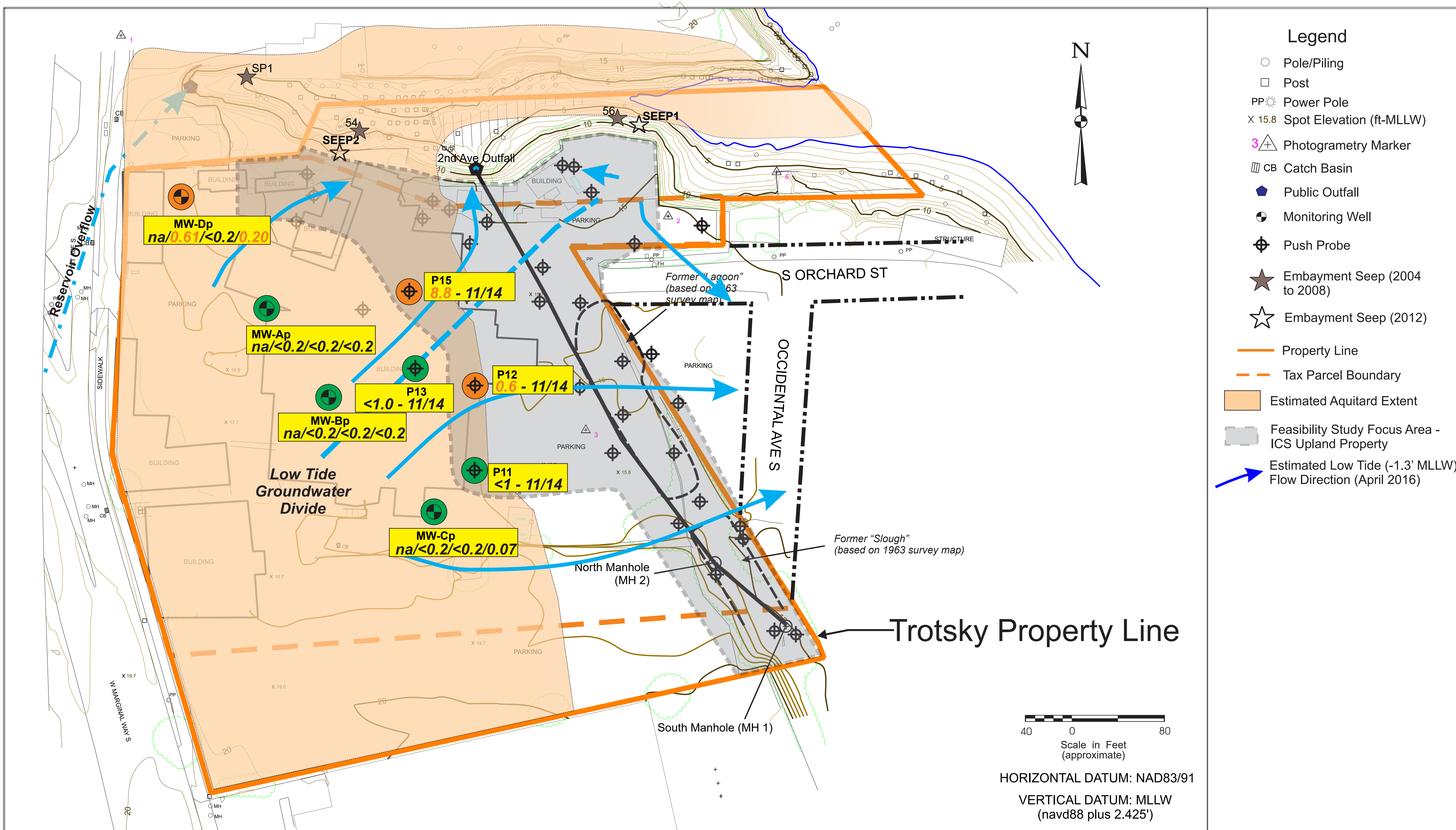
ICS/NW Cooperage Site
Seattle, Washington

Benzene Along Section B-B'

SUM-008-00 **FIGURE 4-11** Jan. 2020

Dalton, Olmsted & Fuglevand, Inc.

Ref: Ben section B-B'7-2016FS.cdr



Concentration ≤ Cleanup Level (SL = 0.18 ug/l*)

Concentration > Cleanup Level (SL= 0.18 ug/l*)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available; * Surface Water

Ref: VC GW Plot R1-R3revFS.cdr

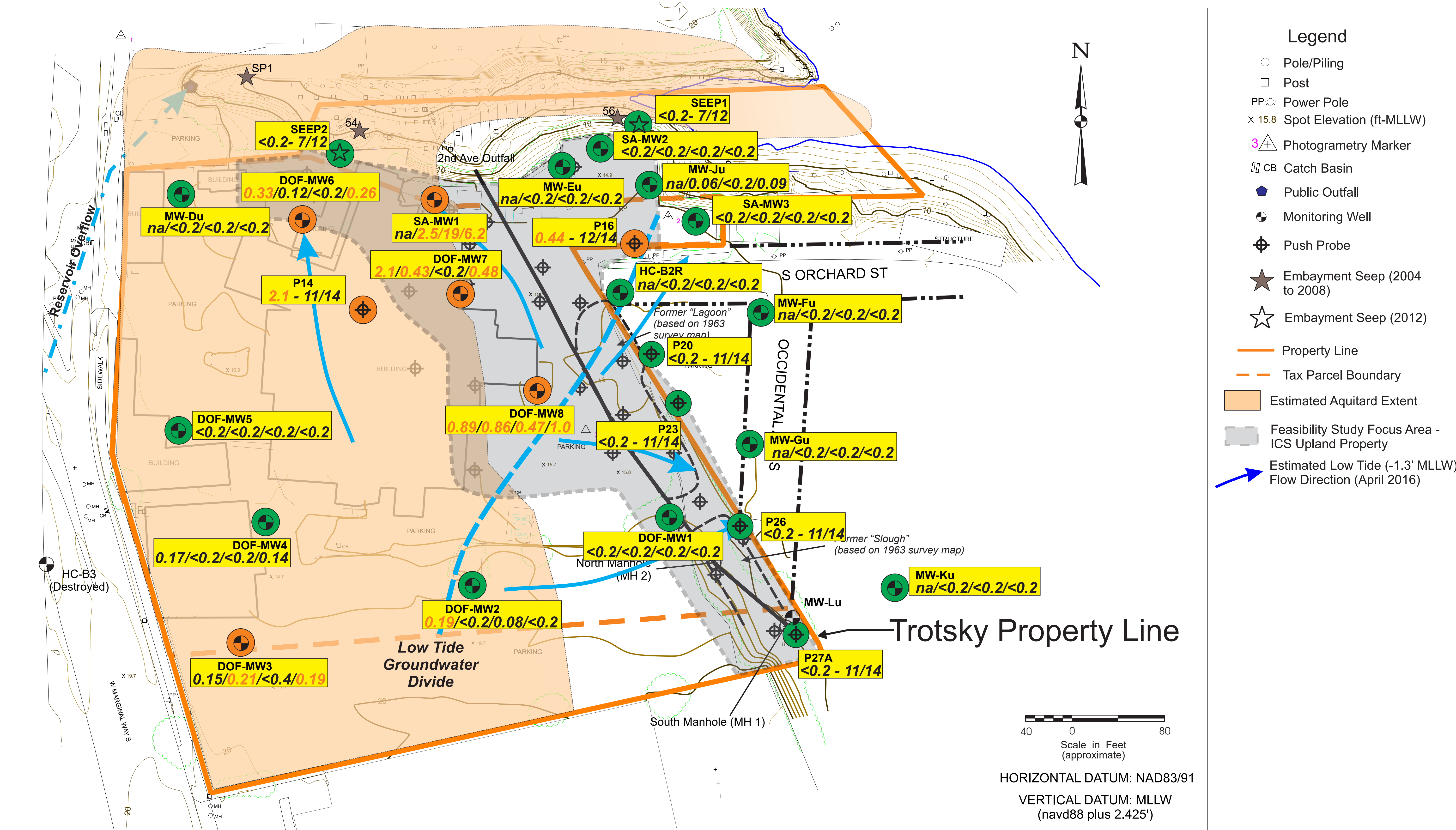
ICS/NW Cooperage Site

Vinyl Chloride Concentrations Water Table Zone Above Aquitard

SUM-008-00 (ICS) *June 2021*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-12a



Concentration ≤ Cleanup Level (SL = 0.18 ug/l*)

Concentration > Cleanup Level (SL= 0.18 ug/l*)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available; * Surface Water

Ref: VC GW Plot R1-R3rev.cdr

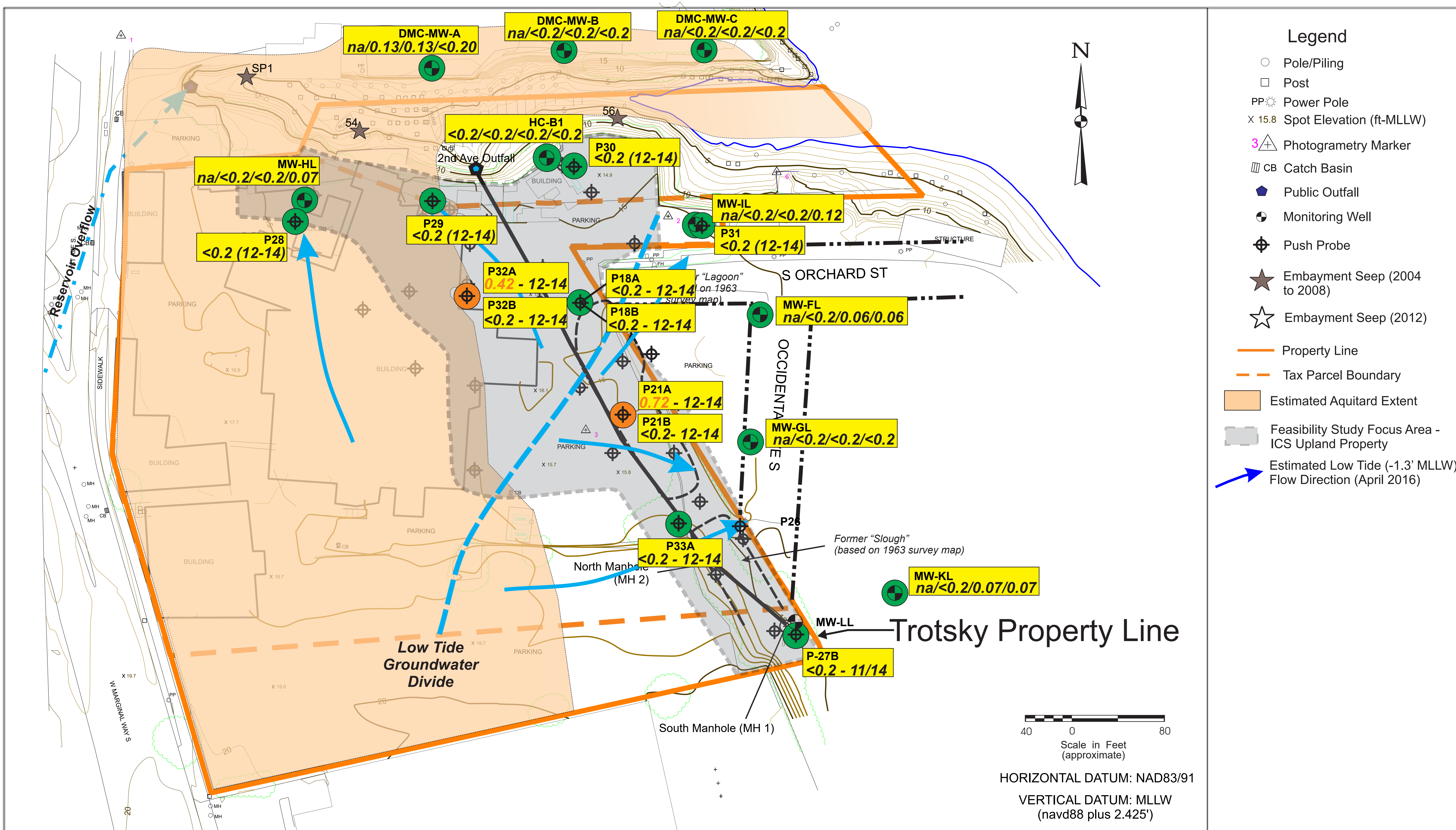
ICS/NW Cooperage Site

Vinyl Chloride Concentrations Upper Zone

SUM-008-00 (ICS) ***June 2021***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-12b



Concentration ≤ Cleanup Level (SL = 0.18 ug/l*)

Concentration > Cleanup Level (SL= 0.18 ug/l*)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available; * Surface Water

Ref: VC GW Plot R1-R3rev.cdr

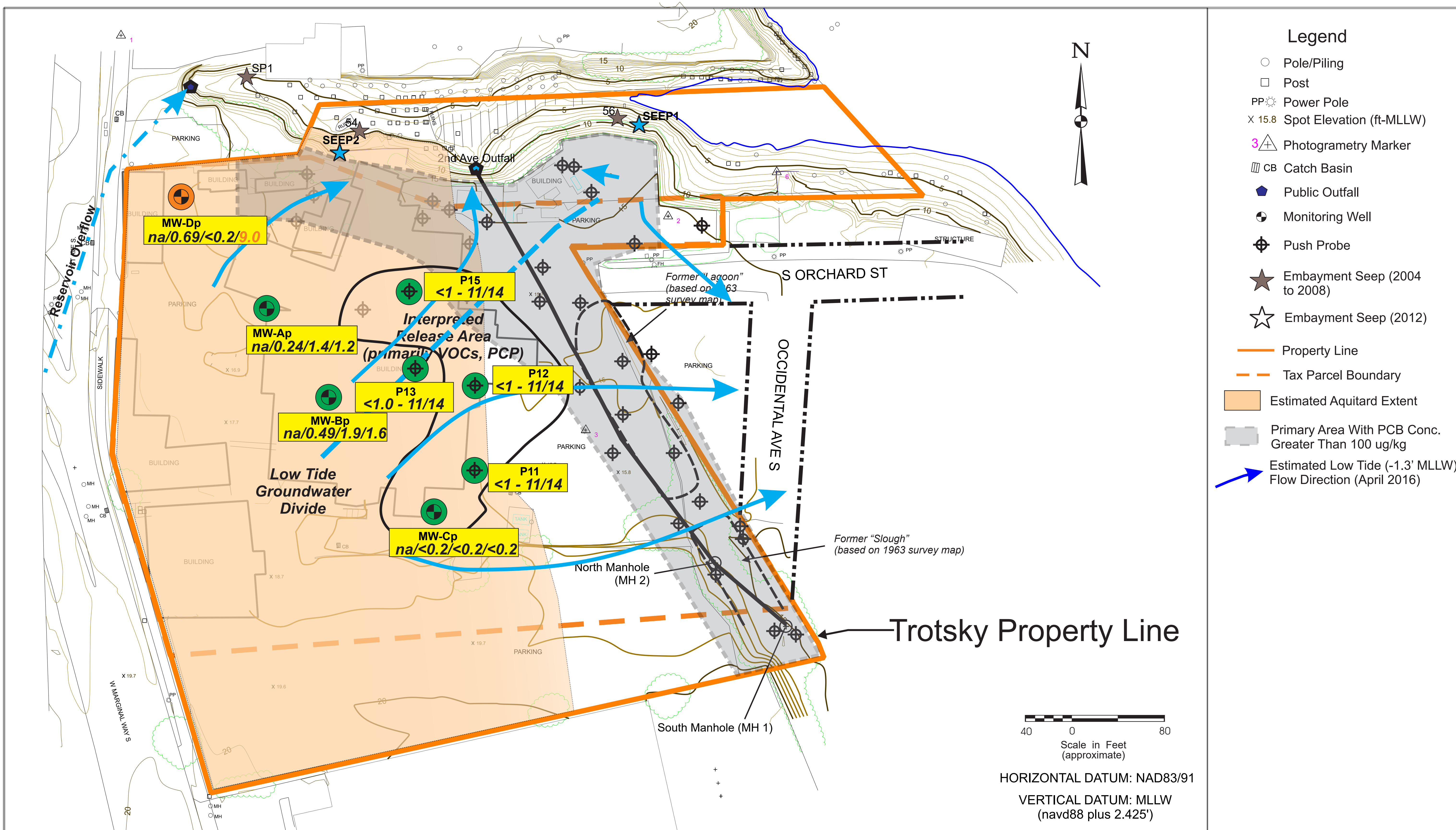
ICS/NW Cooperage Site

Vinyl Chloride Concentrations
Lower Zone

SUM-008-00 (ICS) ***June 2021***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-12c



Concentration ≤ Cleanup Level (CUL=2.9 ug/l*)

Concentration > Cleanup Level (CUL= 2.9 ug/l*)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-2012/11-2015/3-2016/9-2016)

na - Not Available; * Surface Water

Ref: PCE GW Plot R1-R3revFS.cdr

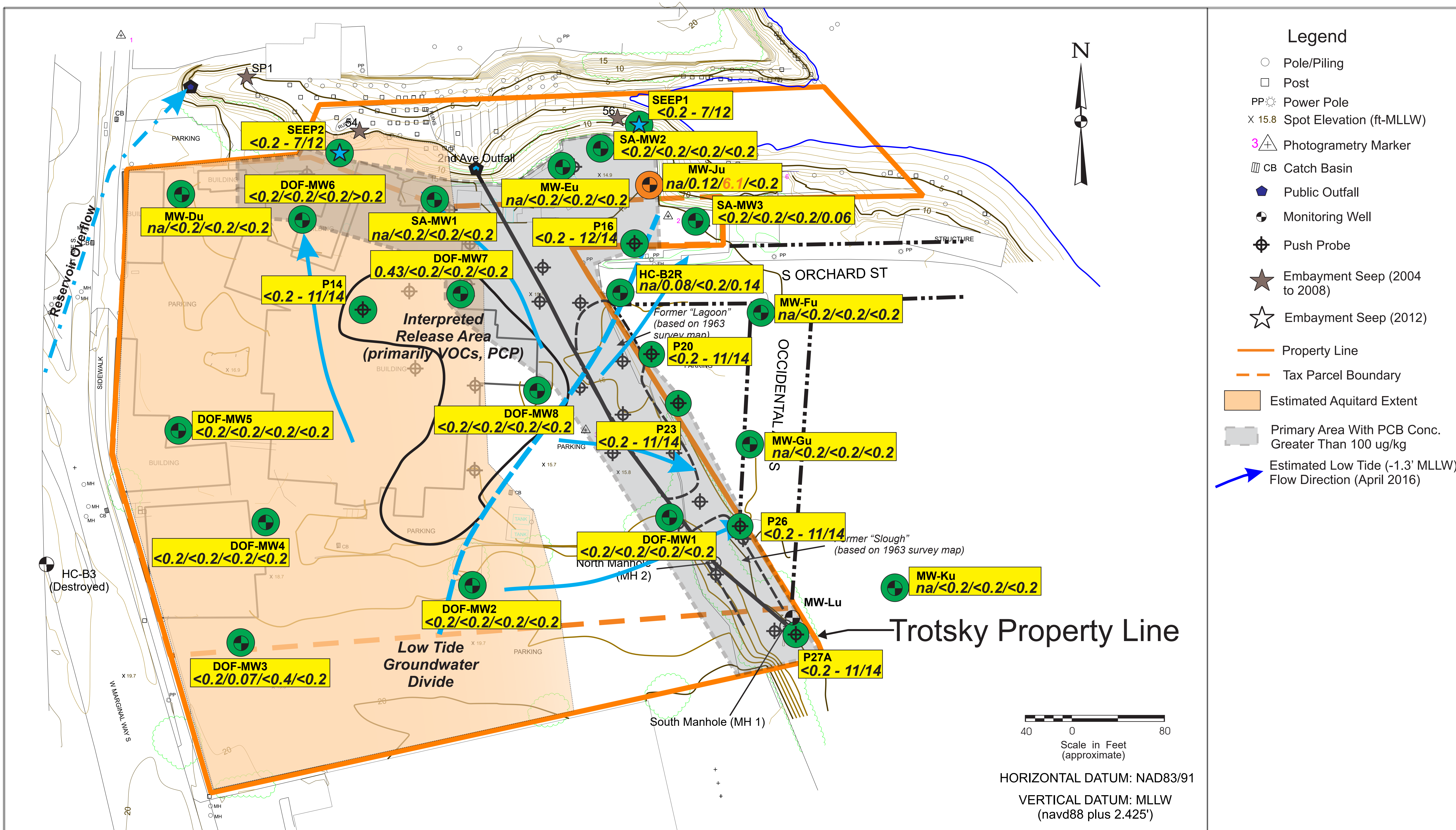
ICS/NW Cooperage Site

Tetrachloroethene Concentrations Water Table Zone Above Aquitard

SUM-008-00 (ICS) ***June 2021***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-13a



Concentration ≤ Cleanup Level (CUL=2.9 ug/l*)

Concentration > Cleanup Level (CUL= 2.9 ug/l*)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-2012/11-2015/3-2016/9-2016)

na - Not Available; * Surface Water

Ref: PCE GW Plot R1-R3revFS.cdr

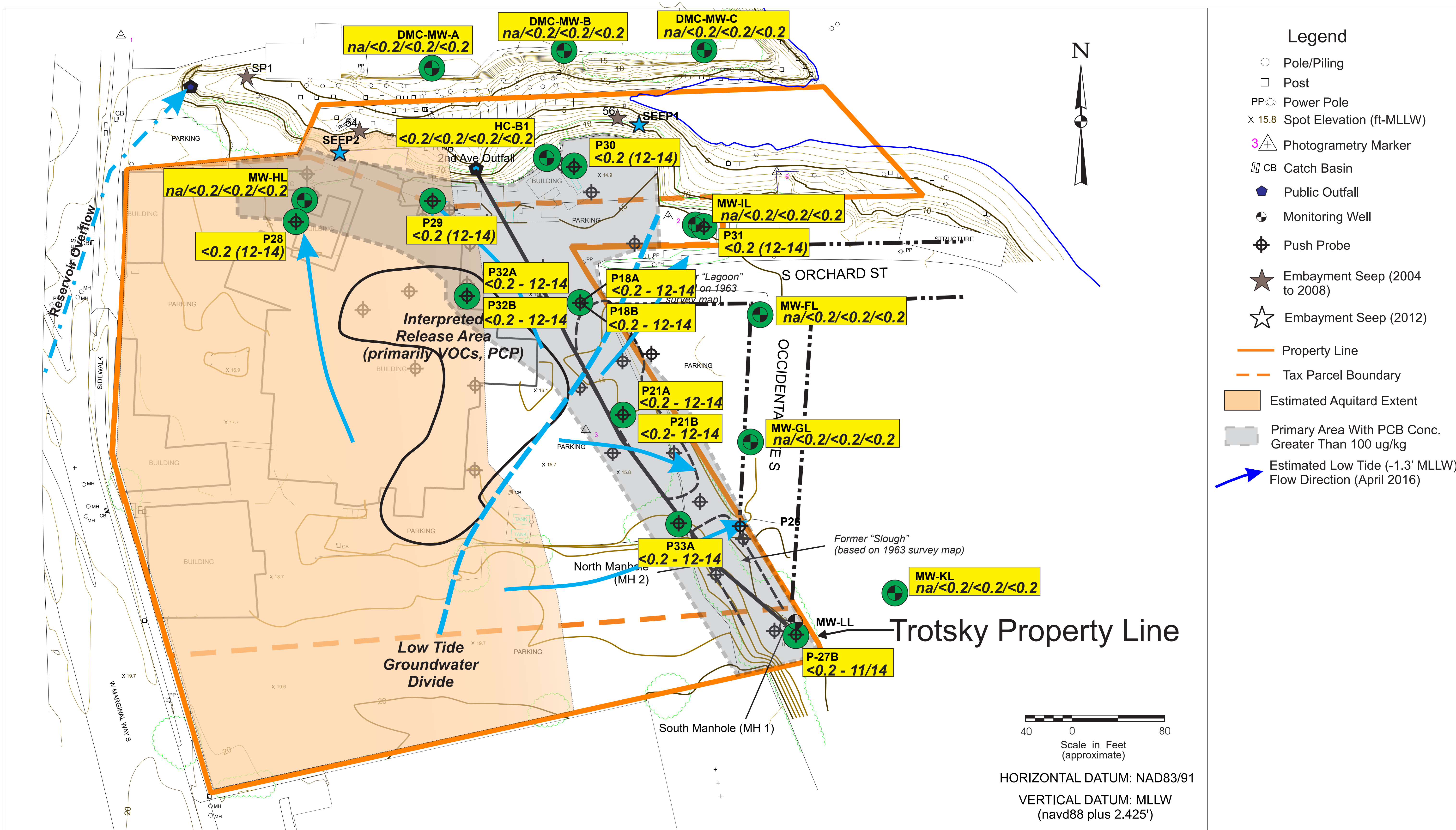
ICS/NW Cooperage Site

Tetrachloroethene Concentrations Upper Zone

SUM-008-00 (ICS) ***June 2021***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-13b



Concentration ≤ Cleanup Level (CUL=2.9 ug/l*) 2.0/5.3/6.0/2.0 Concentration - ug/l (11-2012/11-2015/3-2016/9-2016)

Concentration > Cleanup Level (CUL= 2.9 ug/l*) *na* - Not Available; * Surface Water

Ref:PCE GW Plot R1-R3revFS.cdr

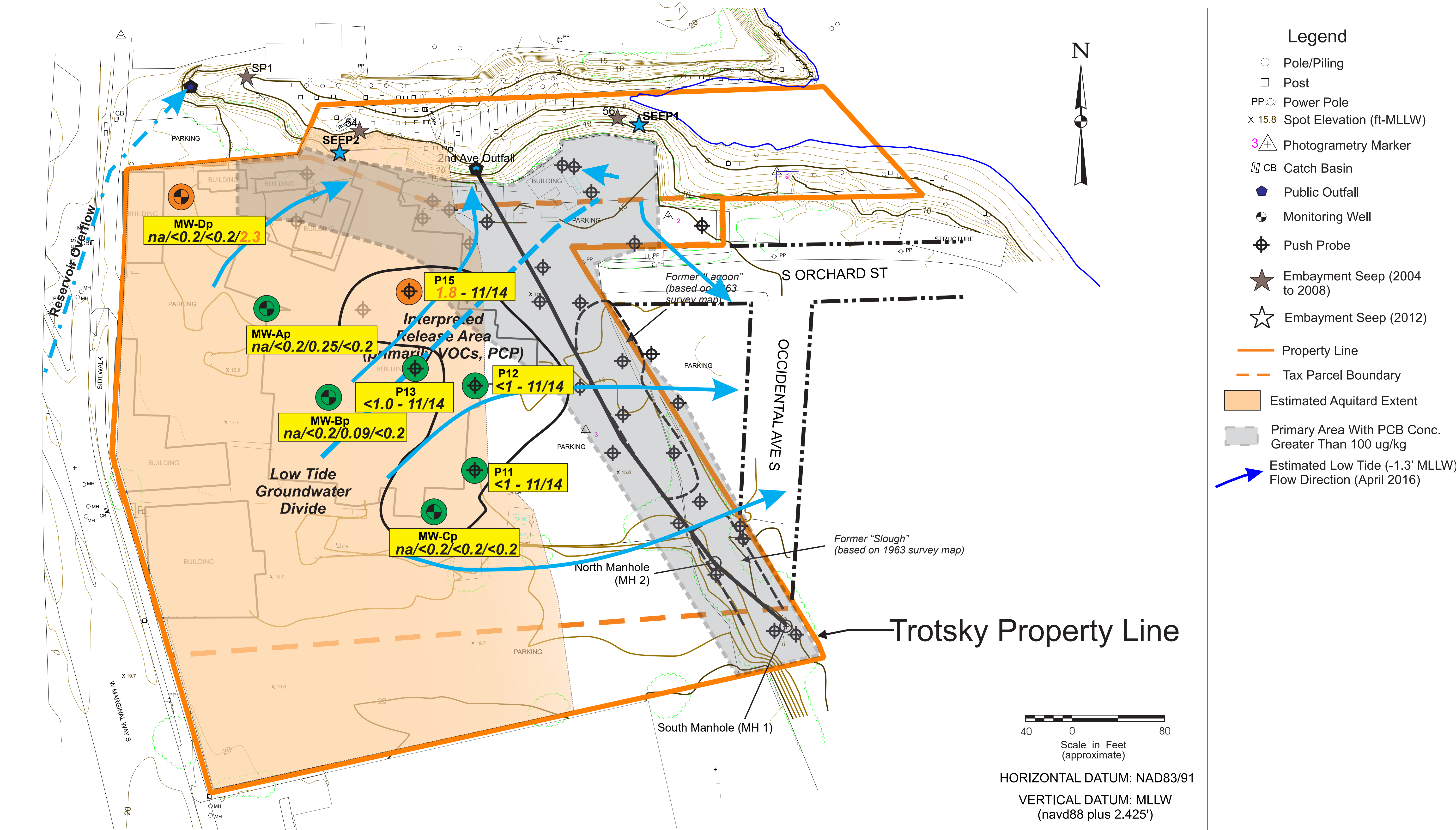
ICS/NW Cooperage Site

Tetrachloroethene Concentrations Lower Zone

SUM-008-00 (ICS) ***June 2021***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-13c



Concentration ≤ Cleanup Level (CUL= 0.7 ug/l*)

Concentration > Cleanup Level (CUL= 0.7 ug/l*)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-2012/11-2015/3-2016/9-2016)

na - Not Available; * Surface Water

Ref: TCE GW Plot R1-R3revFS.cdr

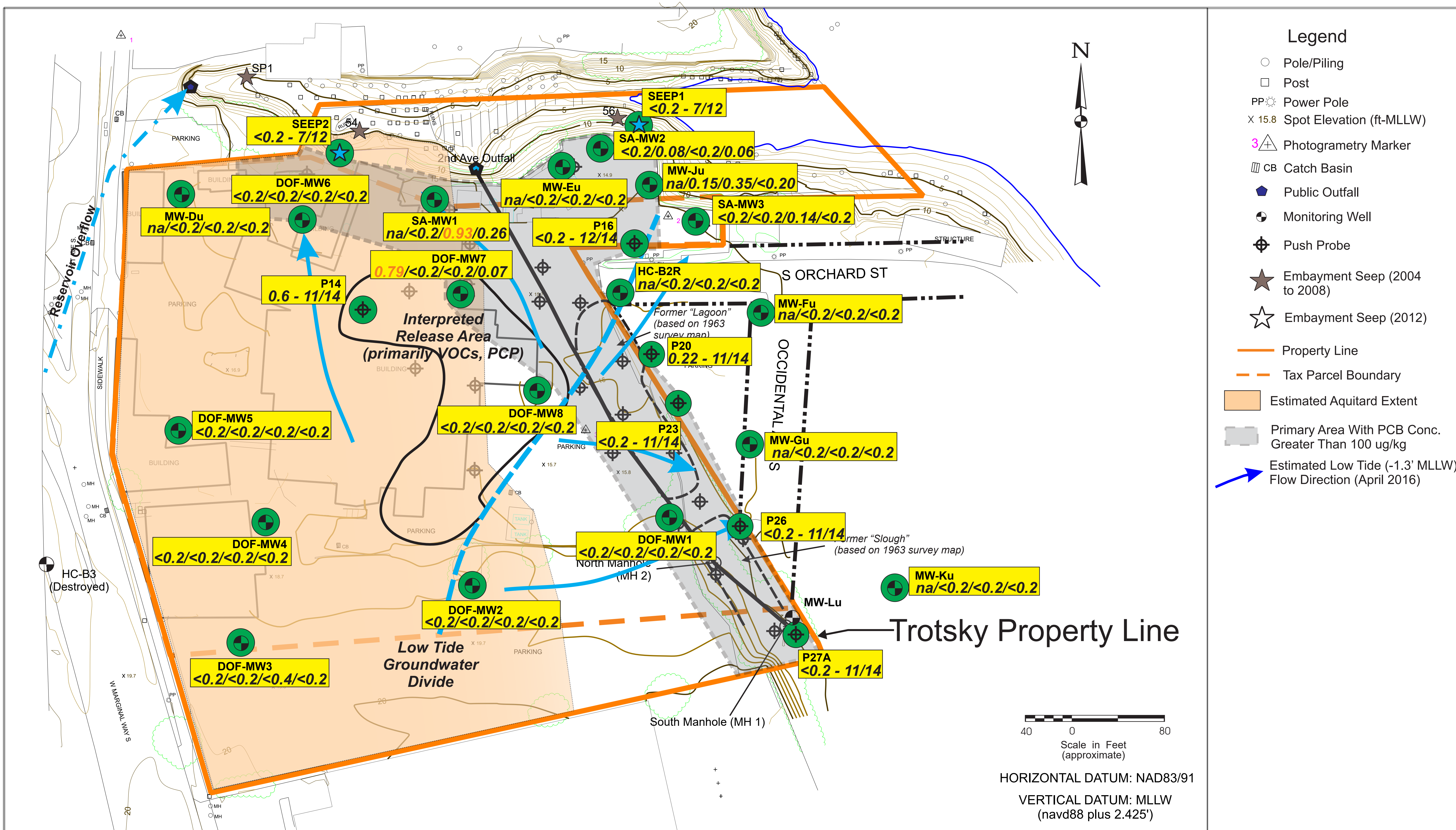
ICS/NW Cooperage Site

Trichloroethene Concentrations Water Table Zone Above Aquitard

SUM-008-00 (ICS) ***June 2021***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-14a



Concentration ≤ Cleanup Level (CUL= 0.7 ug/l*)

Concentration > Cleanup Level (CUL= 0.7 ug/l*)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-2012/11-2015/3-2016/9-2016)

na - Not Available; * Surface Water

Ref: TCE GW Plot R1-R3revFS.cdr

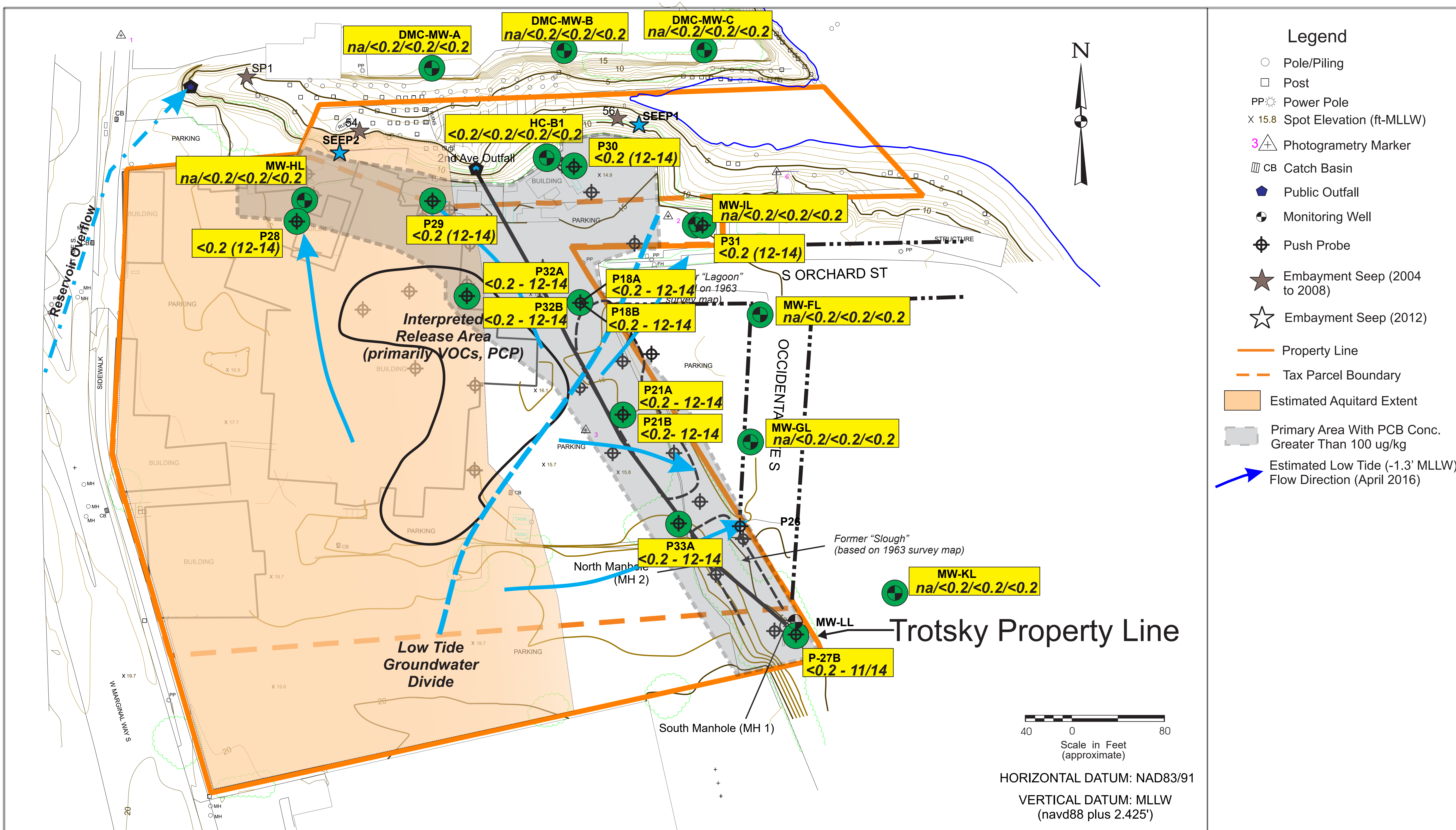
ICS/NW Cooperage Site

Trichloroethene Concentrations Upper Zone

SUM-008-00 (ICS) *June 2021*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-14b



Concentration ≤ Cleanup Level (CUL= 0.7 ug/l*)

Concentration > Cleanup Level (CUL= 0.7 ug/l*)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-2012/11-2015/3-2016/9-2016)

na - Not Available; * Surface Water

Ref:TCE GW Plot R1-R3revFS.cdr

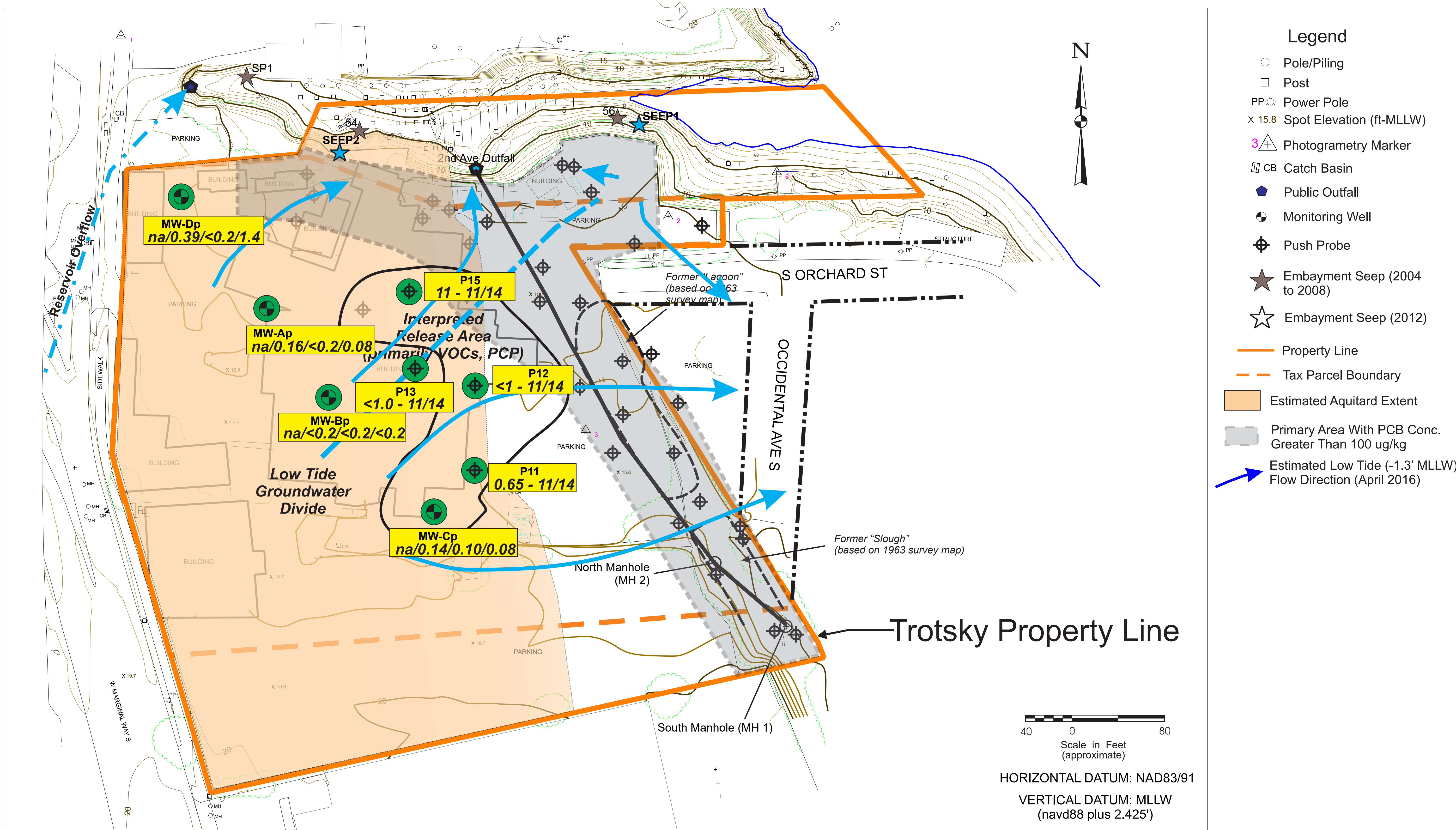
ICS/NW Cooperage Site

Trichloroethene Concentrations Lower Zone

SUM-008-00 (ICS) ***June 2021***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-14c



Concentration ≤ Screening Level (CUL= 380,000 ug/l*)

Concentration > Screening Level (CUL= 380,000 ug/l*)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-2012/11-2015/3-2016/9-2016)

na - Not Available; * Surface Water CUL

Ref: cis12DCE GW Plot R1-R3revFS.cdr

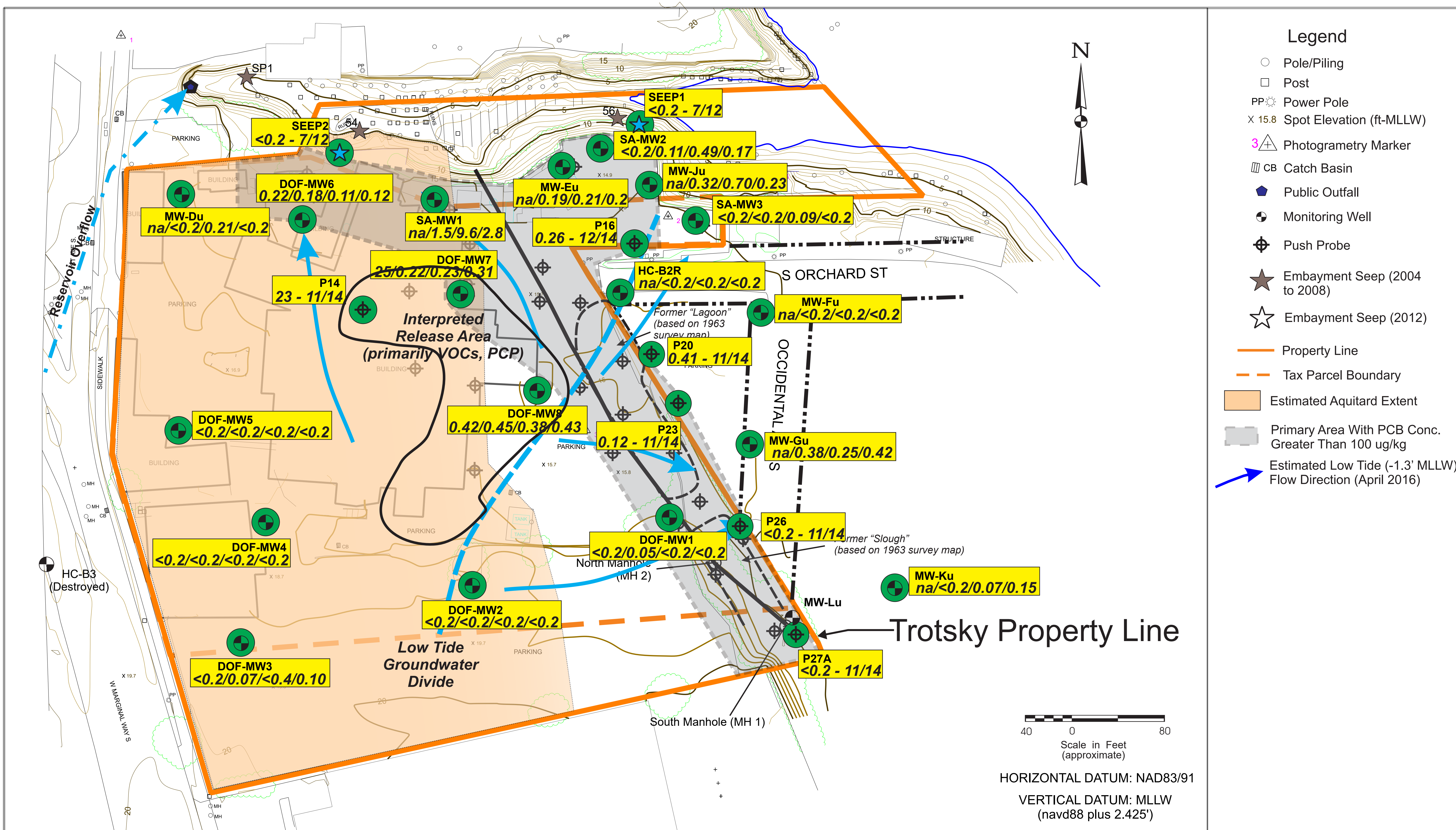
ICS/NW Cooperage Site

cis-1,2-Dichloroethene Concentrations Water Table Zone Above Aquitard

SUM-008-00 (ICS) ***June 2021***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-15a



● Concentration ≤ Screening Level (CUL= 380,000 ug/l*)

● Concentration > Screening Level (CUL= 380,000 ug/l*)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-2012/11-2015/3-2016/9-2016)

na - Not Available; * Surface Water CUL

Ref: cis12DCE GW Plot R1-R3revFS.cdr

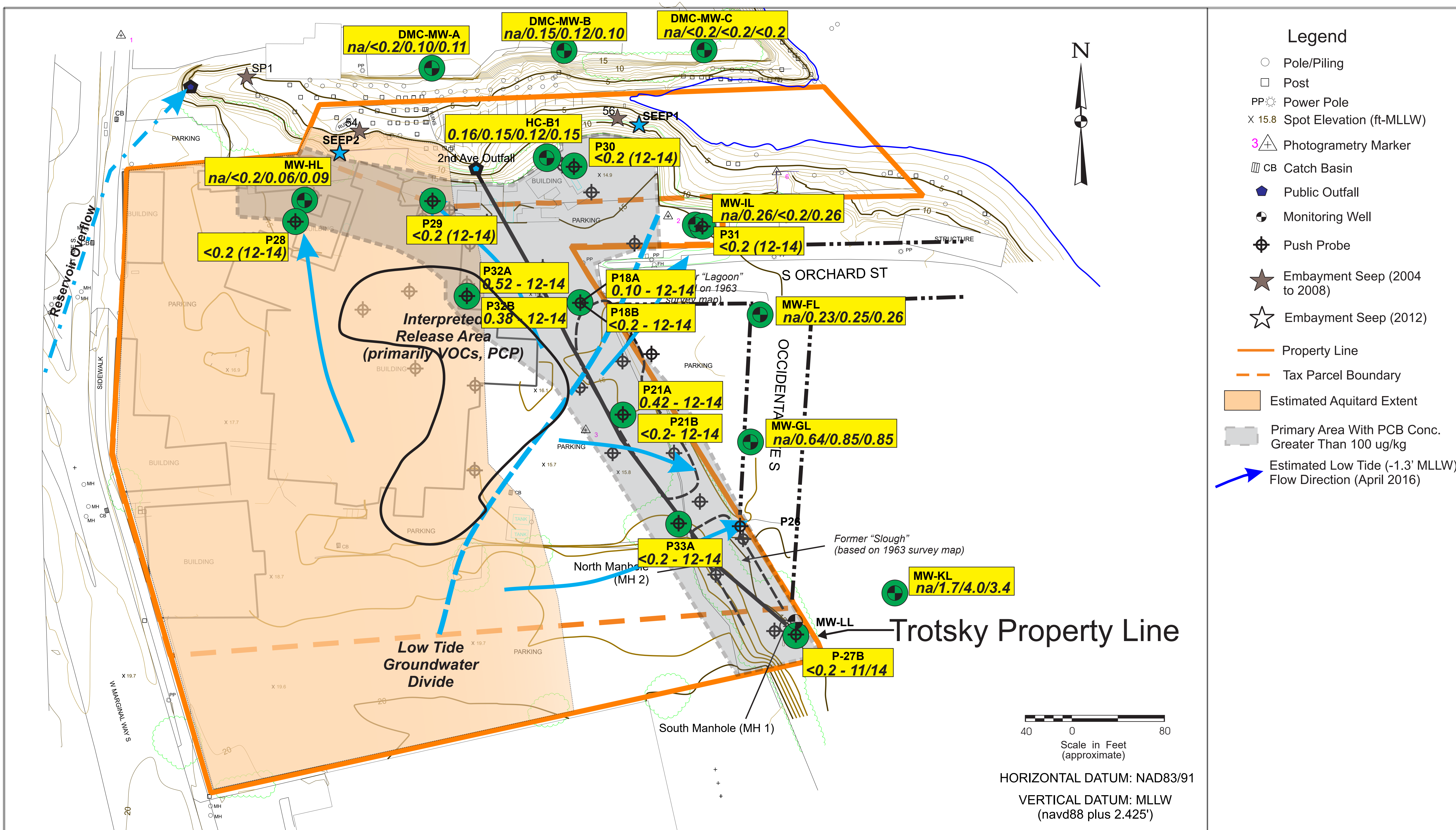
ICS/NW Cooperage Site

cis-1,2-Dichloroethene Concentrations Upper Zone

SUM-008-00 (ICS) ***June 2021***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-15b



Concentration ≤ Screening Level (CUL= 380,000 ug/l*)

Concentration > Screening Level (CUL= 380,000 ug/l*)

2.0/5.3/6.0/2.0 Concentration - ug/l (11-2012/11-2015/3-2016/9-2016)

na - Not Available; * Surface Water CUL

Ref:Cis12DCE GW Plot R1-R3revFS.cdr

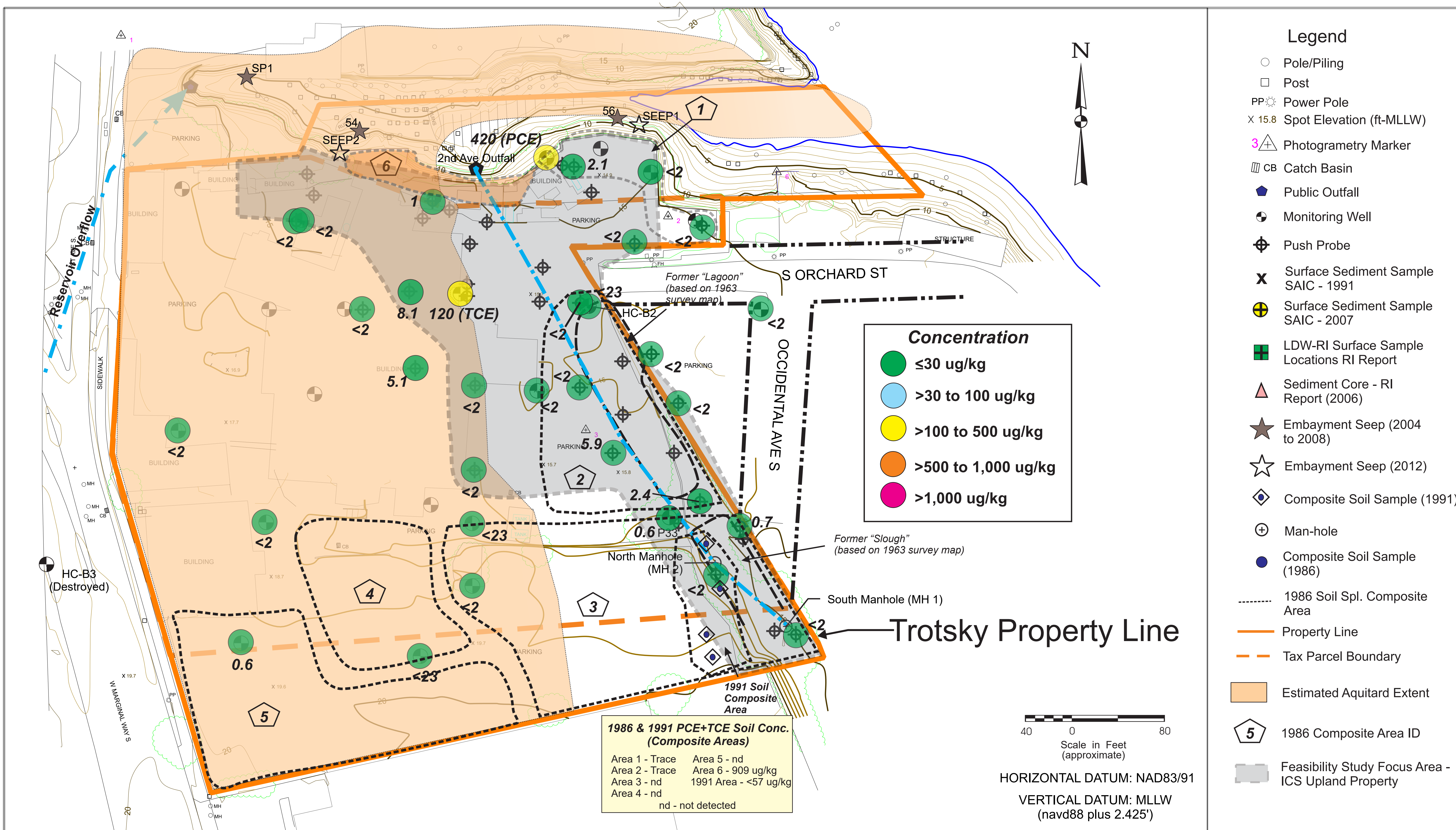
ICS/NW Cooperage Site

cis-1,2-Dichloroethene Concentrations Lower Zone

SUM-008-00 (ICS) ***June 2021***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-15c



Soil Contact Screening Levels (SLs)
PCE - 21,000,000 ug/kg
TCE - 1,750,000 ug/kg

SL to Protect Groundwater
PCE - 50 ug/kg
TCE - 30 ug/kg

Ref: Upland Phase2a PCE+TCE FSrev.cdr

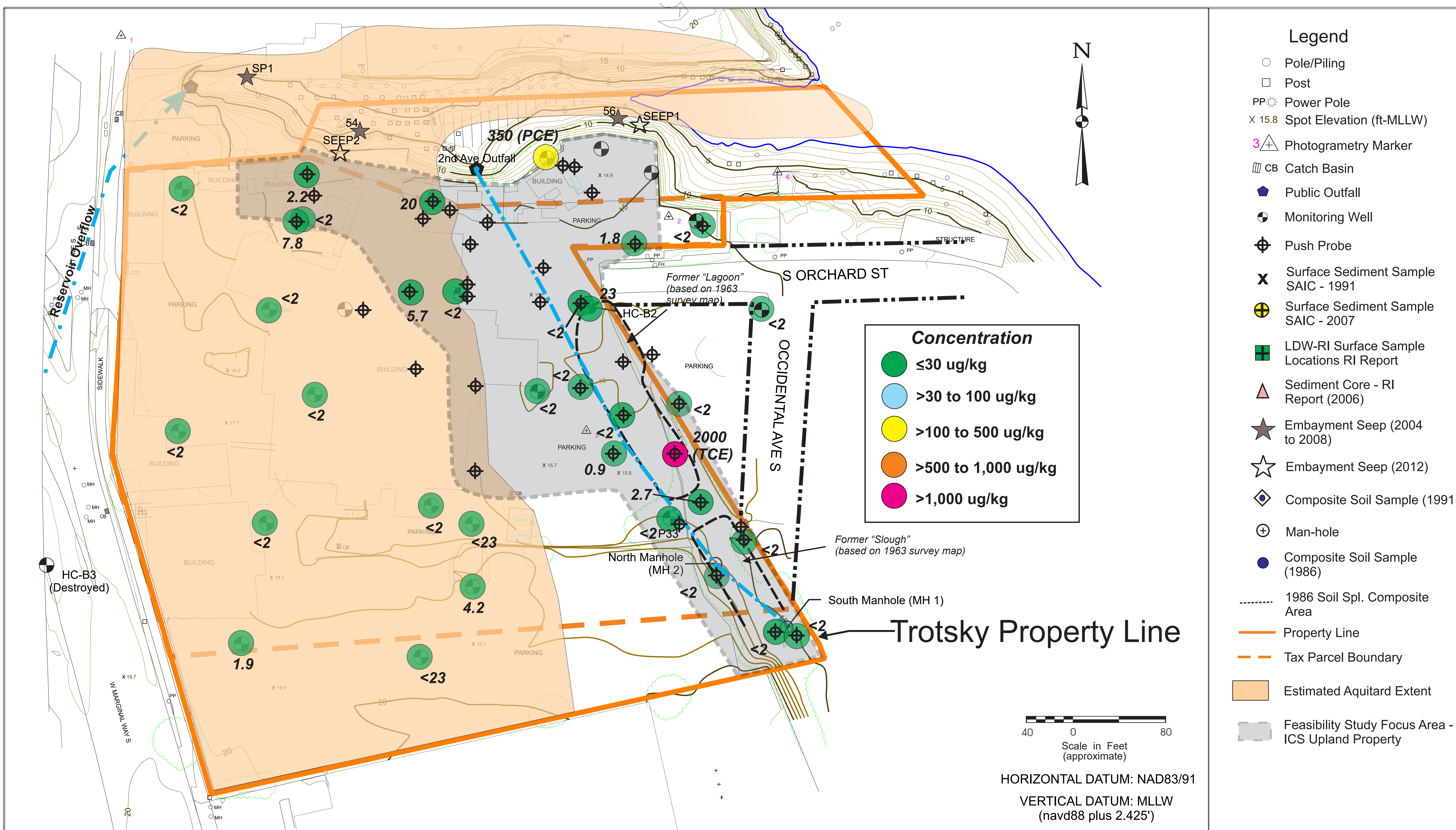
ICS/NW Cooperage Site

Extent of PCE and TCE in Soil Less than Five Feet Deep

SUM-008-00 (ICS) ***June 2021***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-16a



Soil Contact Screening Levels (SLs)
PCE - 21,000,000 ug/kg
TCE - 1,750,000 ug/kg

SL to Protect Groundwater
PCE - 50 ug/kg
TCE - 30 ug/kg

Ref: Upland Phase2a PCE+TCE FSrev.cdr

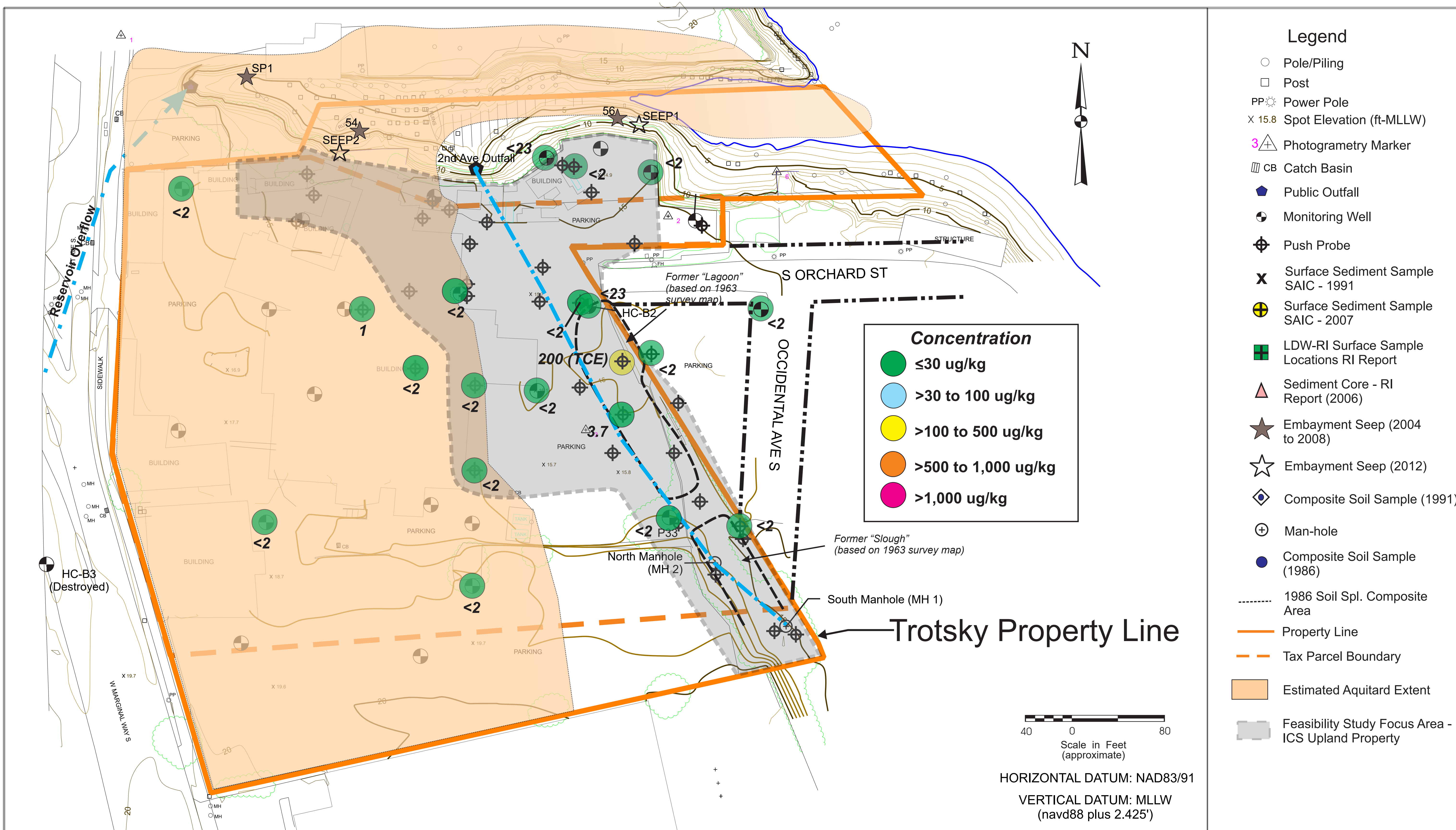
ICS/NW Cooperage Site

Extent of PCE and TCE in Soil Five to Ten Feet Deep

SUM-008-00 (ICS) ***June 2021***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-16b



Soil Contact Screening Levels (SLs)
PCE - 21,000,000 ug/kg
TCE - 1,750,000 ug/kg

SL to Protect Groundwater
PCE - 50 ug/kg
TCE - 30 ug/kg

Ref: Upland Phase2a PCE+TCE FSrev.cdr

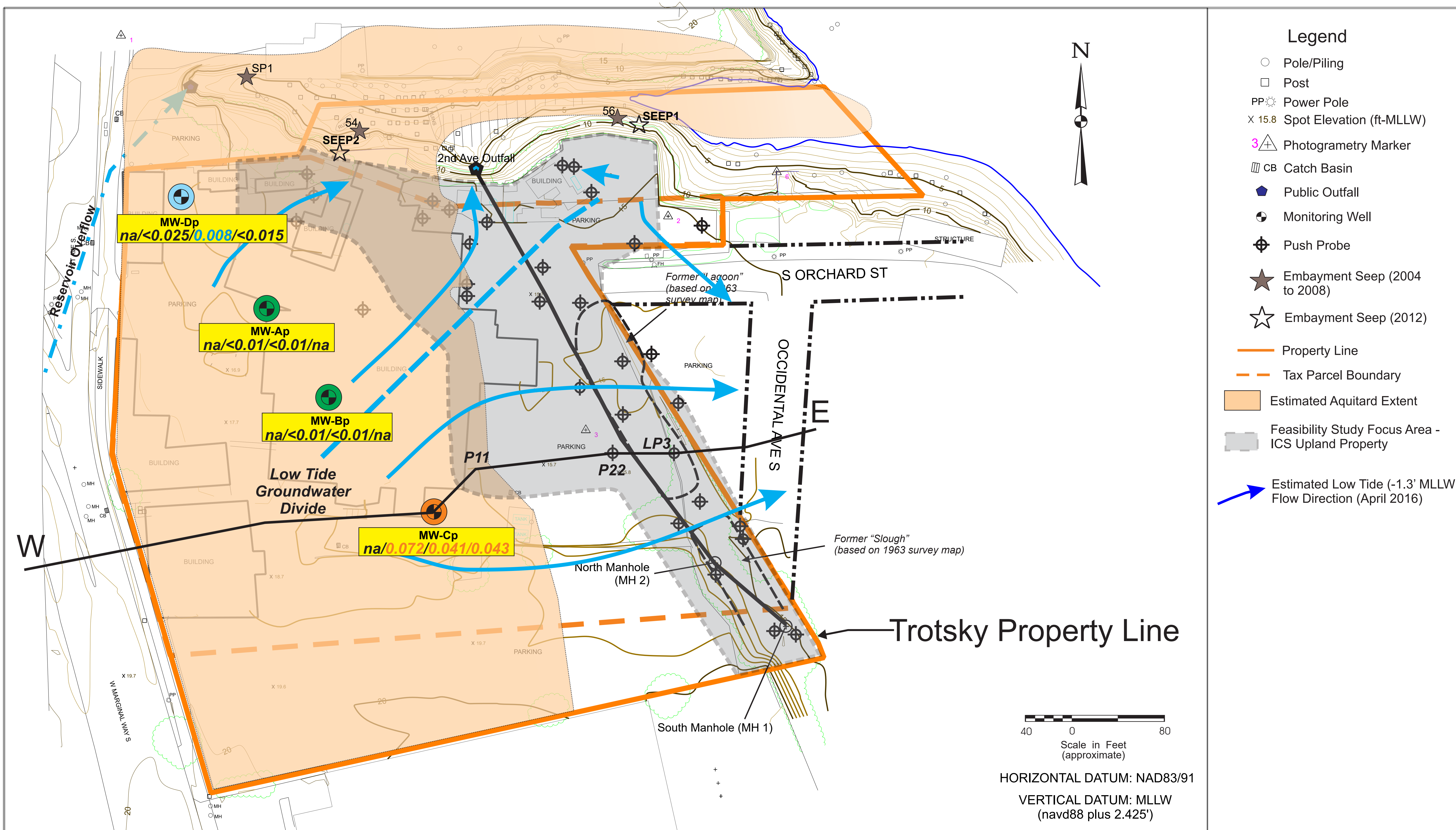
ICS/NW Cooperage Site

Extent of PCE and TCE in Soil
Ten to Fifteen Feet Deep

SUM-008-00 (ICS) ***June 2021***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-16c



Concentration ≤ Screening Level (SL= 7.0E-06*; PQL=0.01 ug/l)

Concentration > Screening Level (SL= 7.0/E-06*; PQL=0.01 ug/l)

Detection at or below PQL

2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available; * SL Based on Aroclor PQL

Ref: TPCBs GW Plot R1-R3revFS.cdr

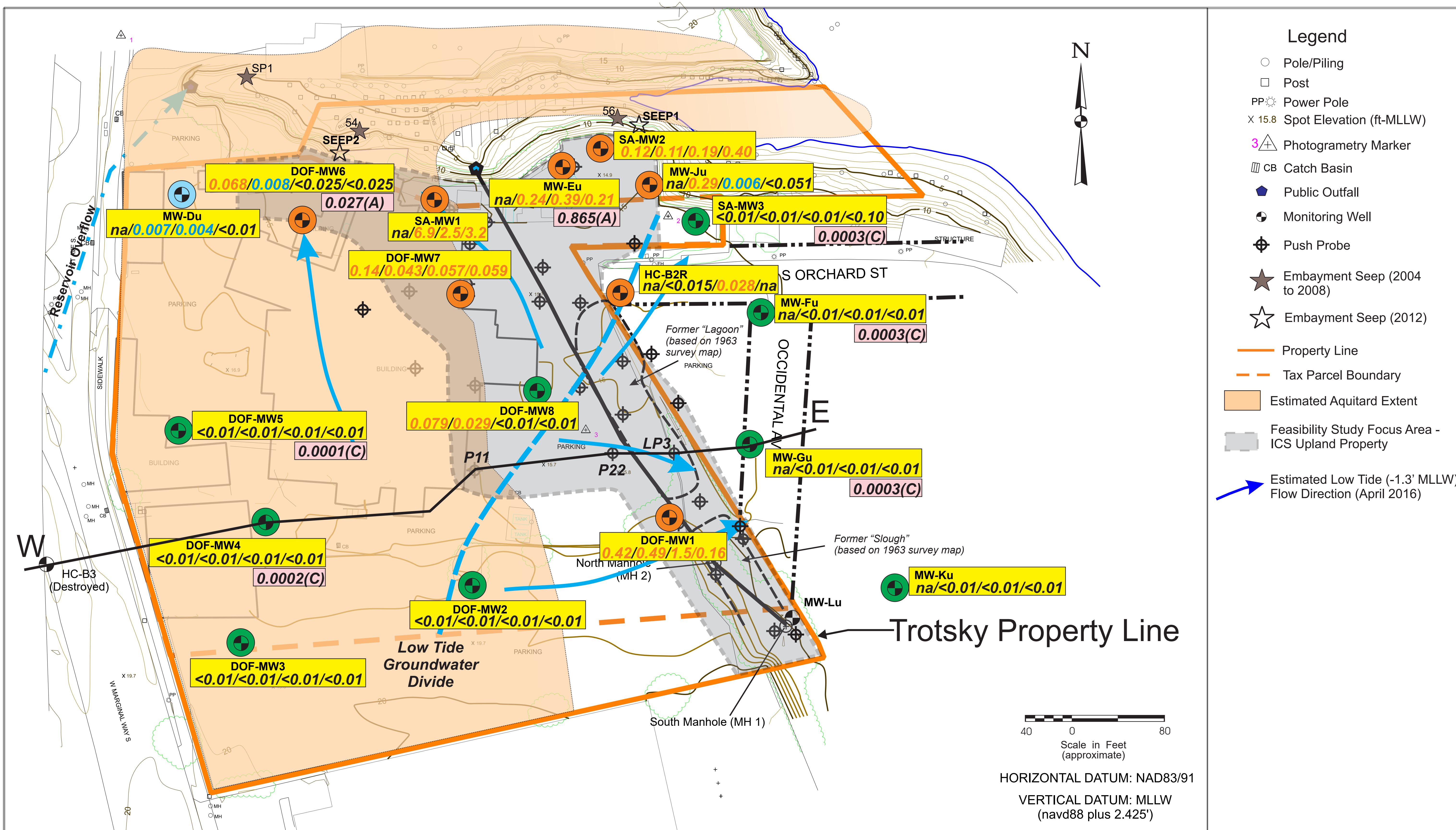
ICS/NW Cooperage Site

Total PCB Concentrations Water Table Zone Above Aquitard

SUM-008-00 (ICS) ***Jan. 2020***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-17a



Concentration ≤ Screening Level (SL= 7.0E-06*; PQL=0.01 ug/l)

Concentration > Screening Level (SL= 7.0/E-06*; PQL=0.01 ug/l)

Detection at or below PQL

2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available; * SL Based on Aroclor PQL

0.006(C) or (A) February 2019 Sample; C=Congener Analysis; A=Aroclor Analysis

Ref: TPCBs GW Plot R1-R3revFS.cdr

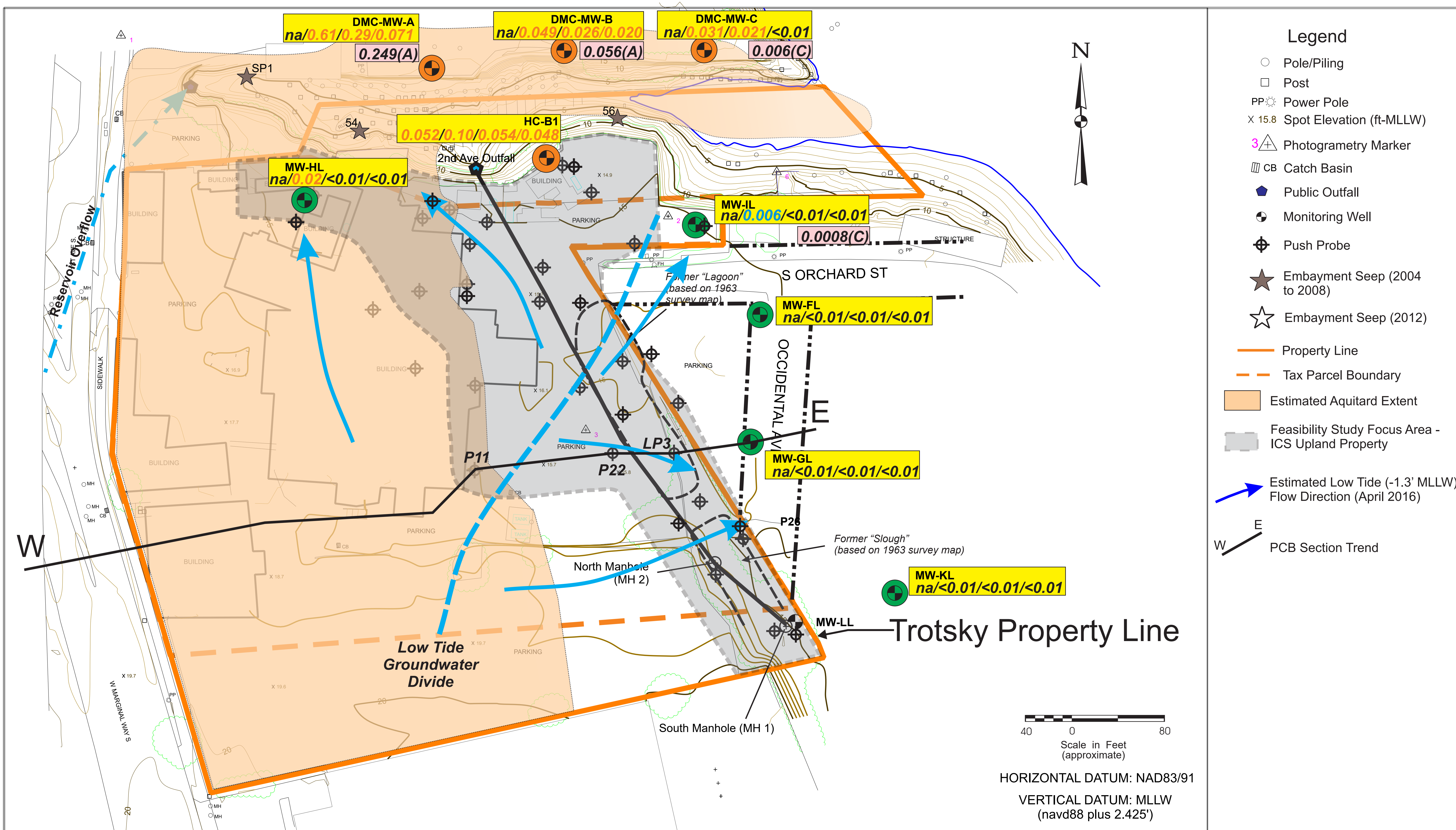
ICS/NW Cooperage Site

Total PCB Concentrations Upper Zone

SUM-008-00 (ICS) ***Jan. 2020***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-17b



Concentration ≤ Screening Level (SL= 7.0E-06*; PQL=0.01 ug/l)

Concentration > Screening Level (SL= 7.0/E-06*; PQL=0.01 ug/l)

Detection at or below PQL

2.0/5.3/6.0/2.0 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available; * SL Based on Aroclor PQL

0.006(C) or (A) February 2019 Sample; C=Congener Analysis; A=Aroclor Analysis

Ref: TPCBs GW Plot R1-R3revFS.cdr

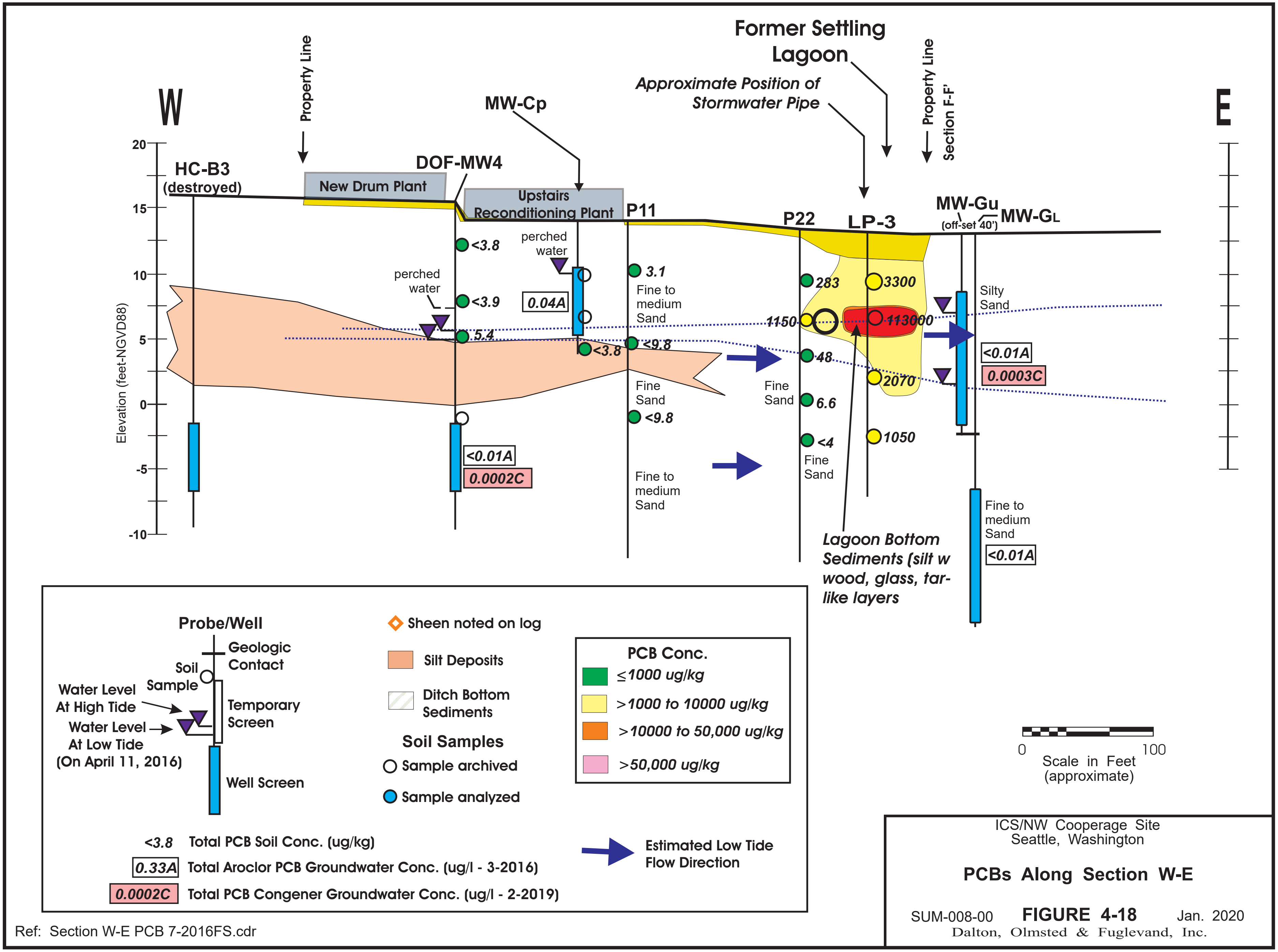
ICS/NW Cooperage Site

Total PCB Concentrations Lower Zone

SUM-008-00 (ICS) ***Jan. 2020***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-17c



ICS/NW Cooperage Site
Seattle, Washington

PCBs Along Section W-E

SUM-008-00 **FIGURE 4-18** Jan. 2020

Dalton, Olmsted & Fuglevand, Inc.

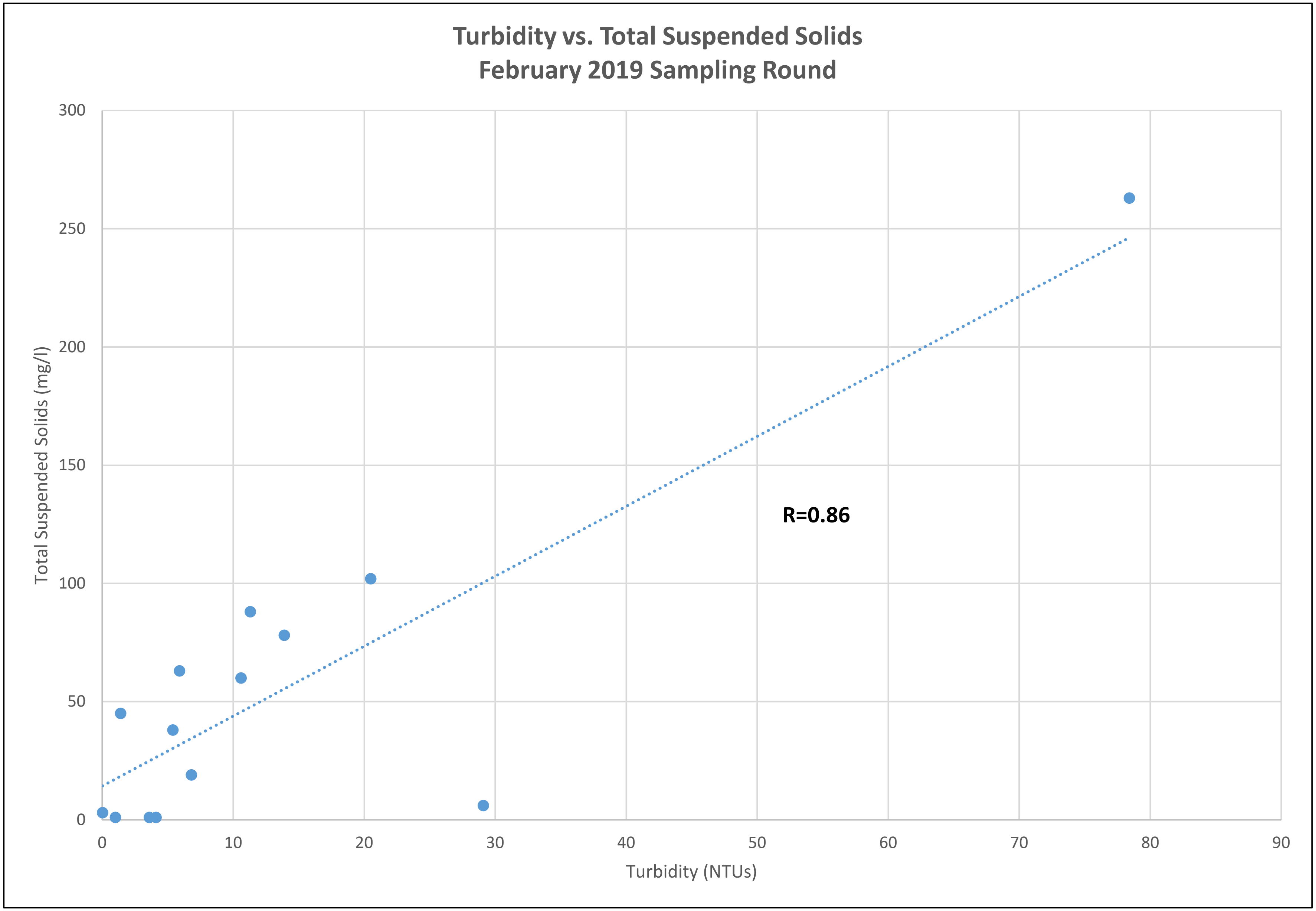
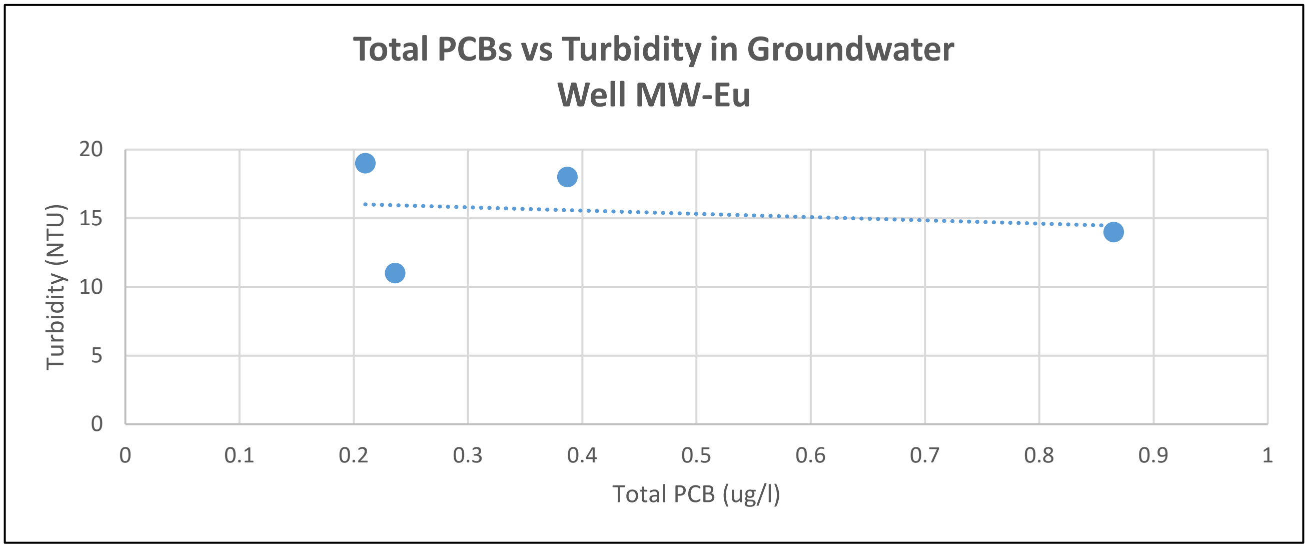
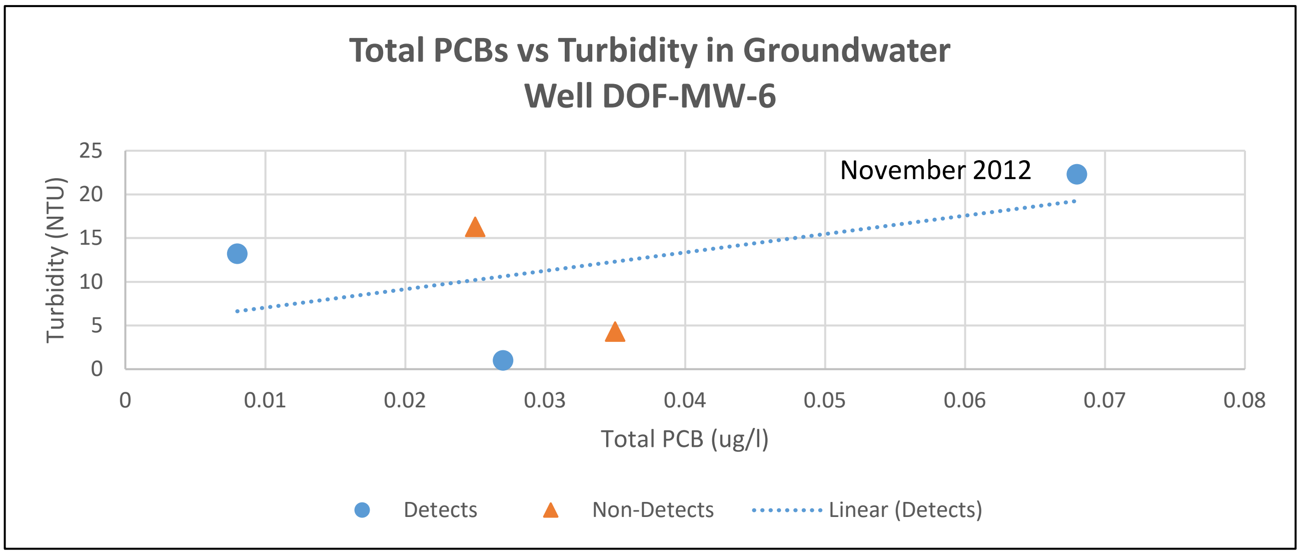


FIGURE 4-19 - Turbidity vs. TSS





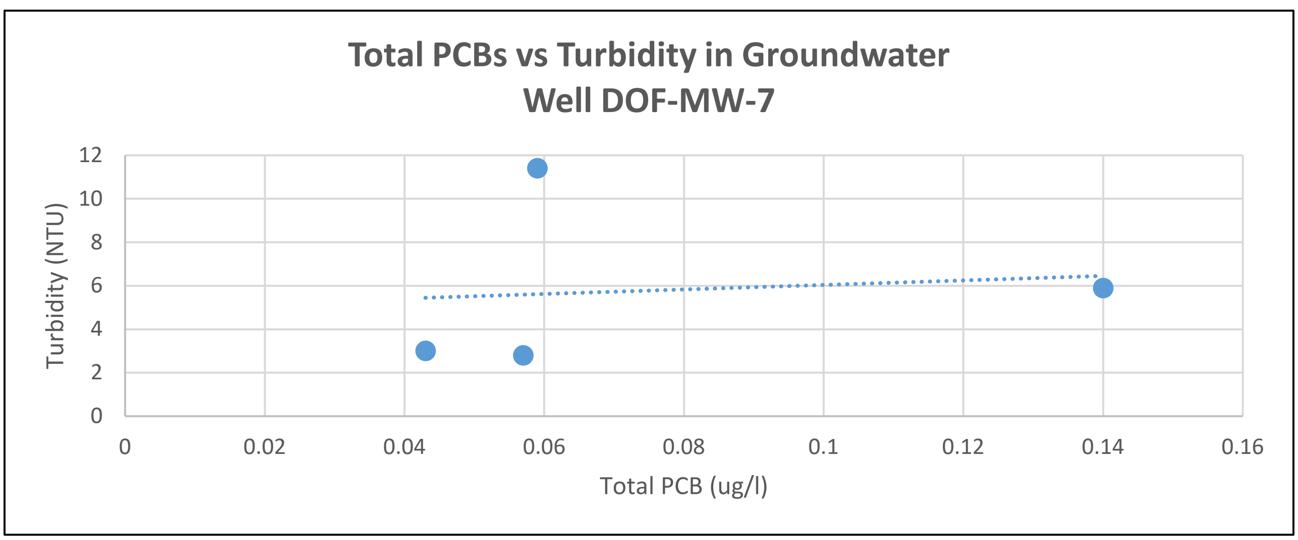
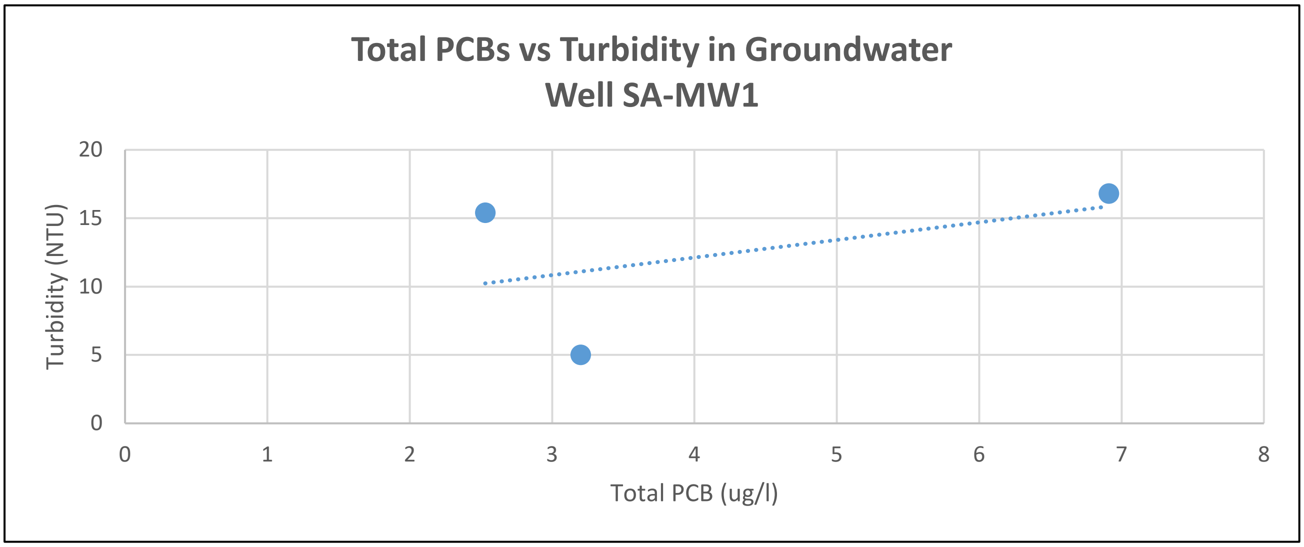
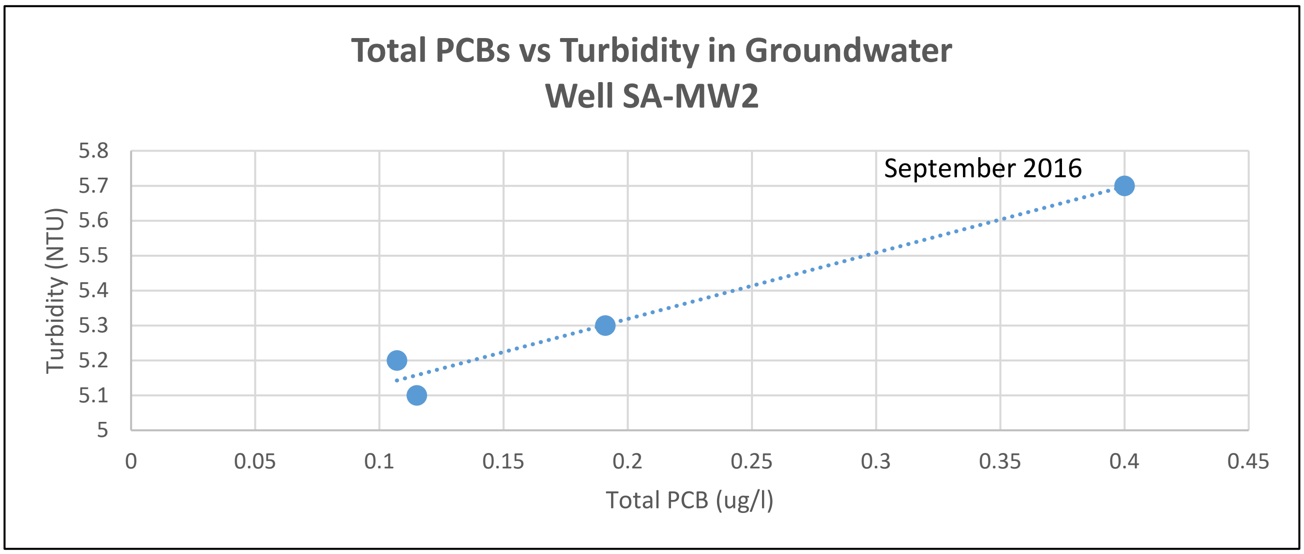
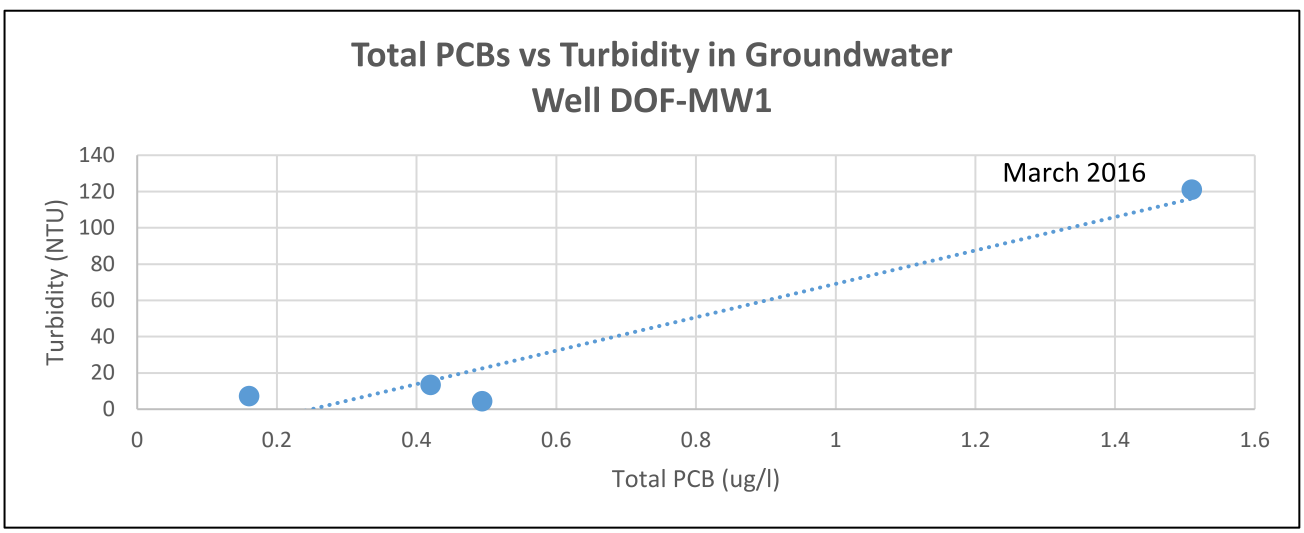


Figure 4-20 Total PCB vs. Turbidity - ICS Property Wells

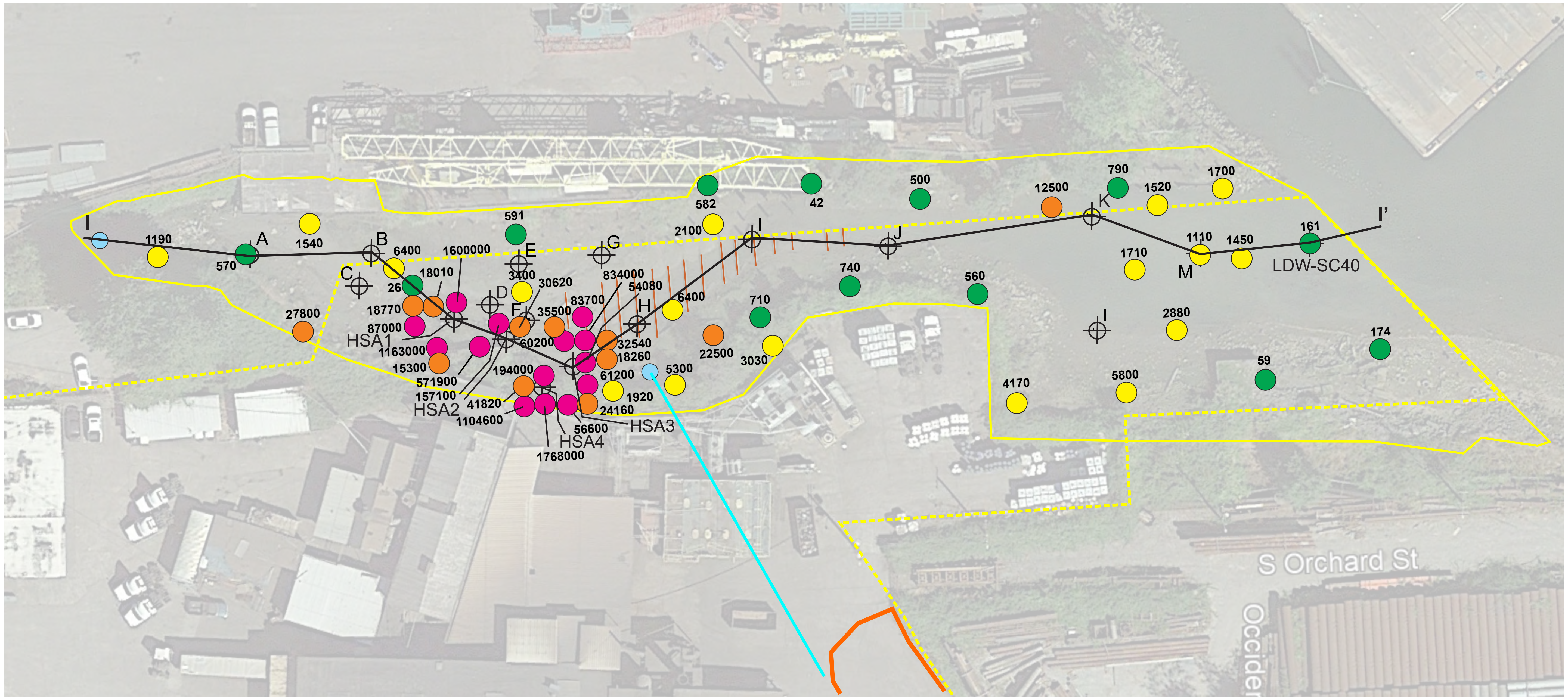






Dalton, Olmsted Fuglevand, Inc.

Figure 4-20 Total PCB vs. Turbidity - ICS Property Wells



Legend

Total PCBs

- ≤1000 ug/kg
- >1000 to 10,000 ug/kg
- >10000 to 50,000 ug/kg
- >50,000 ug/kg

Outfall

Stormsewer

Former Lagoon

Sediment Core

1920 Conc. (ug/kg)

I — I' Section Trend

Sediment CUL = 2 ug/kg - dw (ROD RAL)

0 — 200 Scale in Feet (approximate)

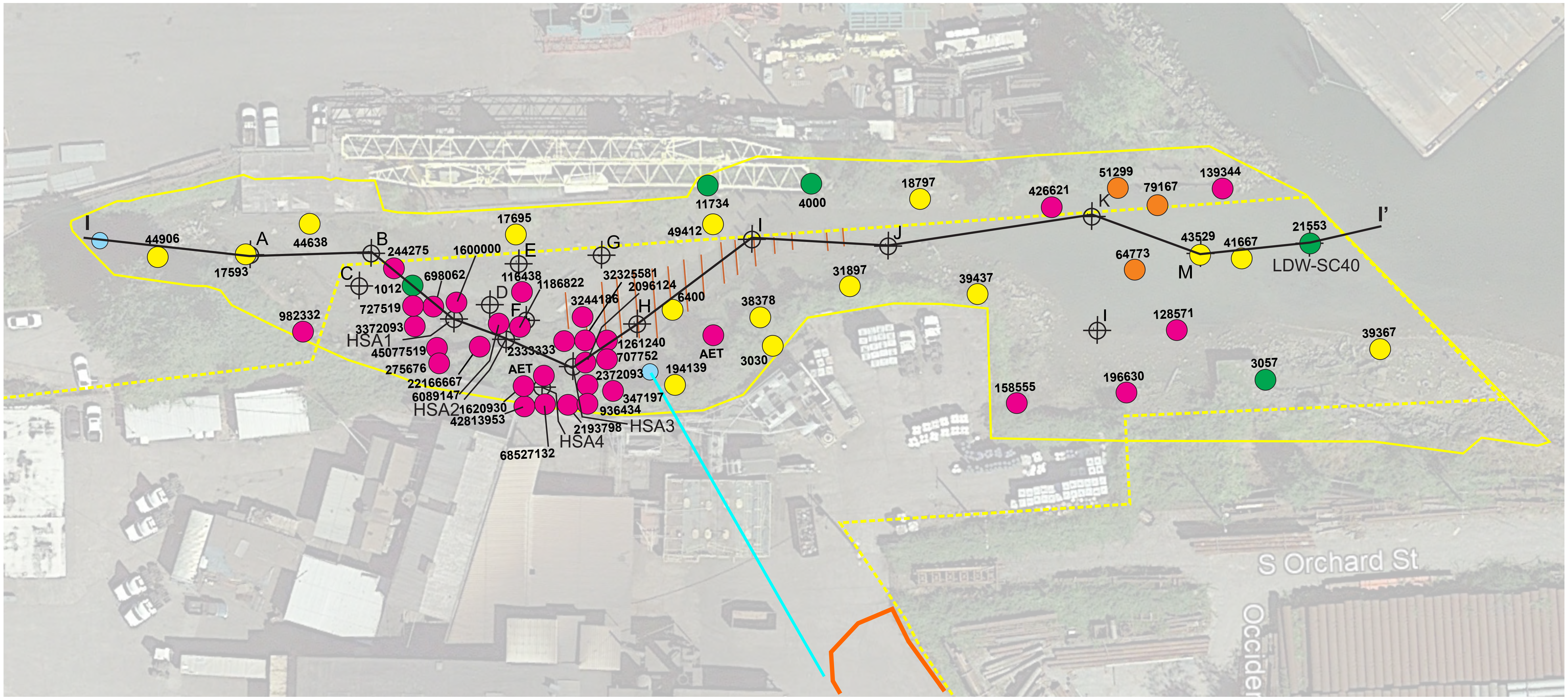
N

ICS/NW Cooperage
Seattle, Washington

PCBs (dry weight) in Sediment (approx. <1.0')

SUM-008-03 FS **FIGURE 4-21a** June 2021
Dalton, Olmsted & Fuglevand, Inc.

Ref: Embay 0 to 1' sed concFS.cdr



Legend

Total PCBs OCN		
≤12,000 ug/kg	Outfall	**1920** Conc. (ug/kg - OCN)
>12000 to 50,000 ug/kg	Stormsewer	I — I' Section Trend
>50000 to 100,000 ug/kg	Former Lagoon	OCN - Organic Carbon Normalized
>100,000 ug/kg	Sediment Core	AET - Exceeds Apparent Effects Threshold - TOC >3.5%

Sediment CUL = 12,000 ug/kg - OCN (ROD RAL)

0 — 200
Scale in Feet
(approximate)

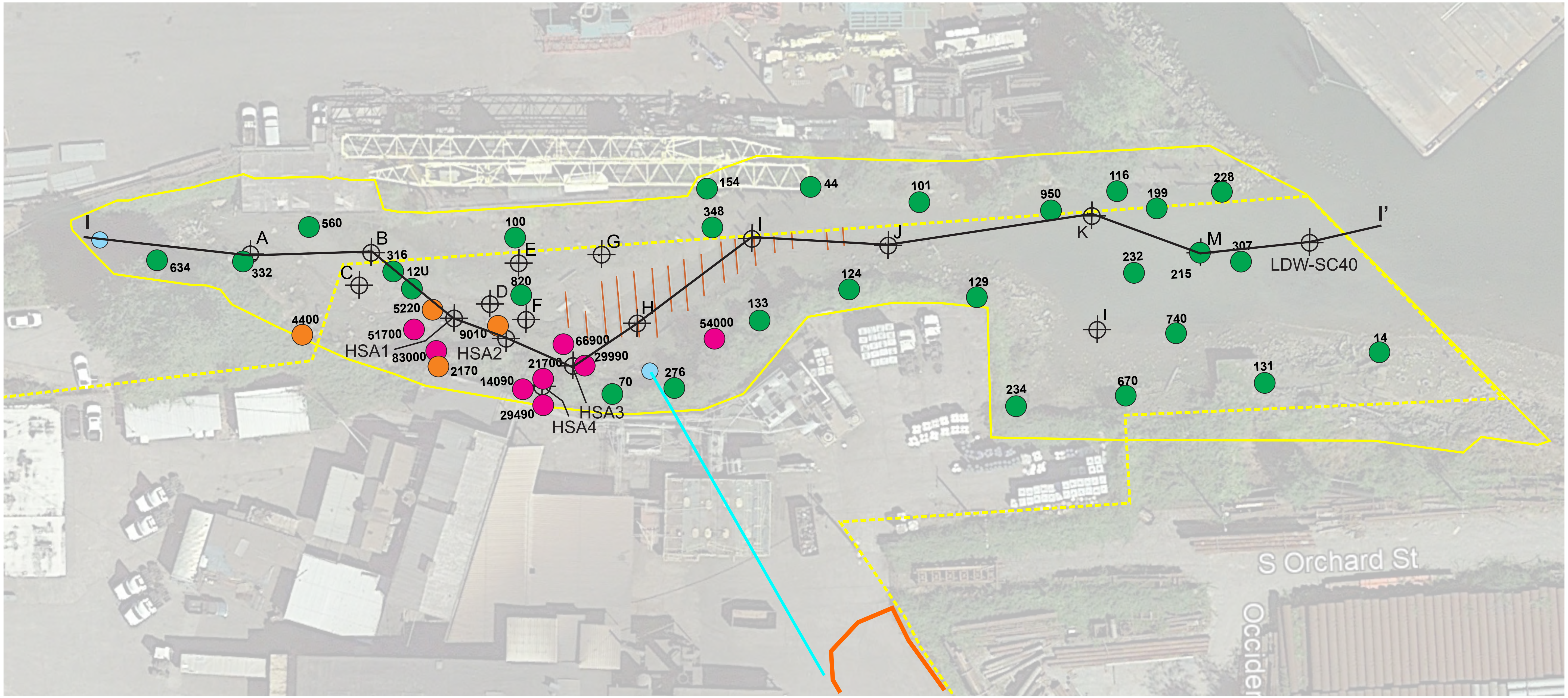
N

ICS/NW Cooperage
Seattle, Washington

PCBs (OCN) in Sediment
(approx. <1.0')

SUM-008-03 FS **FIGURE 4-21b** June 2021
Dalton, Olmsted & Fuglevand, Inc.

Ref: Embay 0 to 1' sed concFS.cdr



Legend

DRO+RRO

- ≤2000 mg/kg
- >2000 to 10,000 mg/kg
- >10000 mg/kg

Outfall

Stormsewer

Former Lagoon

Sediment Core

276 Conc. (mg/kg)

I I' Section Trend

Sediment CUL = 2,000 mg/kg

0 200

Scale in Feet (approximate)

N

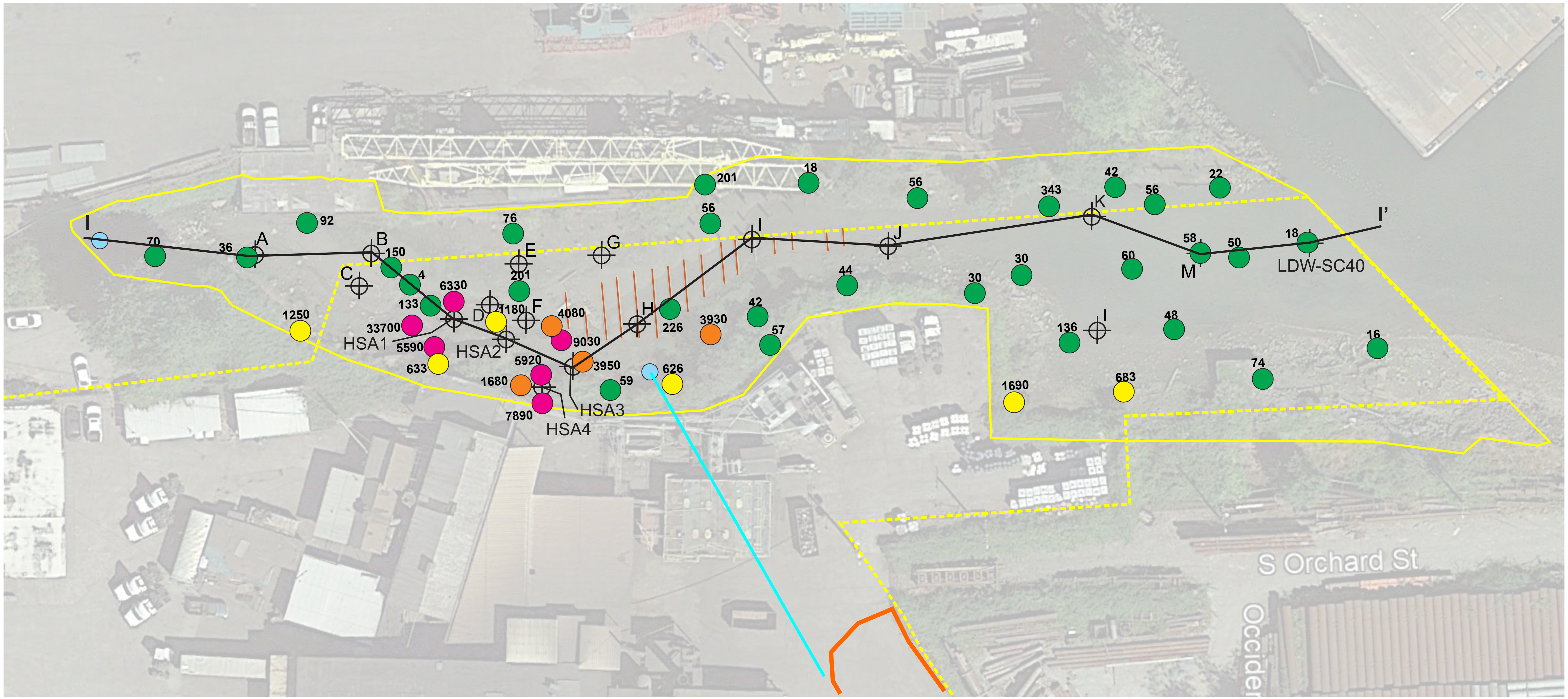
ICS/NW Cooperage
Seattle, Washington

DRO+RRO in Sediment (approx. <1.0')

SUM-008-03 FS **FIGURE 4-21c** June 2021

Dalton, Olmsted & Fuglevand, Inc.

Ref: Embay 0 to 1' sed concFS.cdr



Legend

Lead

- ≤450 mg/kg
- >450 to 2,000 mg/kg
- >2000 to 5,000 mg/kg
- >5000 mg/kg

Outfall

Stormsewer

Former Lagoon

Sediment Core

276 Conc. (mg/kg)

I — I'
Section Trend

Sediment CUL = 450 mg/kg (ROD RAL)

0 — 200
Scale in Feet
(approximate)

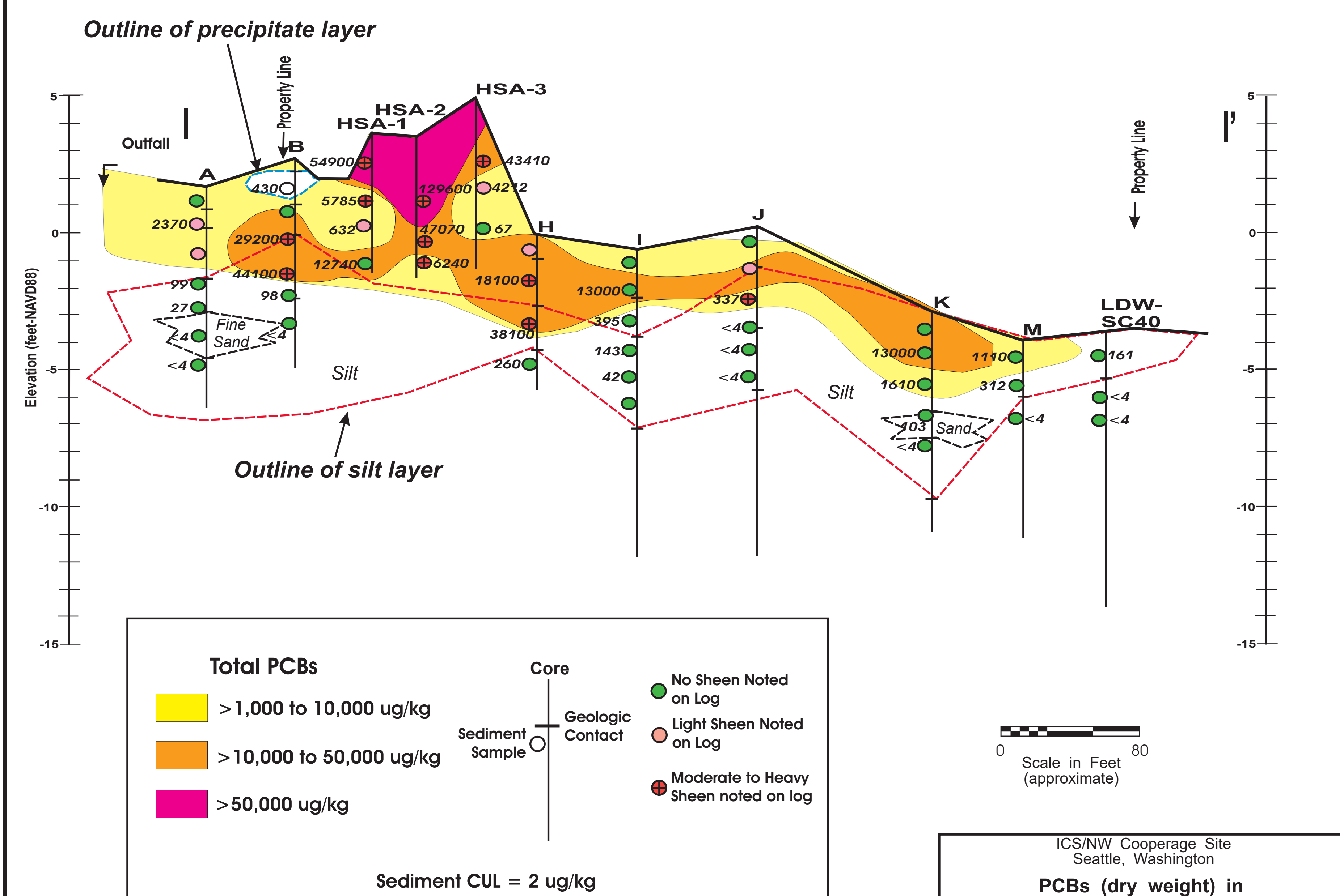
N

Ref: Embay 0 to 1' sed concFS.cdr

ICS/NW Cooperage
Seattle, Washington

Lead in Sediment
(approx. <1.0')

SUM-008-03 FS **FIGURE 4-21d** June 2021
Dalton, Olmsted & Fuglevand, Inc.



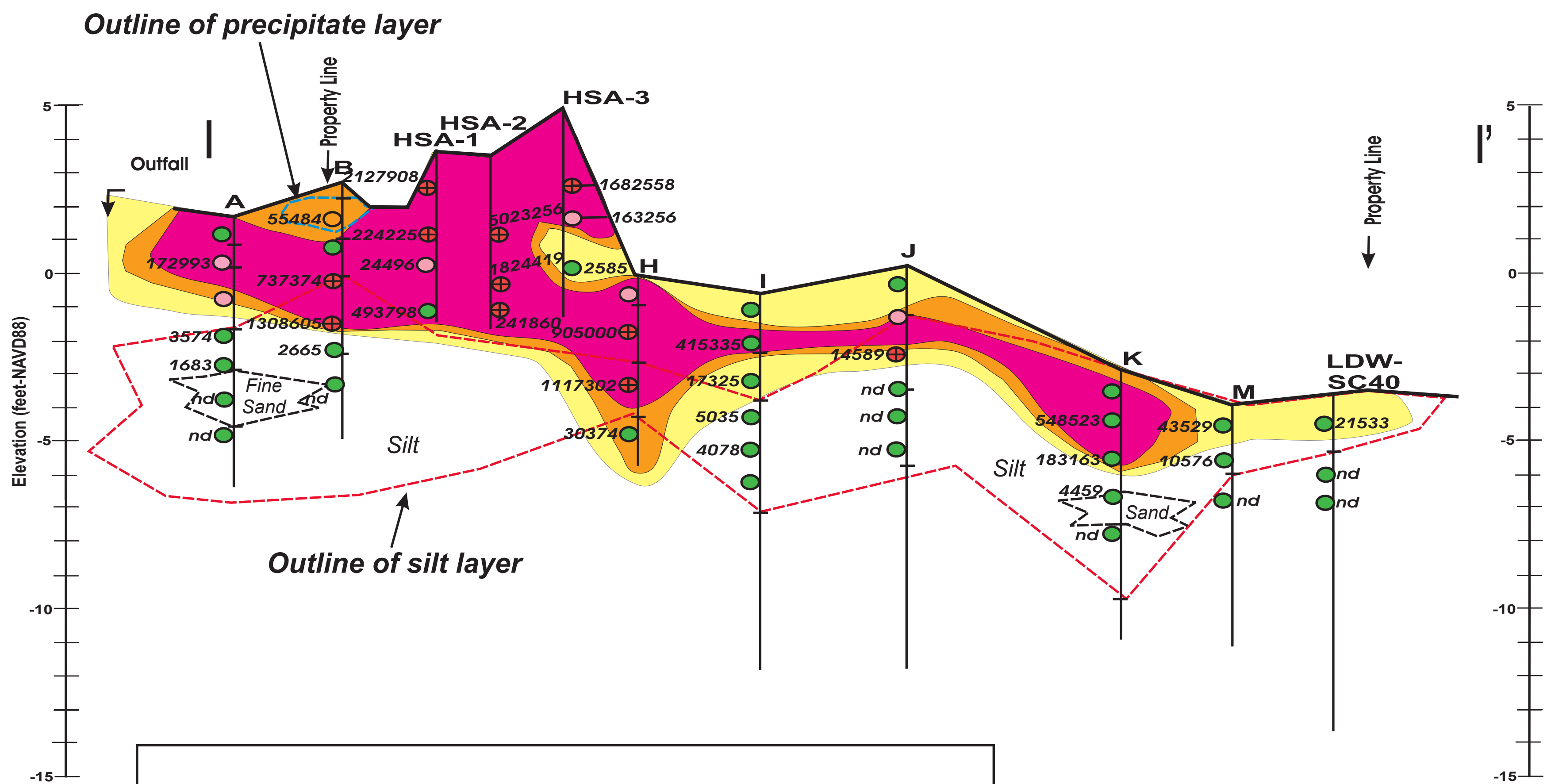
Ref: Section I-I' Embayment rev2PCB FS.cdr

ICS/NW Cooperage Site
Seattle, Washington

PCBs (dry weight) in Subsurface Sediment

SUM-008-00 **FIGURE 4-22a** June 2021

Dalton, Olmsted & Fuglevand, Inc.



Total PCBs - OCN

- >12,000 to 50,000 ug/kg
- >50,000 to 100,000 ug/kg
- >100,000 ug/kg

Core

Sediment Sample

Geologic Contact

No Sheen Noted on Log

Light Sheen Noted on Log

Moderate to Heavy Sheen noted on log

Sediment CUL = 12,000 ug/kg OCN

0 80
Scale in Feet (approximate)

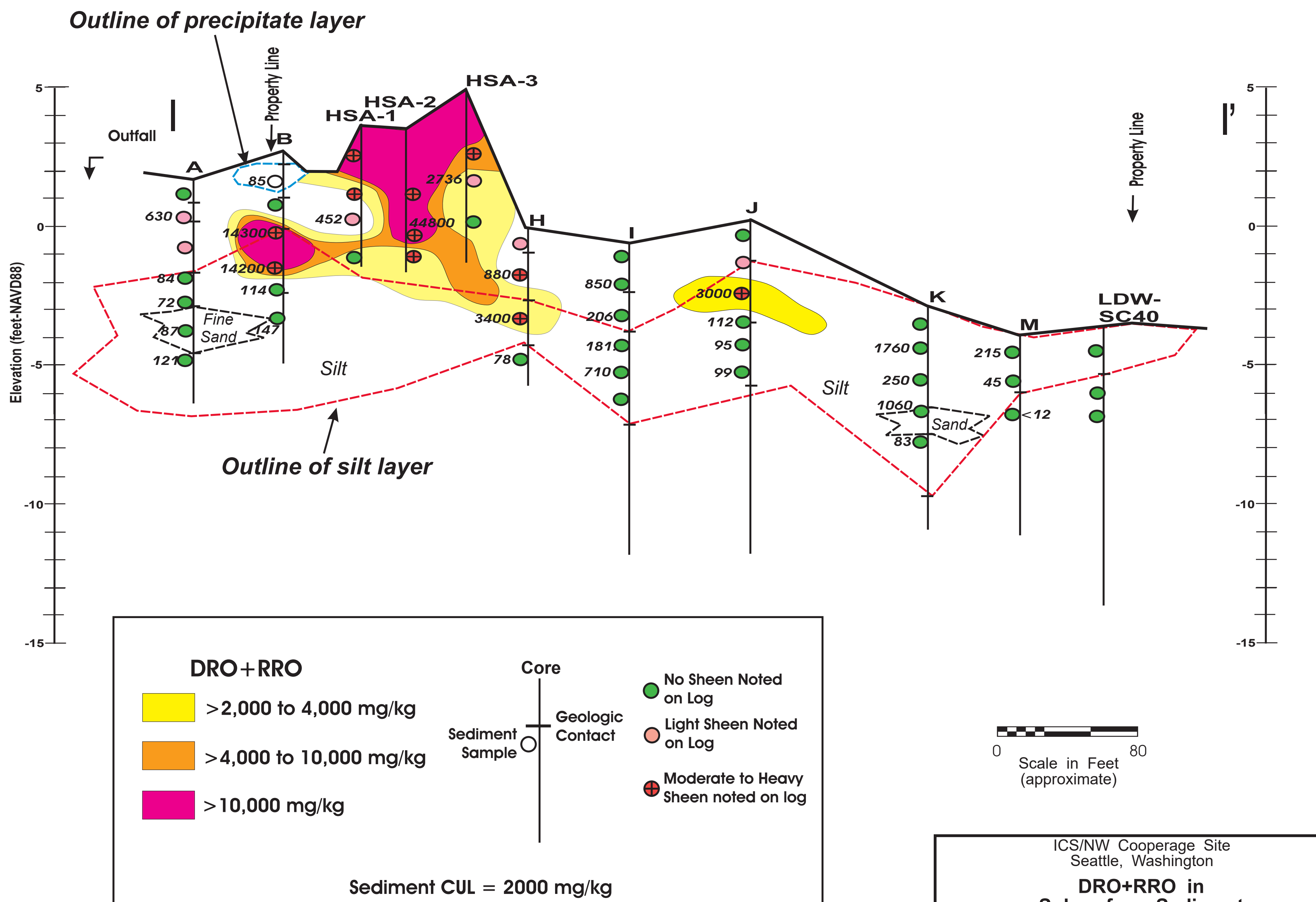
ICS/NW Cooperage Site
Seattle, Washington

PCBs (OCN) in Subsurface Sediment

SUM-008-00 **FIGURE 4-22b** June 2021

Dalton, Olmsted & Fuglevand, Inc.

Ref: Section I-I' Embayment rev2PCB FS.cdr



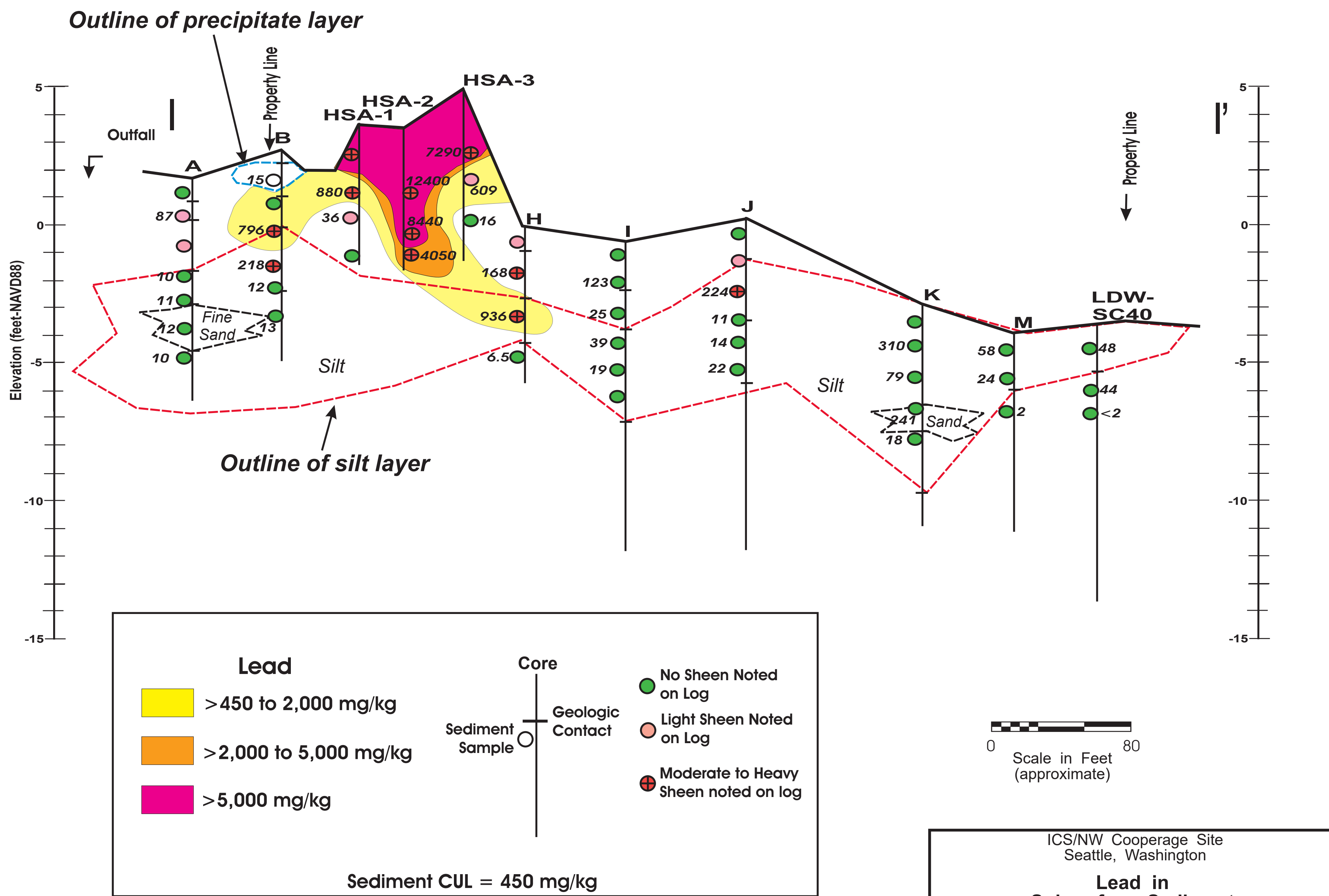
ICS/NW Cooperage Site
Seattle, Washington

DRO+RRO in Subsurface Sediment

SUM-008-00 **FIGURE 4-22c** June 2021

Dalton, Olmsted & Fuglevand, Inc.

Ref: Section I-I' Embayment rev2PCB FS.cdr



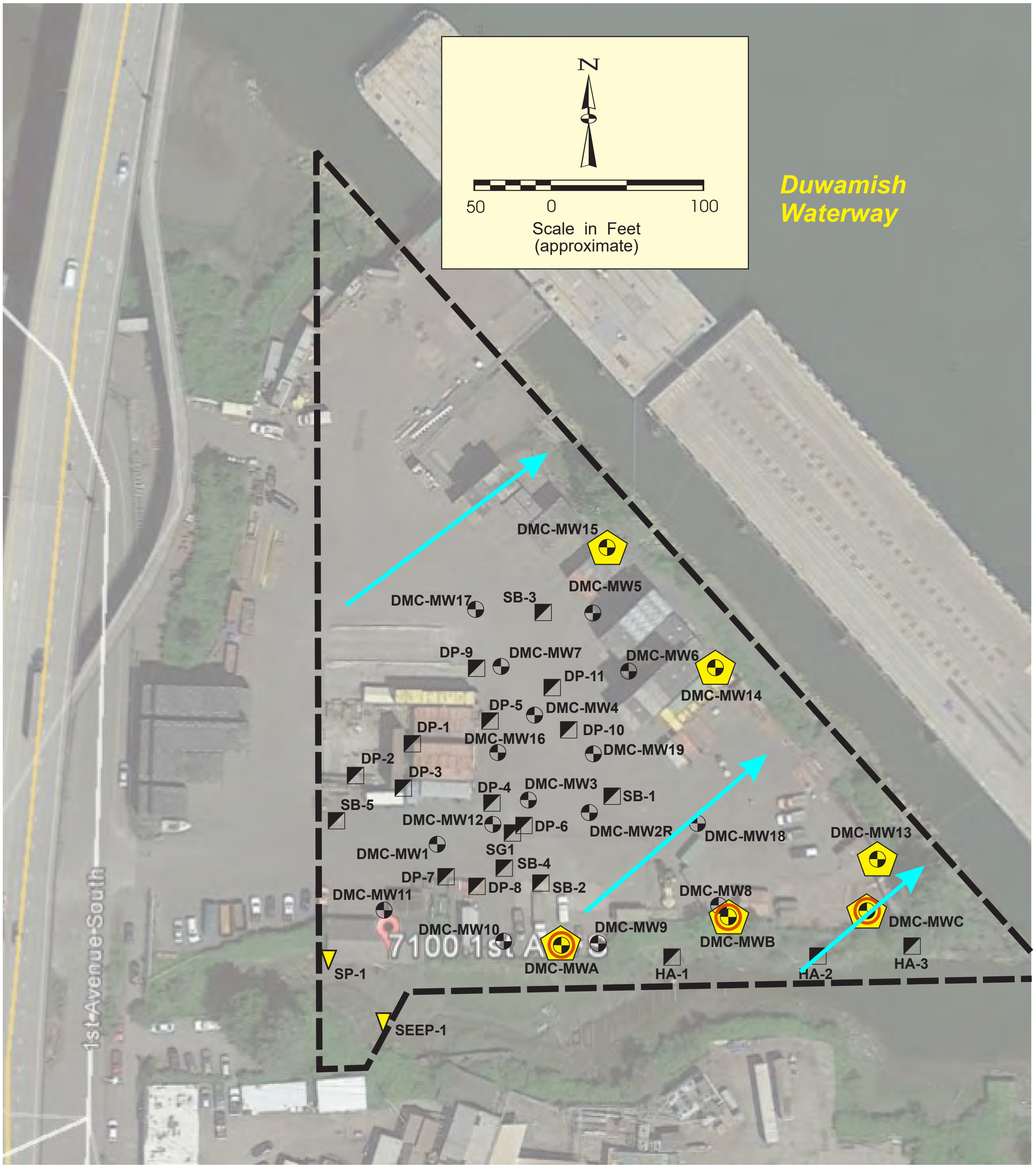
ICS/NW Cooperage Site
Seattle, Washington

Lead in Subsurface Sediment

SUM-008-00 **FIGURE 4-22d** June 2021

Dalton, Olmsted & Fuglevand, Inc.

Ref: Section I-I' Embayment rev2PCB FS.cdr



DMC-MW11 Monitoring Well Upper Zone

DMC-MWA Monitoring Well Lower Zone

SB-1 Soil Boring

SP-1 Embayment Seep

Well Sampled in Feb. 2019

Modelled Average Lower Zone Groundwater Flow Direction

Ref: Douglas SpIFS. Locations

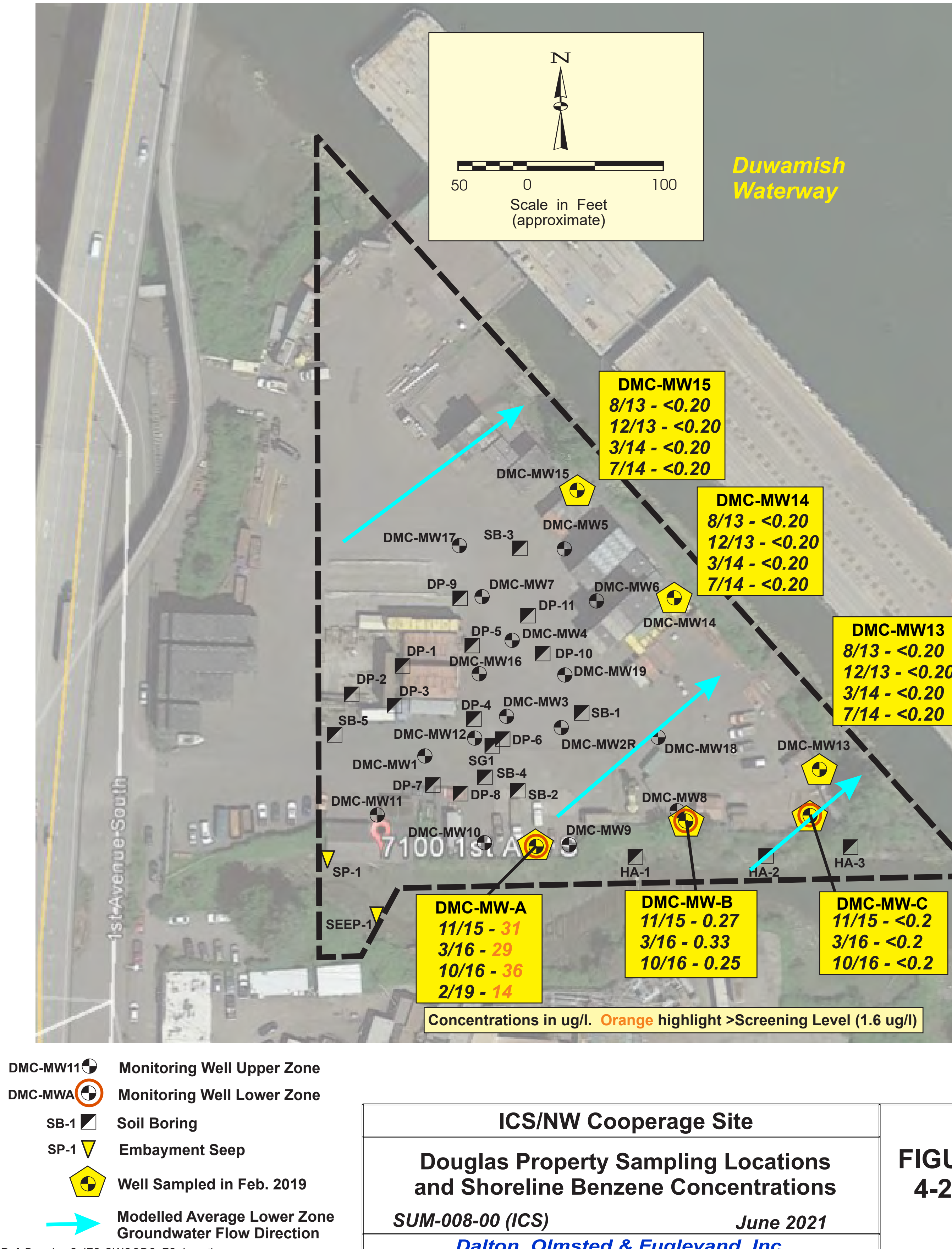
ICS/NW Cooperage Site

Douglas Property Sampling Locations and Average Lower Zone Flow Directions

SUM-008-00 (ICS) *Jan. 2020*

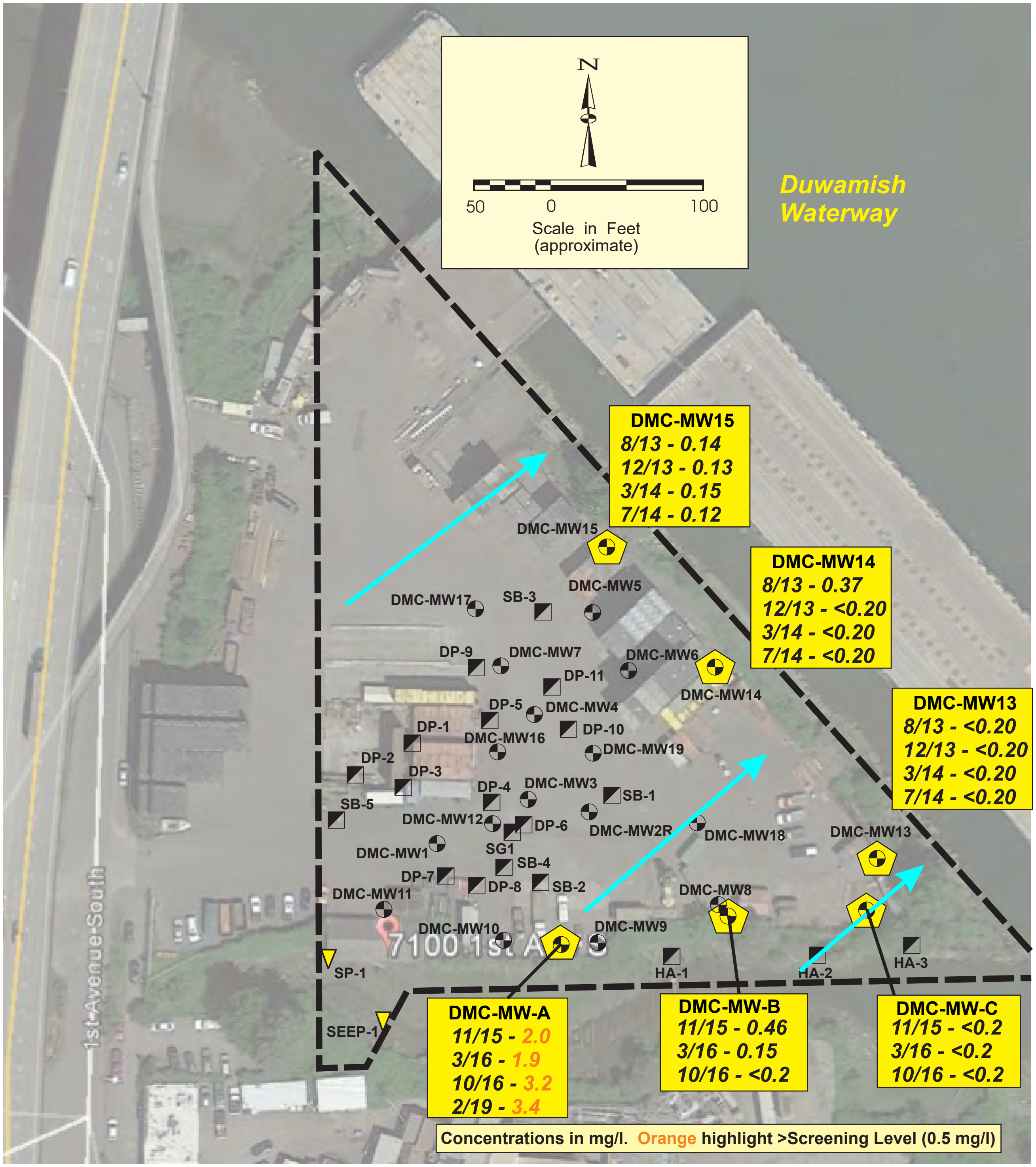
Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-23



Ref: Douglas SpIFS GWCOPCsFS. Locations

ICS/NW Cooperage Site	FIGURE 4-24a
Douglas Property Sampling Locations and Shoreline Benzene Concentrations	
SUM-008-00 (ICS) *June 2021*	
Dalton, Olmsted & Fuglevand, Inc.	



DMC-MW11 Monitoring Well Upper Zone

DMC-MWA Monitoring Well Lower Zone

SB-1 Soil Boring

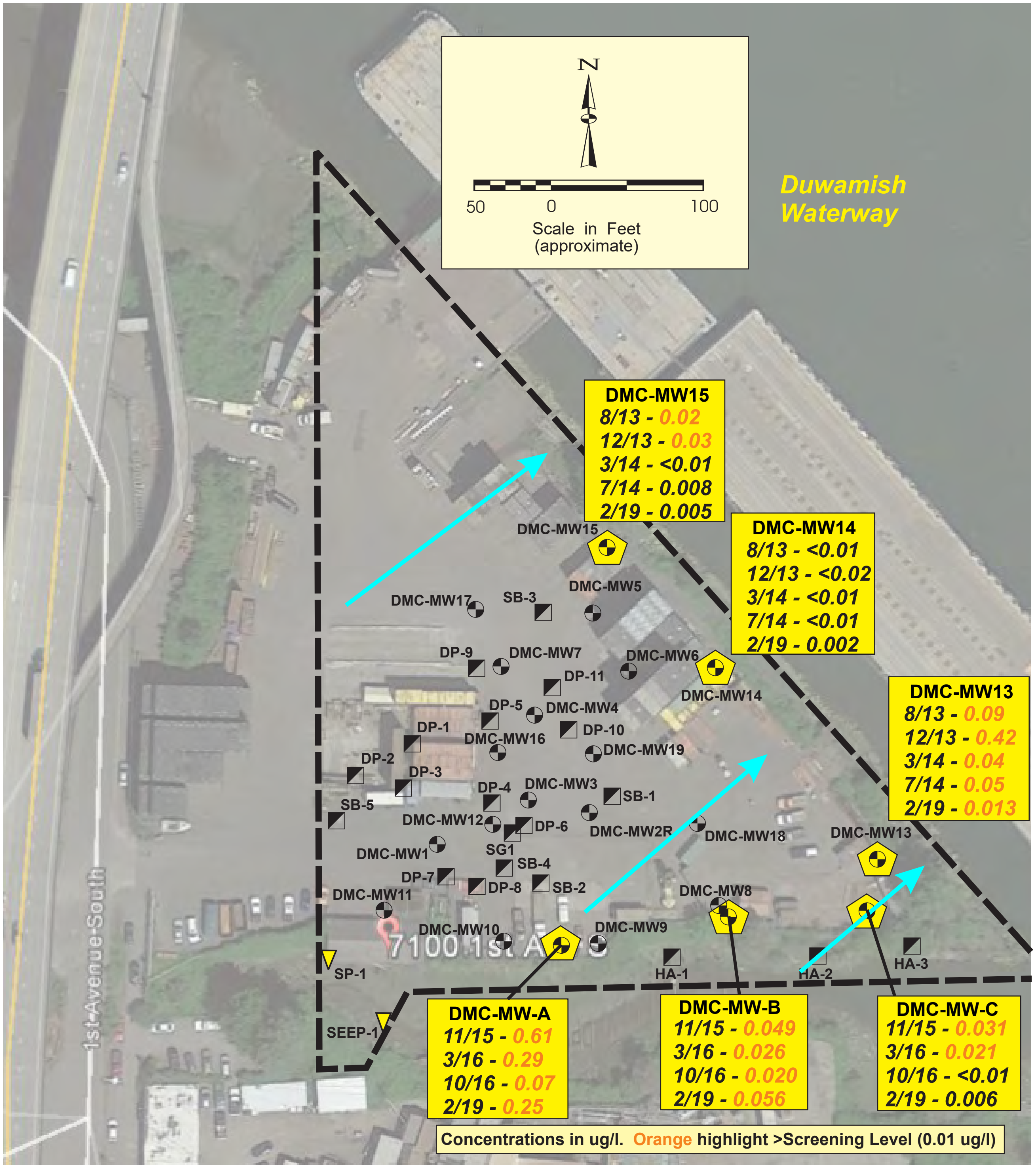
SP-1 Embayment Seep

Well Sampled in Feb. 2019

Modelled Average Lower Zone Groundwater Flow Direction

Ref: Douglas SpIFS GWCOPCsFS. Locations

ICS/NW Cooperage Site	FIGURE 4-24b
Douglas Property Sampling Locations and Shoreline DRO+RRO Concentrations	
SUM-008-00 (ICS) *June 2021*	
Dalton, Olmsted & Fuglevand, Inc.	



DMC-MW11 Monitoring Well Upper Zone

DMC-MWA Monitoring Well Lower Zone

SB-1 Soil Boring

SP-1 Embayment Seep

Well Sampled in Feb. 2019

Modelled Average Lower Zone Groundwater Flow Direction

Ref: Douglas SplFS GWCOPCsFS. Locations

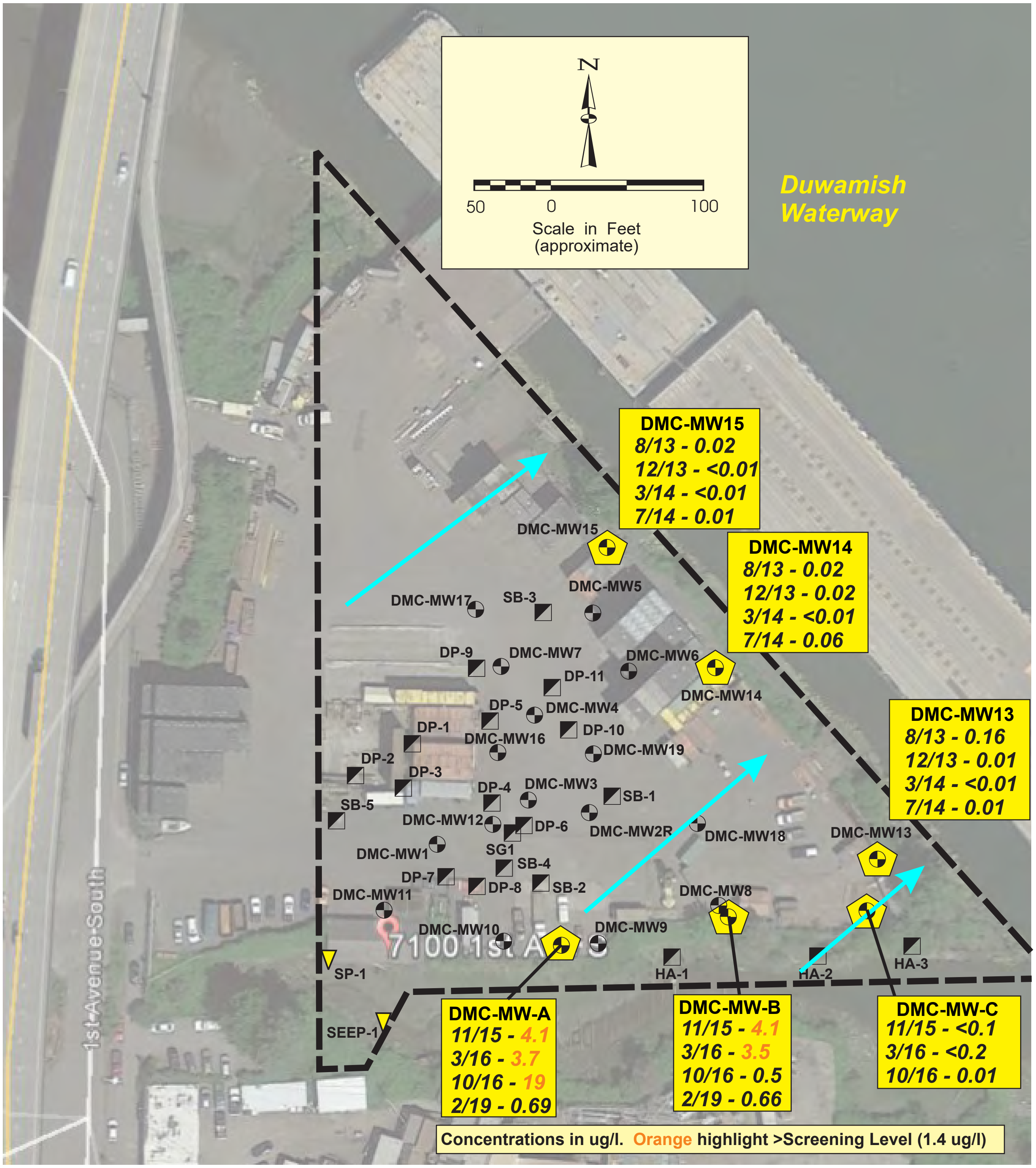
ICS/NW Cooperage Site

Douglas Property Sampling Locations and Shoreline PCB Concentrations

SUM-008-00 (ICS) June 2021

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-24c



DMC-MW11 Monitoring Well Upper Zone

DMC-MWA Monitoring Well Lower Zone

SB-1 Soil Boring

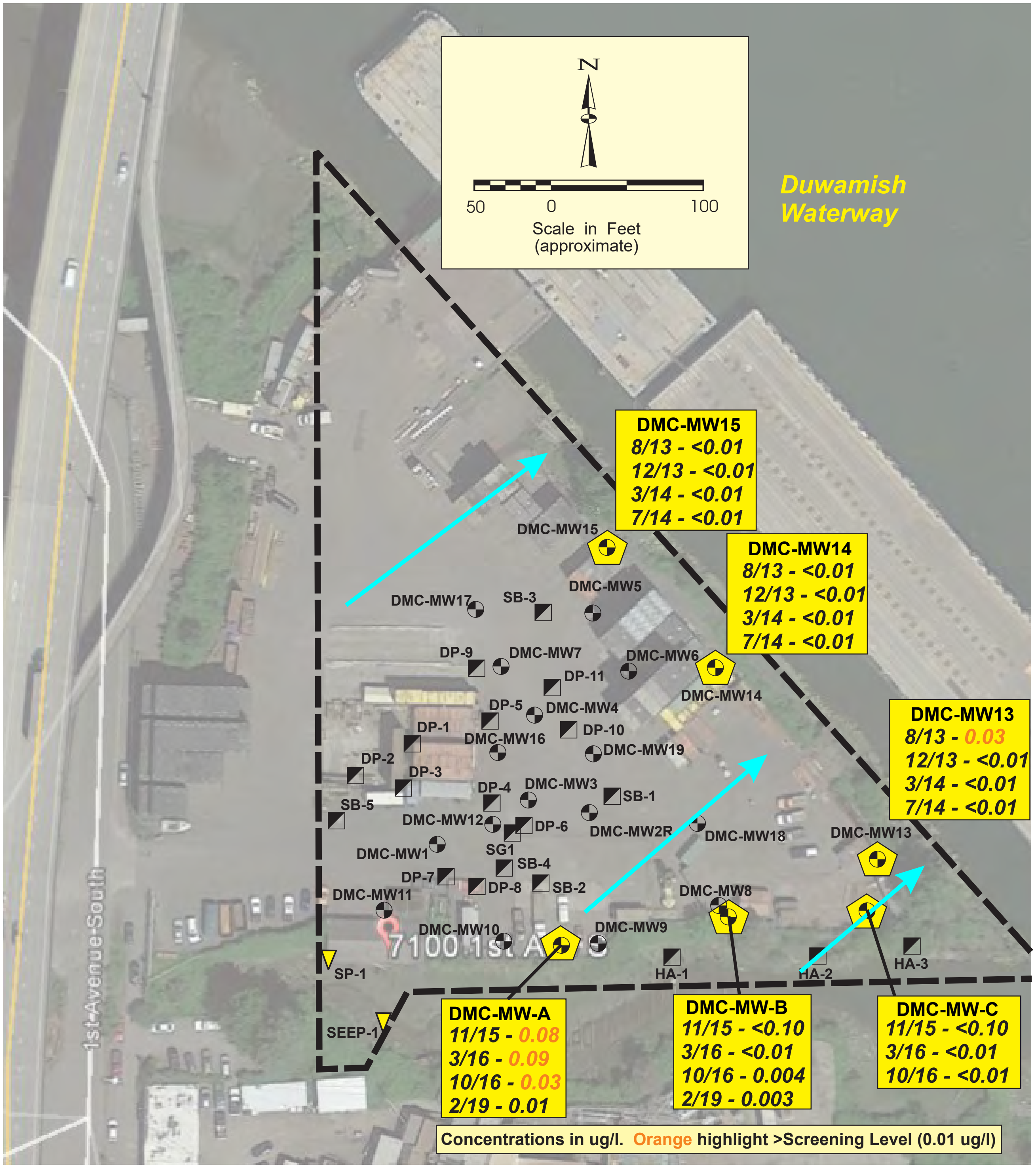
SP-1 Embayment Seep

Well Sampled in Feb. 2019

Modelled Average Lower Zone Groundwater Flow Direction

Ref: Douglas SpIFS GWCOPCsFS. Locations

ICS/NW Cooperage Site	FIGURE 4-24d
Douglas Property Sampling Locations and Shoreline Naphthalene Concentrations	
SUM-008-00 (ICS) *June 2021*	
Dalton, Olmsted & Fuglevand, Inc.	



DMC-MW11 Monitoring Well Upper Zone

DMC-MWA Monitoring Well Lower Zone

SB-1 Soil Boring

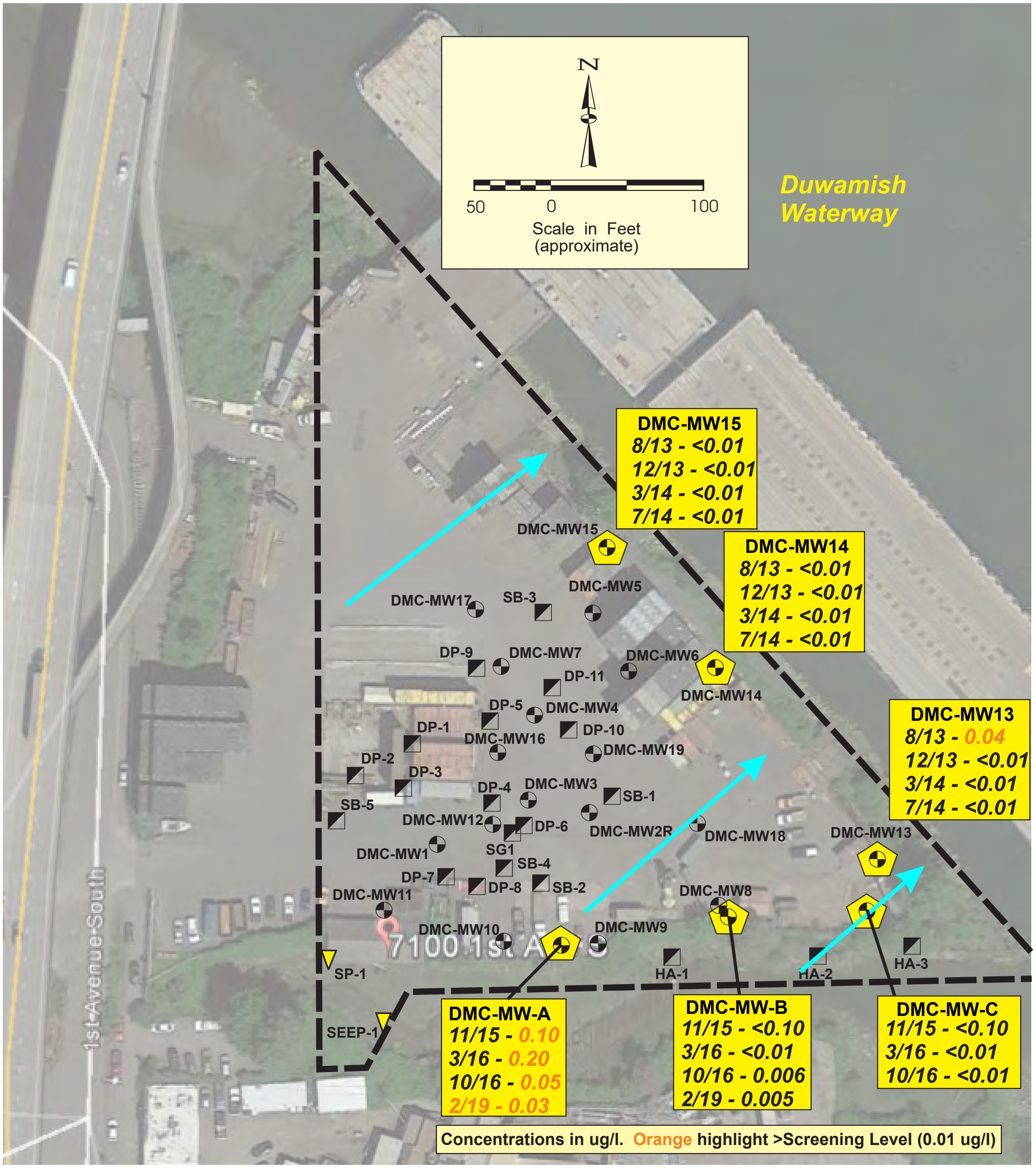
SP-1 Embayment Seep

Well Sampled in Feb. 2019

Modelled Average Lower Zone Groundwater Flow Direction

Ref: Douglas SpIFS COPCsFS. Locations

ICS/NW Cooperage Site	FIGURE 4-24e
Douglas Property Sampling Locations and Shoreline Benzo(a)Anthracene Concentrations *SUM-008-00 (ICS)* *June 2021*	
Dalton, Olmsted & Fuglevand, Inc.	



DMC-MW11 Monitoring Well Upper Zone

DMC-MWA Monitoring Well Lower Zone

SB-1 Soil Boring

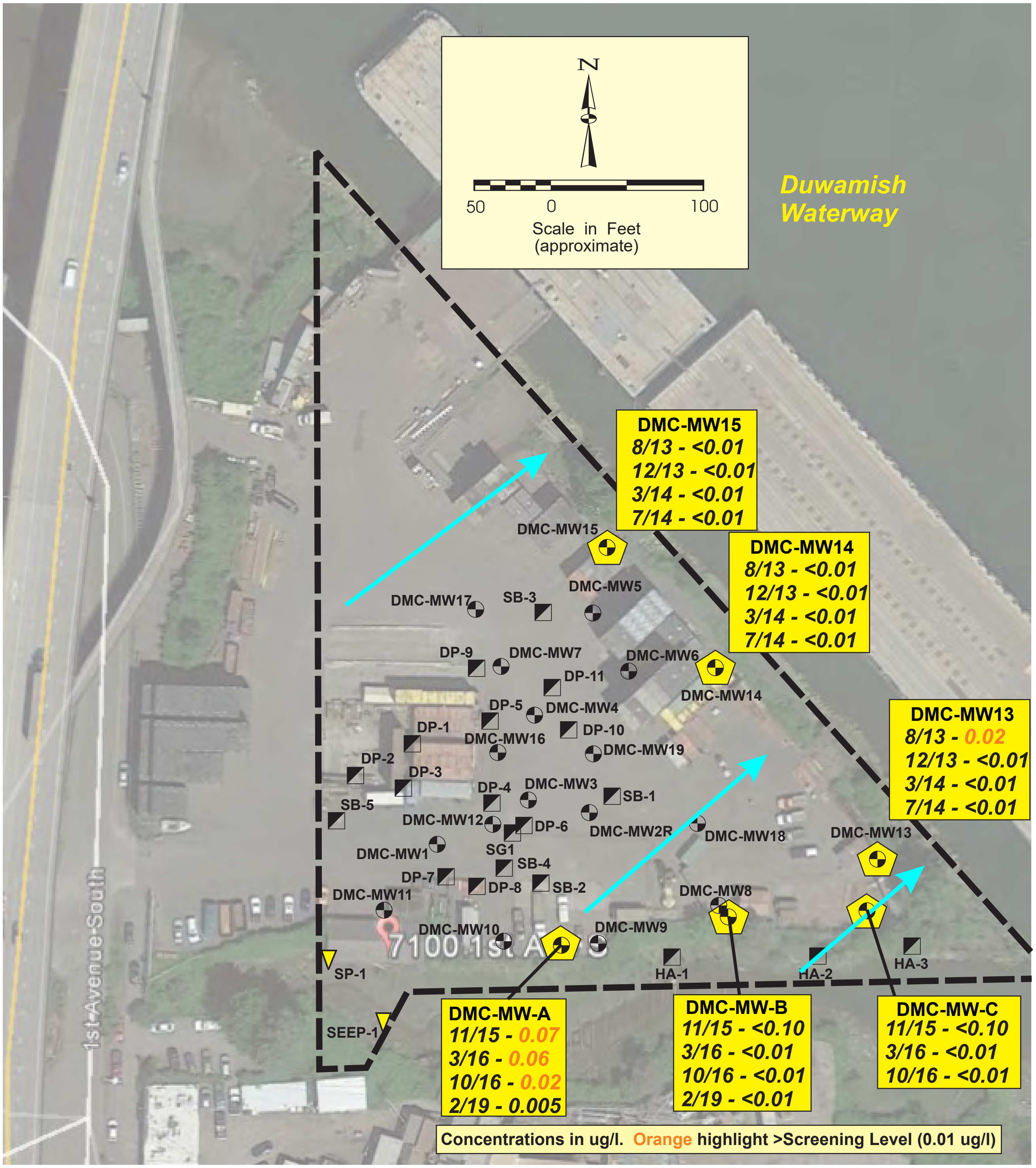
SP-1 Embayment Seep

Well Sampled in Feb. 2019

Modelled Average Lower Zone Groundwater Flow Direction

Ref: Douglas SpIFS GW COPCsFS. Locations

ICS/NW Cooperage Site	FIGURE 4-24f
Douglas Property Sampling Locations and Shoreline Chrysene Concentrations	
SUM-008-00 (ICS) *June 2021*	
Dalton, Olmsted & Fuglevand, Inc.	



DMC-MW11 Monitoring Well Upper Zone

DMC-MWA Monitoring Well Lower Zone

SB-1 Soil Boring

SP-1 Embayment Seep

Well Sampled in Feb. 2019

Modelled Average Lower Zone Groundwater Flow Direction

Ref: Douglas SplFS GW COPCsFS. Locations

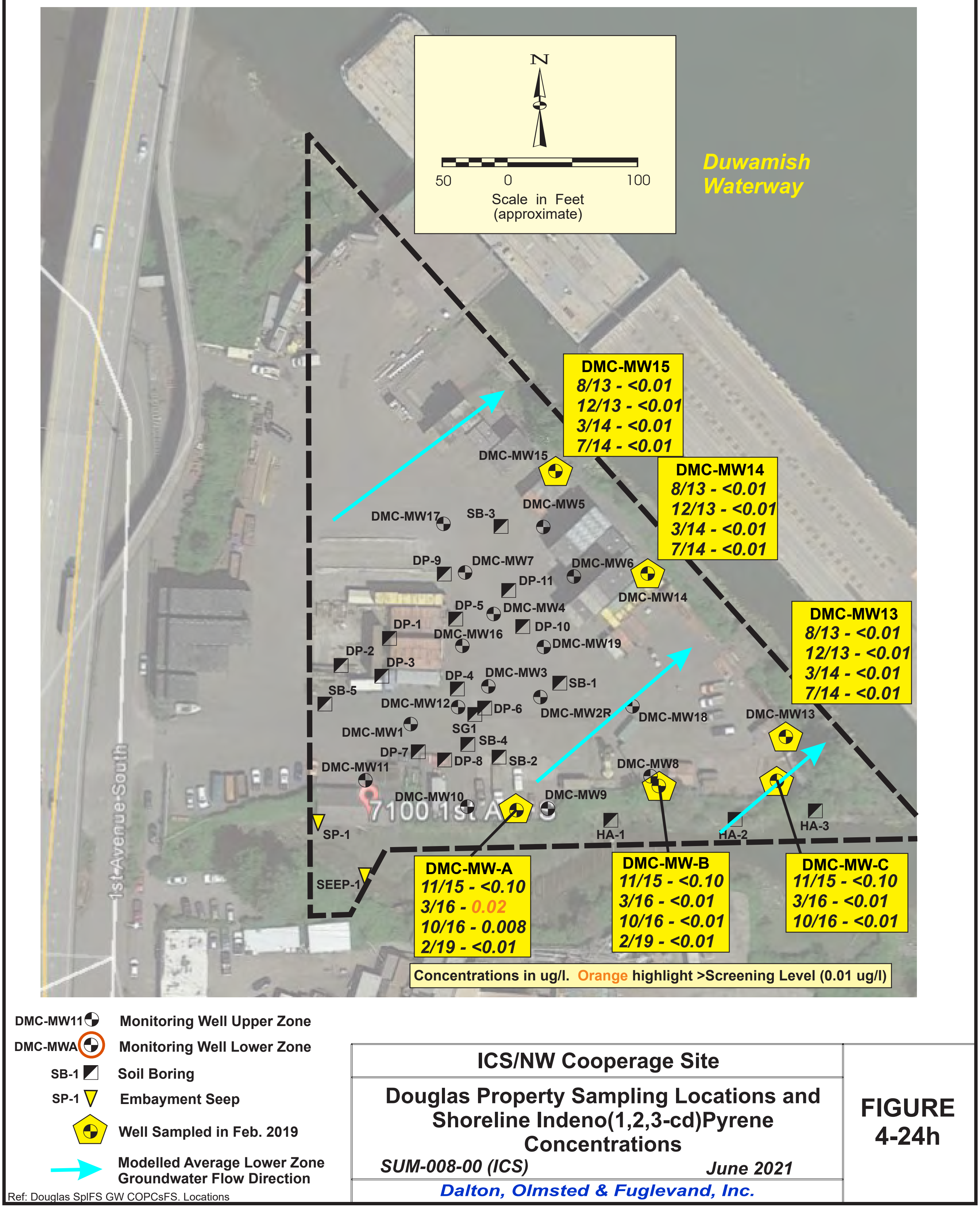
ICS/NW Cooperage Site

Douglas Property Sampling Locations and Shoreline Benzo(a)Pyrene Concentrations

SUM-008-00 (ICS) *June 2021*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-24g



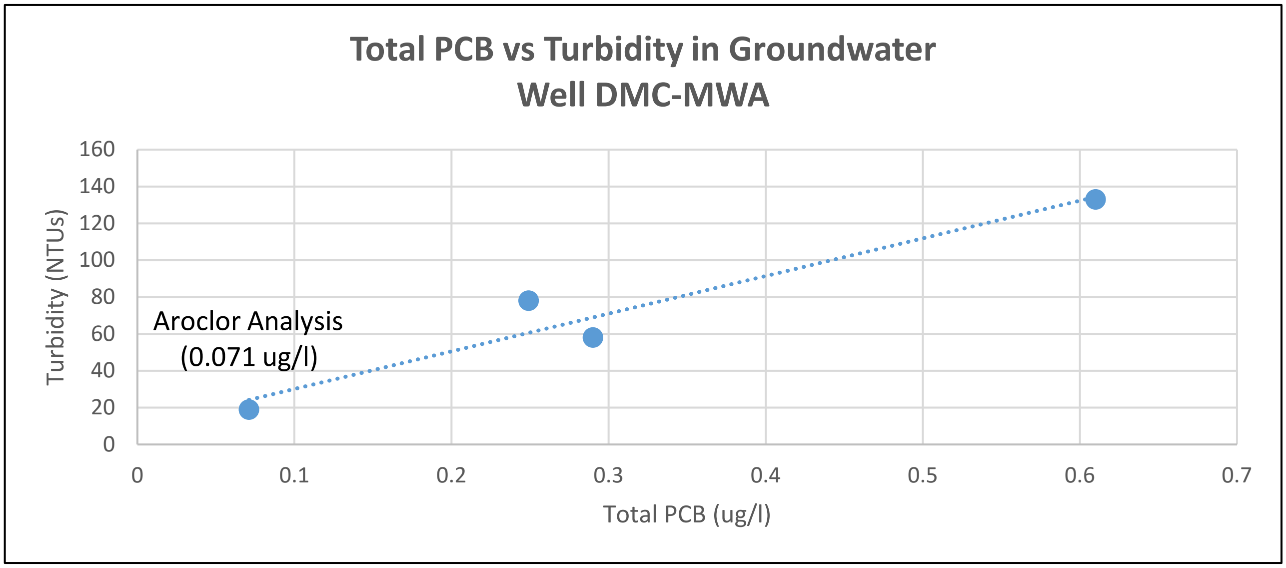
ICS/NW Cooperage Site

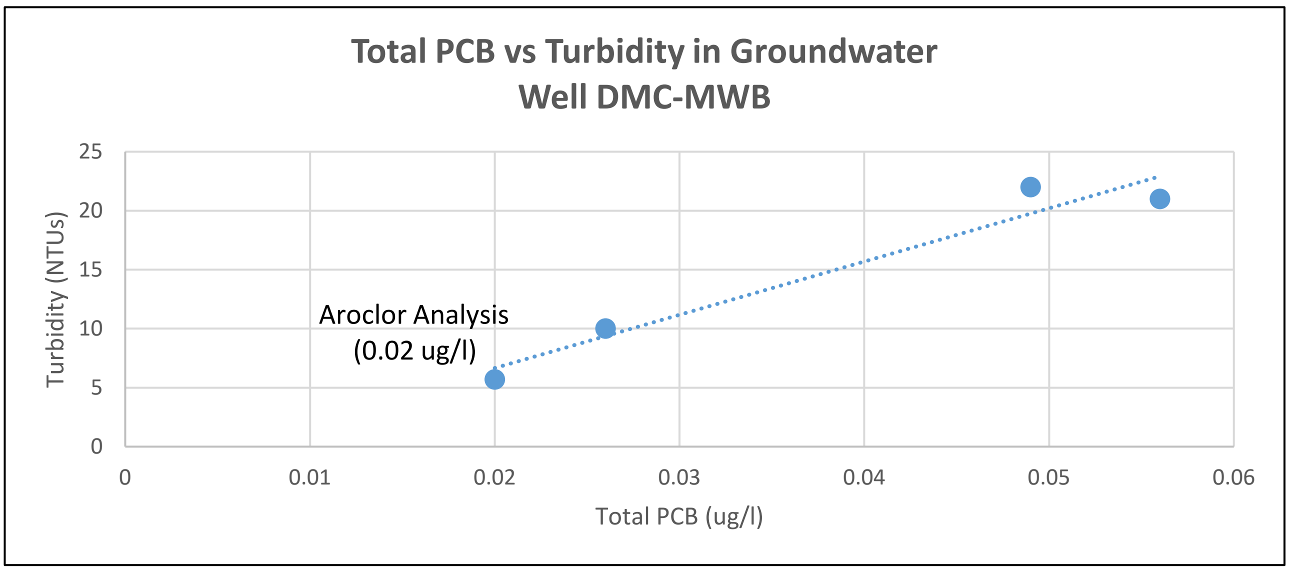
Douglas Property Sampling Locations and Shoreline Indeno(1,2,3-cd)Pyrene Concentrations

SUM-008-00 (ICS) *June 2021*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 4-24h





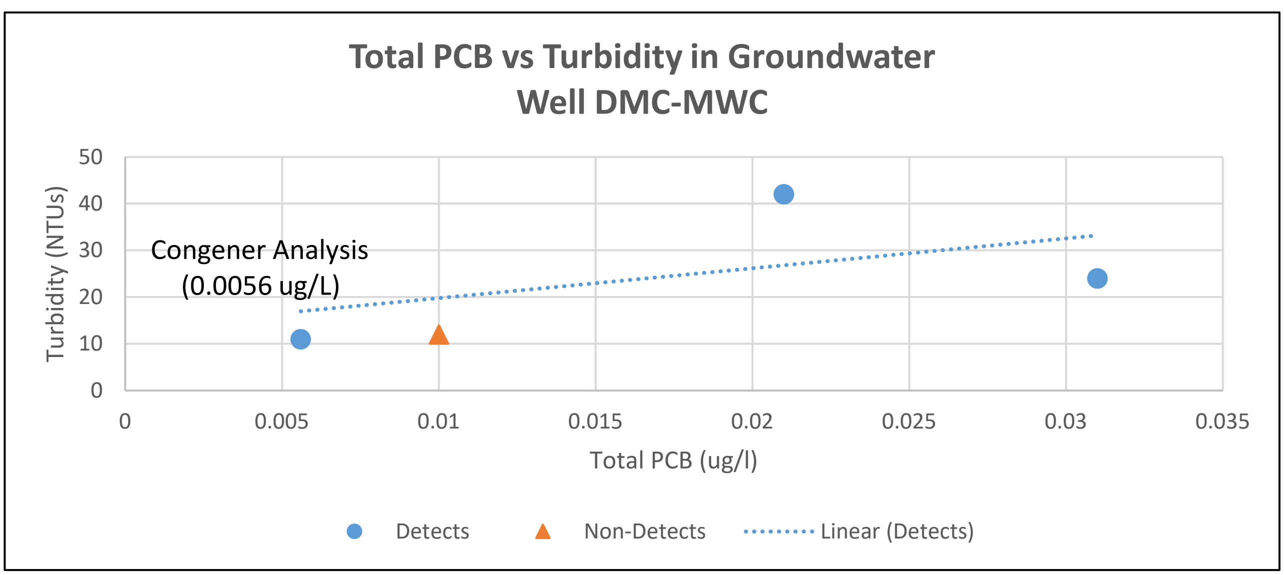
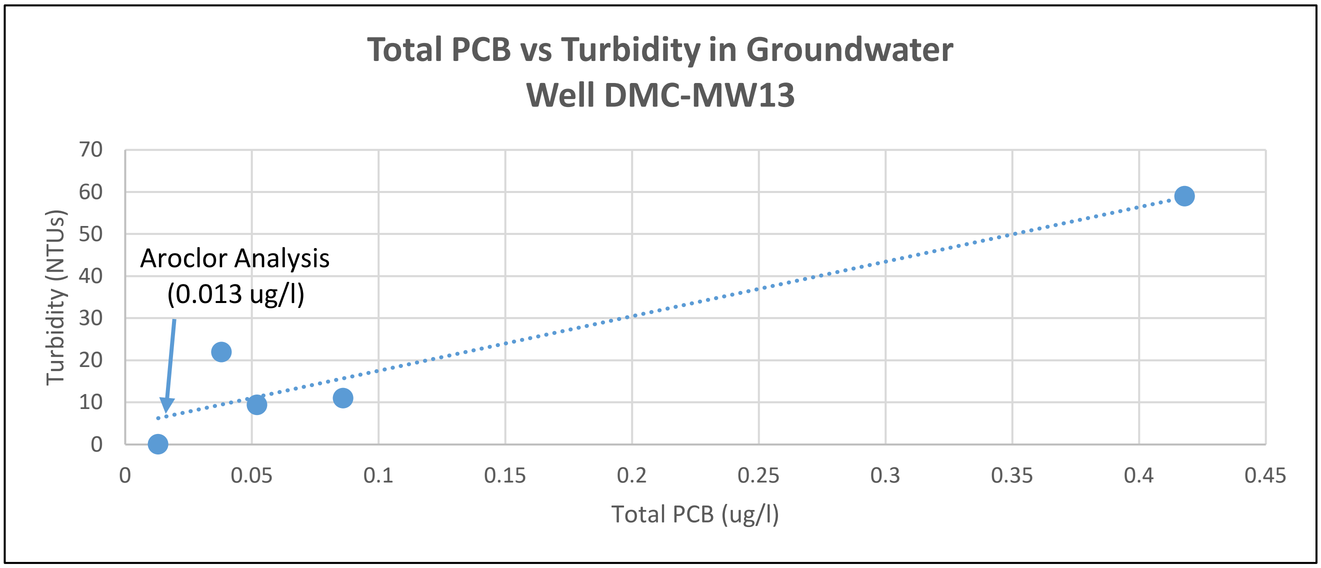
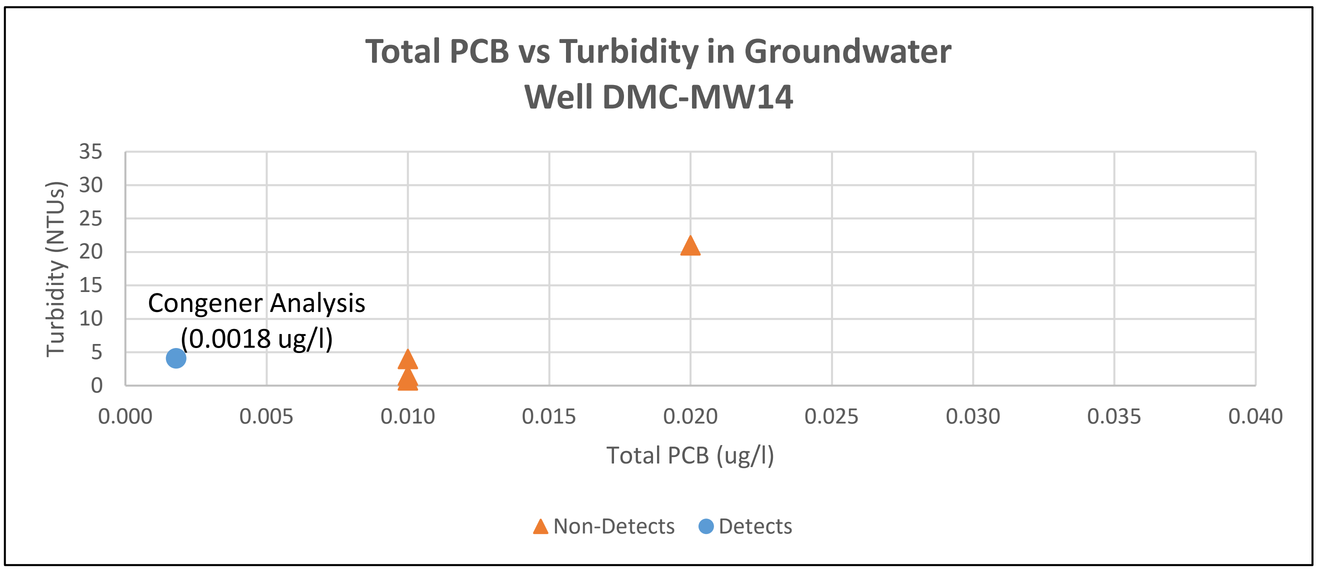
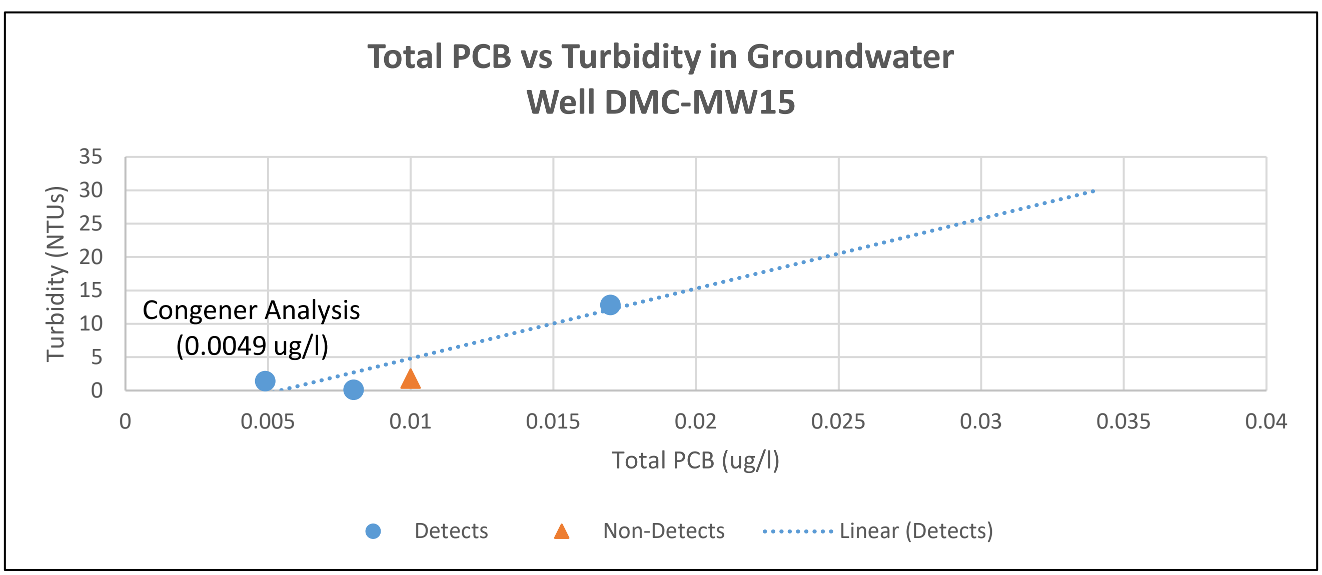


FIGURE 4-25 - Total PCB vs. Turbidity Douglas Property Wells



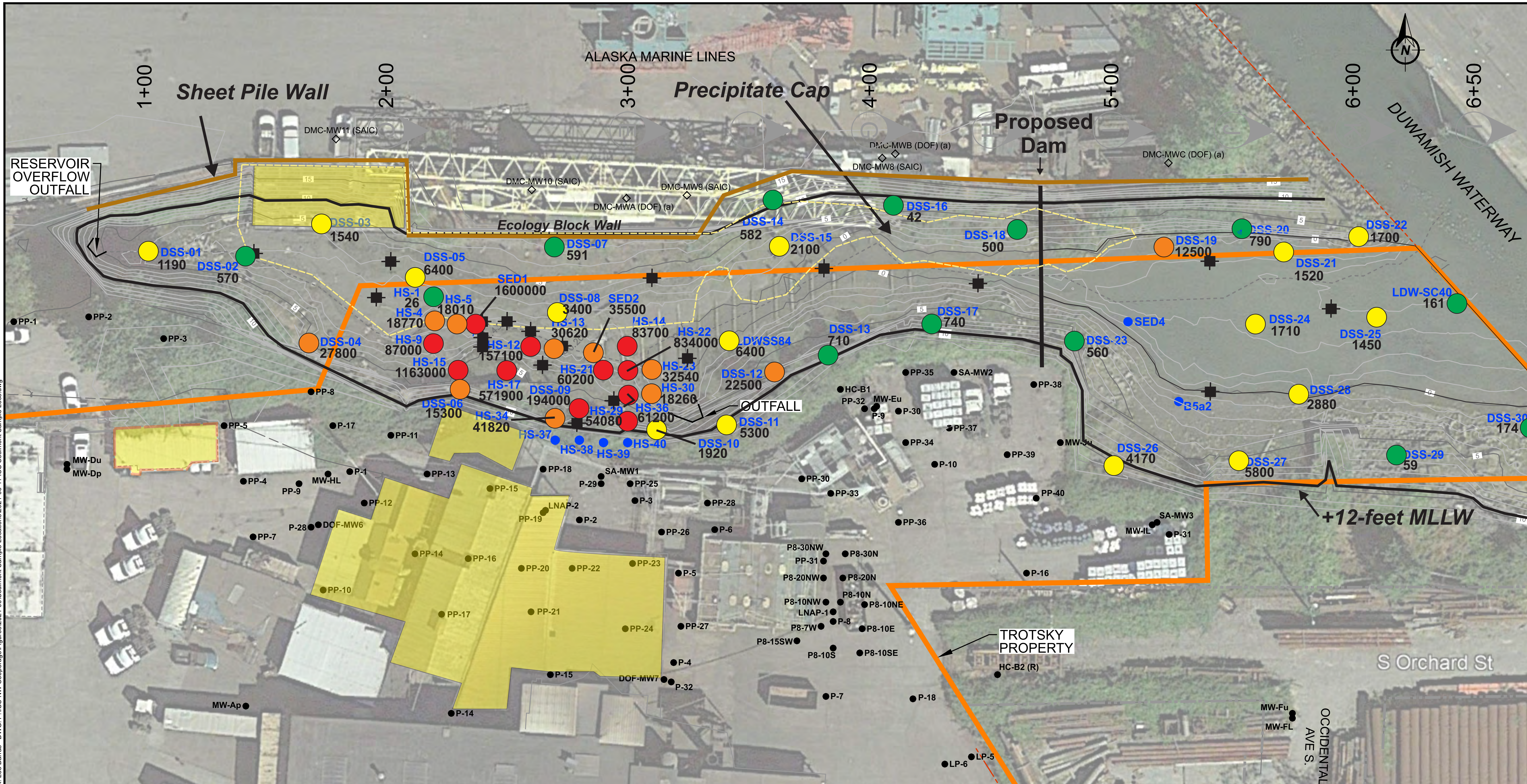




Dalton Olmsted Fuglevand, Inc.

(Turb vs TSS 2-2019 DataFS.xlsx-DougPlots)

FIGURE 4-25 - Total PCB vs. Turbidity Douglas Property Wells



NOTES

1. Topographic and feature survey performed by Bush, Roed & Hitchings, Inc. - July 2018
2. Horizontal Datum: NAD 83/91 Washington State Plane Coordinates, North Zone (US feet).
3. Vertical Datum: NAVD88 (feet). Difference from NAVD 88 to MLLW = 2.39'
4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations Surface 10-25-22

LEGEND

DSS-26 Surface Sediment Sample Location

Core J Sediment Core Location

DMC-MW10 Well Location

P-7 Push-Probe Location

Existing Contours (2018)

330 Dry Wt. - ug/kg

ENR-UL - 97 mg/kg-OCN (most samples exceed ENR-UL - see Figure 4-21b)

Buildings to Remove

NA Not Available

PCB Dry Wt. Concentrations

- ≤ - 1,000 ug/kg
- > - 1,000 to 10,000 ug/kg
- > - 10,000 to 50,000 ug/kg
- > - 50,000 ug/kg

0 40 Scale in Feet

ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

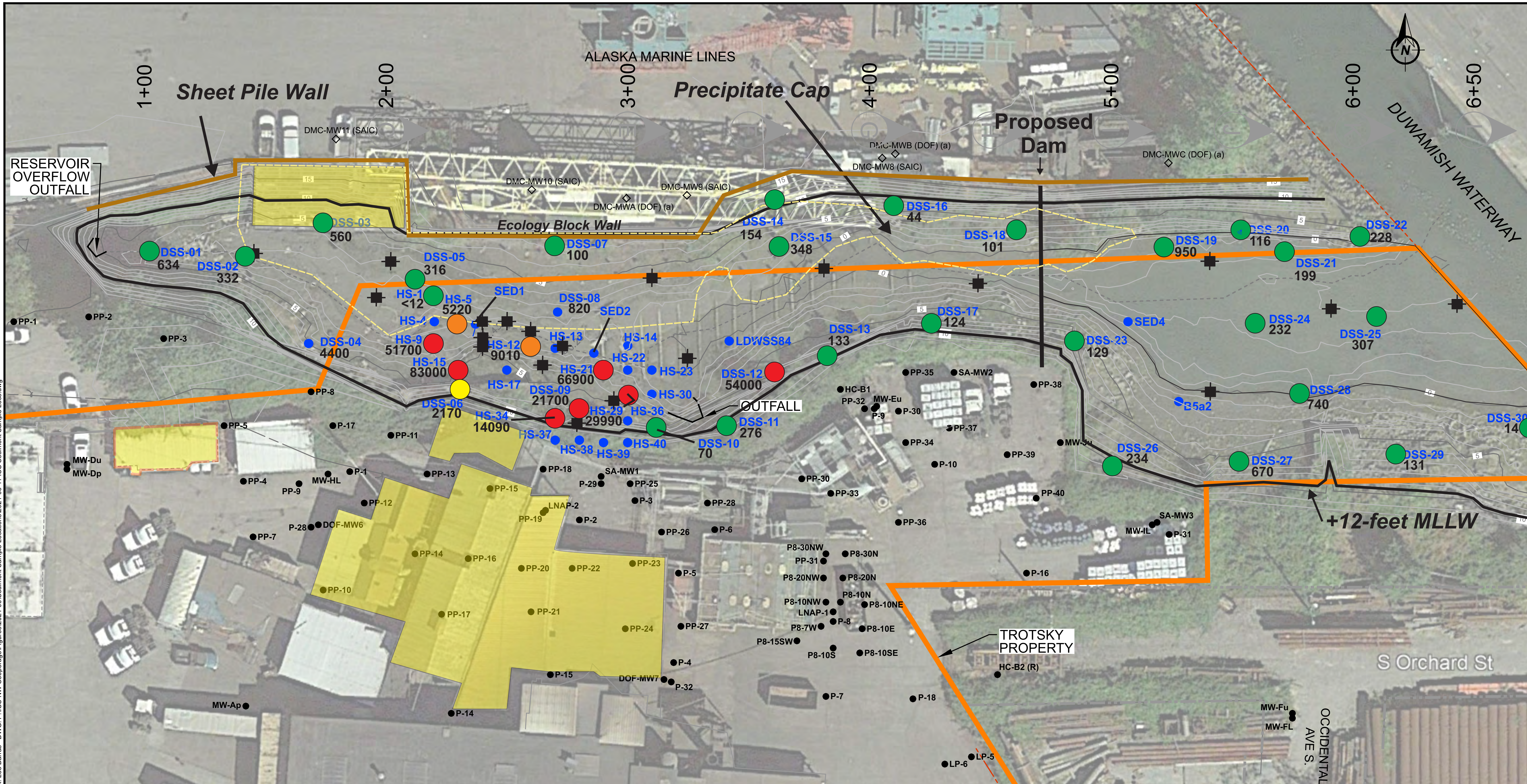
PCB Concentrations Surface Sediment (0-1')

DALTON OLMSTED FUGLEVAND

FIGURE 7-1a

SUM-008-03FS 10/25/2022

PLOT TIME: 6/11/2021 1:14 PM MOD TIME: 6/11/2021 1:13 PM USER: Lee Barras DWG: P:\ICS-NW Cooperage\Figures\2021-06\Sediment Sample Locations\2021-06-11 ICS Sediment Sample Locs.dwg



NOTES

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4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations Surface 10-25-22

LEGEND

DSS-26 Surface Sediment Sample Location

Core J Sediment Core Location

DMC-MW10 Well Location

P-7 Push-Probe Location

Existing Contours (2018)

330 Dry Wt. - mg/kg

ENR-UL - Not Available

Buildings to Remove

NA Not Available

DRO+RRO Dry Wt. Concentrations

≤ - 2,000 mg/kg

> - 2,000 to 4,000 mg/kg

> - 4,000 to 10,000 mg/kg

> - 10,000 mg/kg

0 40
Scale in Feet

ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

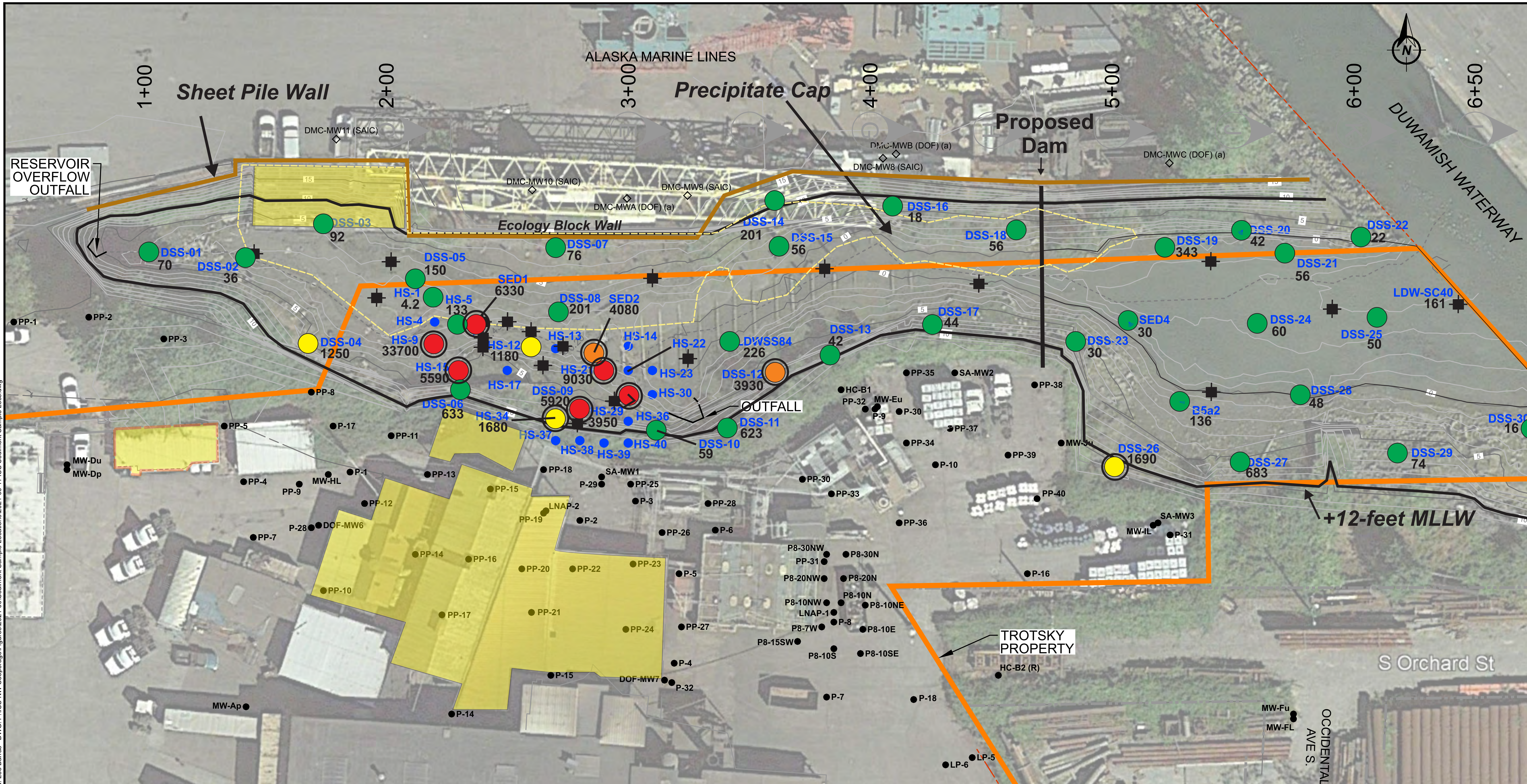
DRO+RRO Concentrations
Surface Sediment (0-1')

DOF DALTON OLMSTED FUGLEVAND

FIGURE
7-1b

SUM-008-03FS 10/25/2022

PLOT TIME: 6/11/2021 1:14 PM MOD TIME: 6/11/2021 1:13 PM USER: Lee Barras DWG: P:\ICS-NW Cooperage\Figures\2021-06\Sediment Sample Locations\2021-06-11 ICS Sediment Sample Locs.dwg



NOTES

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3. Vertical Datum: NAVD88 (feet). Difference from NAVD 88 to MLLW = 2.39'
4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations Surface 10-25-22

LEGEND

DSS-26 Surface Sediment Sample Location

Core J Sediment Core Location

DMC-MW10 Well Location

P-7 Push-Probe Location

Existing Contours (2018)

330 Dry Wt. - mg/kg

ENR-UL - 1350 mg/kg

Exceeds or Likely Exceeds ENR-UL

Buildings to Remove

NA Not Available

Lead Dry Wt. Concentrations

≤ - 1,000 mg/kg

> - 1,000 to 2,000 mg/kg

> - 2,000 to 5,000 mg/kg

> - 5,000 mg/kg

0 40 Scale in Feet

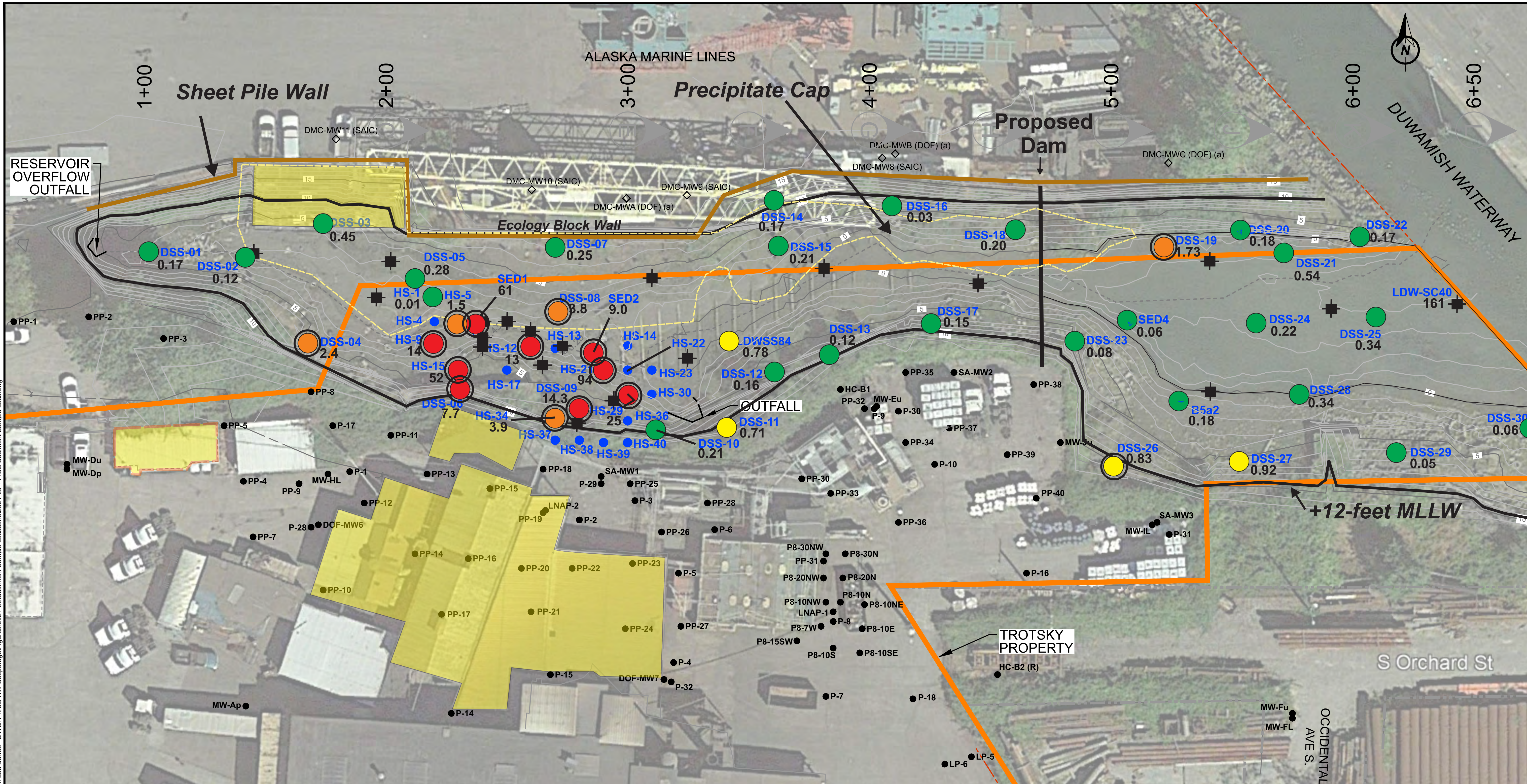
ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

Lead Concentrations Surface Sediment (0-1')

DOF DALTON OLMSTED FUGLEVAND

FIGURE **7-1c**

SUM-008-03FS 10/25/2022



NOTES

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3. Vertical Datum: NAVD88 (feet). Difference from NAVD 88 to MLLW = 2.39'
4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations Surface 10-25-22

LEGEND

DSS-26	Surface Sediment Sample Location
Core J	Sediment Core Location
DMC-MW10	Well Location
P-7	Push-Probe Location
	Existing Contours (2018)
.15	Dry Wt. - mg/kg
ENR-UL - 1.23 mg/kg	
	Exceeds or Likely Exceeds ENR-UL
	Buildings to Remove
NA	Not Available

Mercury Dry Wt. Concentrations

- ≤ 0.59 mg/kg
- > 0.59 to 1.0 mg/kg
- > 1.0 to 4.0 mg/kg
- > 4.0 mg/kg

0 40
Scale in Feet

ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

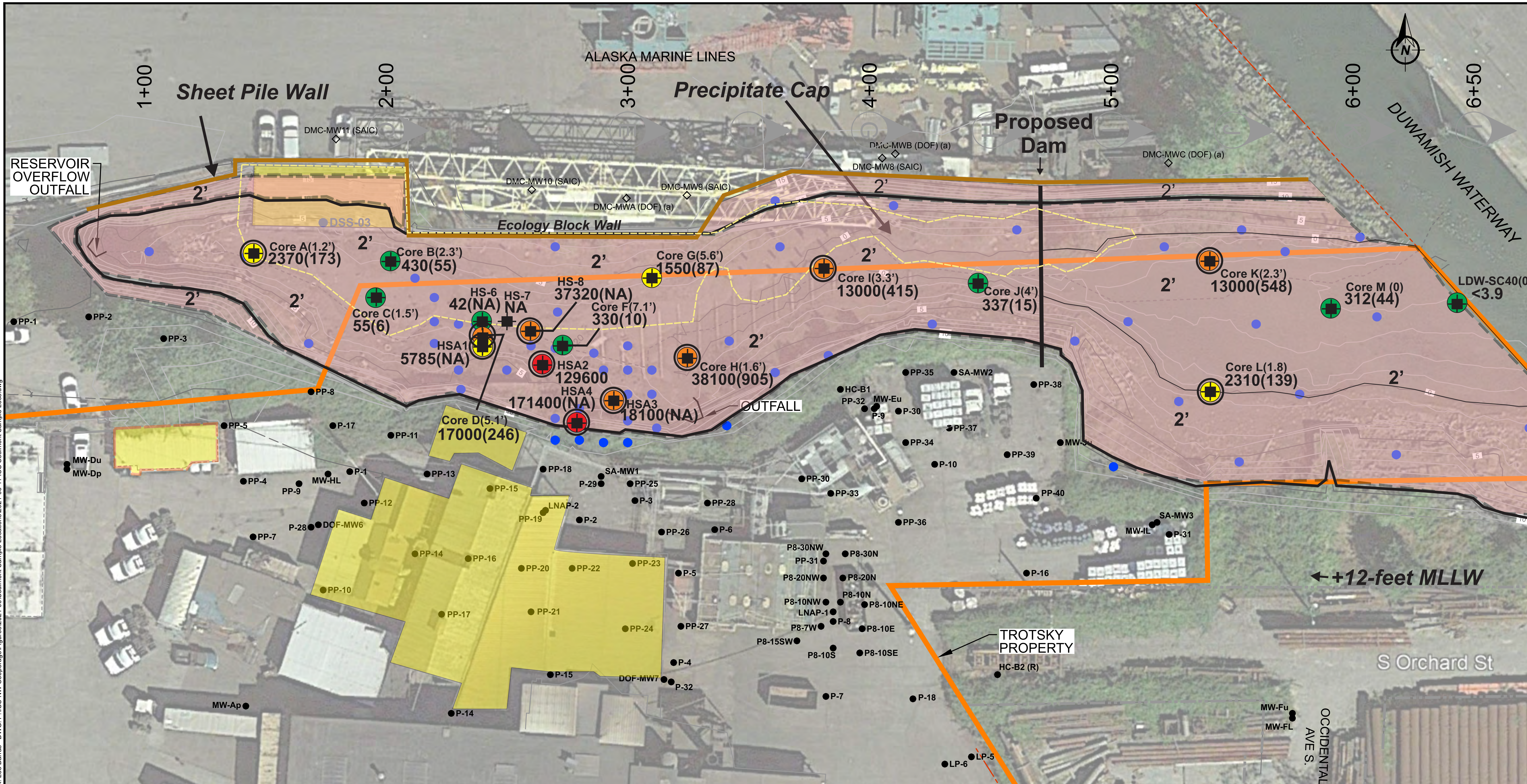
Mercury Concentrations Surface Sediment (0-1')

DALTON OLMSTED FUGLEVAND

FIGURE
7-1d

SUM-008-03FS 10/25/2022

PLOT TIME: 6/11/2021 1:14 PM MOD TIME: 6/11/2021 1:13 PM USER: Lee Barras DWG: P:\ICS-NW Cooperage\Figures\2021-06\Sediment Sample Locations\2021-06-11 ICS Sediment Sample Locs.dwg



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3. Vertical Datum: NAVD88 (feet). Difference from NAVD 88 to MLLW = 2.39'
4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations 2 ft Surface 10-25-22

LEGEND

- Surface Sediment Sample Location
- Core J — Sediment Core Location
- DMC-MW10 — Well Location
- P-7 — Push-Probe Location
- Existing Contours (2018)
- Core J(1.2') — Core Designation & Remaining Silt (aquitard) Thickness
- 330(10) — Dry Wt. - ug/kg (OCN Conc. - mg/kg)
- ENR-UL - 97 mg/kg-OCN
- Exceeds or Likely Exceeds ENR-UL
- 2' — Assumed Excavation Thickness
- Buildings to Remove
- NA — Not Available

PCB Dry Wt. Concentrations

- ≤ - 1,000 ug/kg
- > - 1,000 to 10,000 ug/kg
- > - 10,000 to 50,000 ug/kg
- > - 50,000 ug/kg

0 40
Scale in Feet

ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

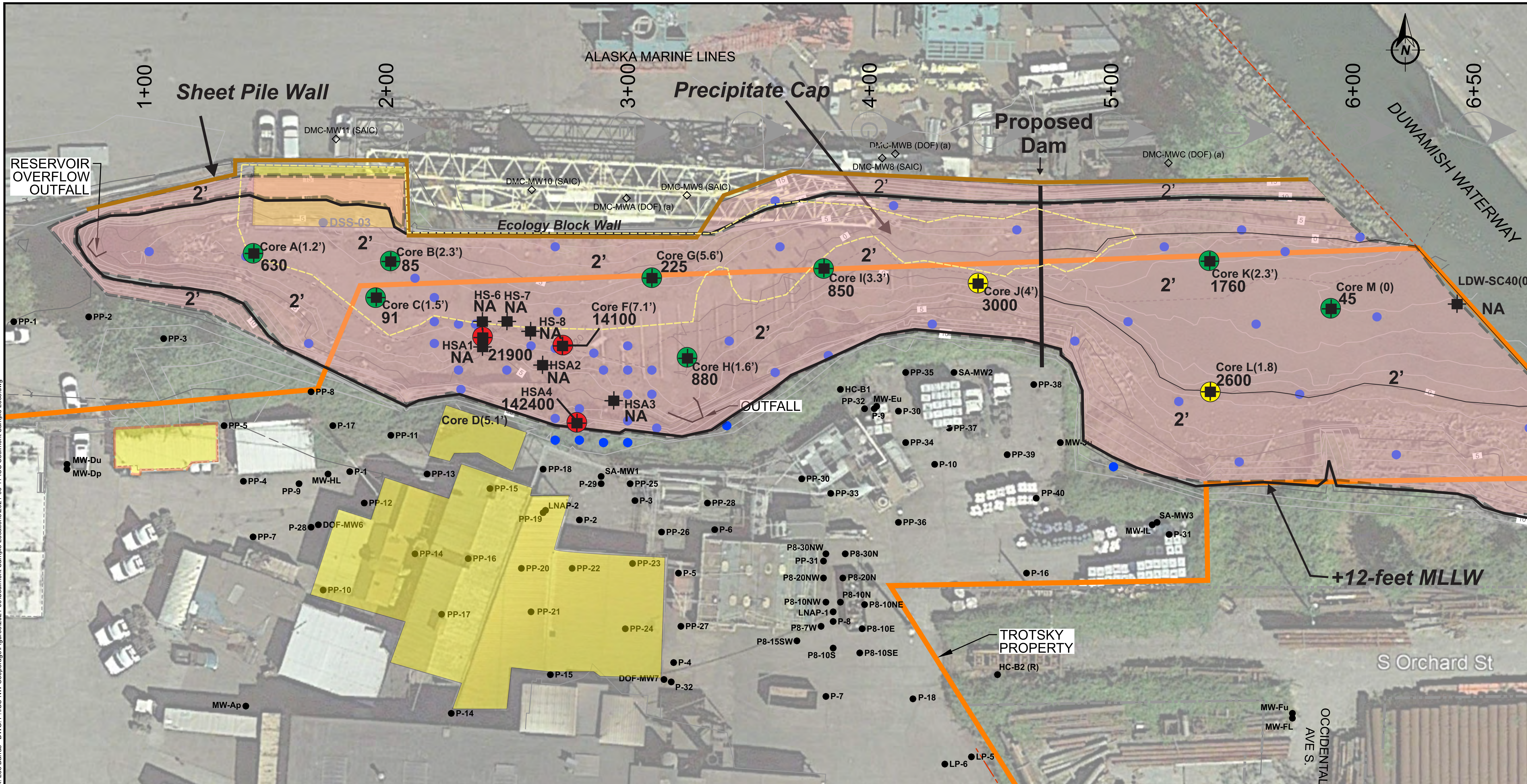
PCB Concentrations Two-Foot Removal Surface

DALTON OLMSTED FUGLEVAND

FIGURE
7-2a

SUM-008-03FS 10/25/2022

PLOT TIME: 6/11/2021 1:14 PM MOD TIME: 6/11/2021 1:13 PM USER: Lee Barras DWG: P:\ICS-NW Cooperage\Figures\2021-06\Sediment Sample Locations\2021-06-11 ICS Sediment Sample Locs.dwg



NOTES

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3. Vertical Datum: NAVD88 (feet). Difference from NAVD 88 to MLLW = 2.39'
4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations 2 ft Surface 10-25-22

LEGEND

- Surface Sediment Sample Location
- Core J — Sediment Core Location
- DMC-MW10 — Well Location
- P-7 — Push-Probe Location
- Existing Contours (2018)
- Core J(1.2') — Core Designation & Remaining Silt (aquitard) Thickness
- 330 — Dry Wt. - mg/kg)
- ENR-UL - Not available
- 2' — Assumed Excavation Thickness
- Buildings to Remove
- NA — Not Available

DRO+RRO Dry Wt. Concentrations

- ≤ - 2,000 mg/kg
- > - 2,000 to 4,000 mg/kg
- > - 4,000 to 10,000 mg/kg
- > - 10,000 mg/kg

0 40
Scale in Feet

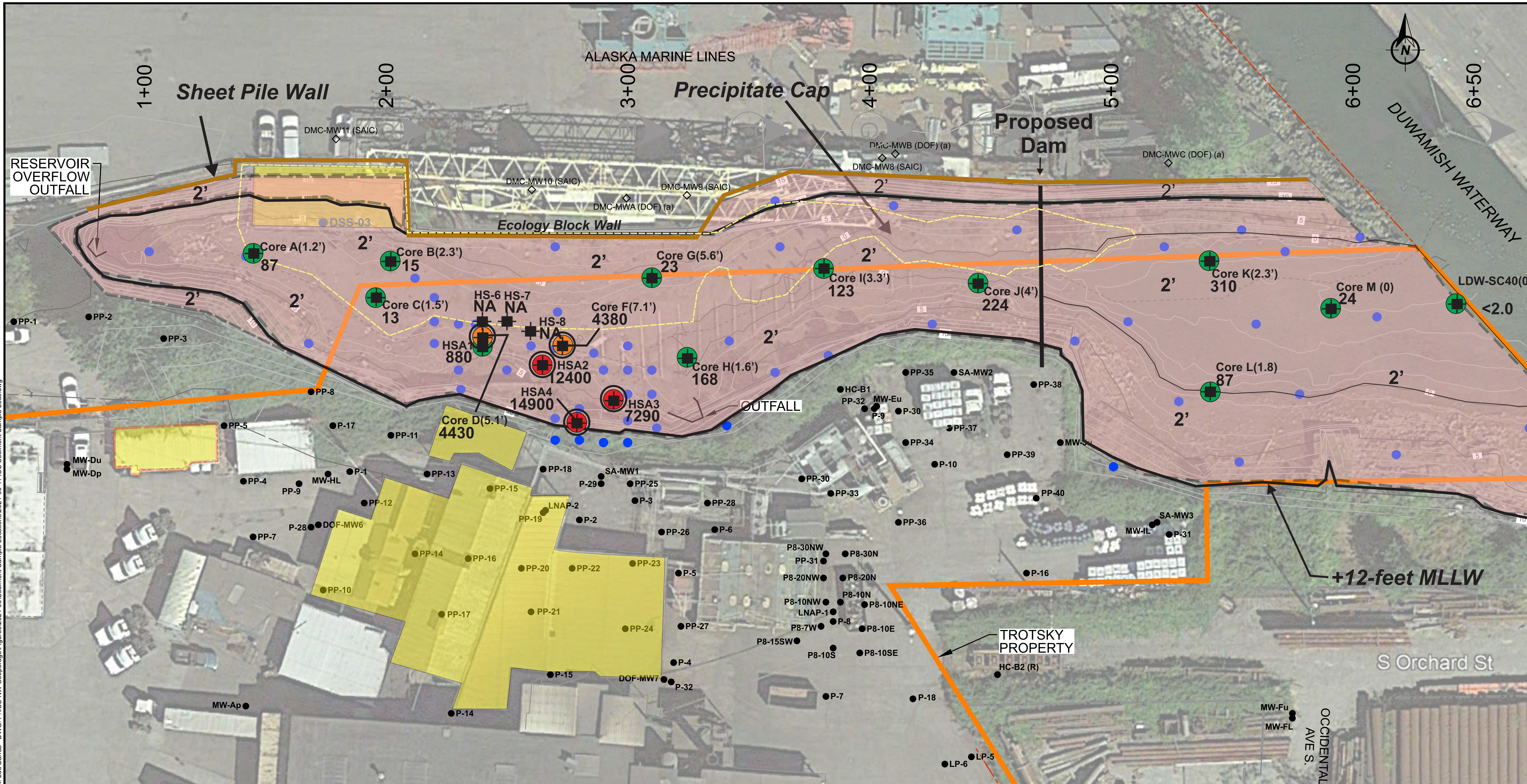
ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

DRO+RRO Concentrations
Two-Foot Removal Surface

DOF DALTON OLMSTED FUGLEVAND

FIGURE
7-2b

SUM-008-03FS 10/25/2022



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3. Vertical Datum: NAVD88 (feet). Difference from NAVD 88 to MLLW = 2.39'
4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations 2 ft Surface 10-25-22

LEGEND

Surface Sediment Sample Location

Core J — Sediment Core Location

DMC-MW10 — Well Location

P-7 — Push-Probe Location

Existing Contours (2018)

Core J(1.2') — Core Designation & Remaining Silt (aquitard) Thickness

330 Dry Wt. - mg/kg

ENR-UL - 1350 mg/kg

Exceeds or Likely Exceeds ENR-UL

2' — Assumed Excavation Thickness

Buildings to Remove

NA — Not Available

Lead Dry Wt. Concentrations

- ≤ - 1,000 mg/kg
- > - 1,000 to 2,000 mg/kg
- > - 2,000 to 5,000 mg/kg
- > - 5,000 mg/kg

0 40
Scale in Feet

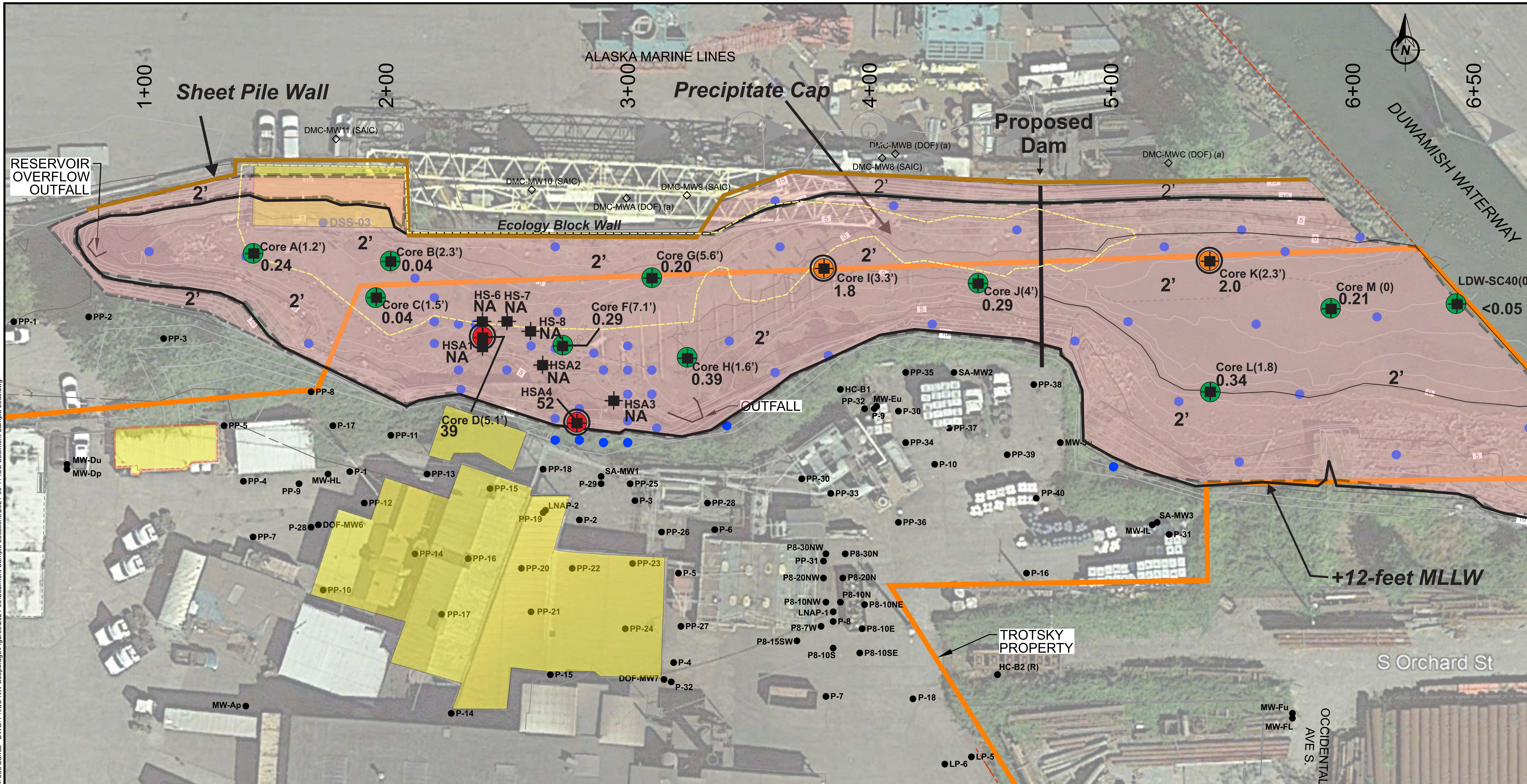
ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

Lead Concentrations Two-Foot Removal Surface

DOF DALTON OLMSTED FUGLEVAND

FIGURE
7-2c

SUM-008-03FS 10/25/2022



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4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations 2 ft Surface 10-25-22

LEGEND

Surface Sediment Sample Location

Core J — Sediment Core Location

DMC-MW10 — Well Location

P-7 — Push-Probe Location

Existing Contours (2018)

Core J(1.2') — Core Designation & Remaining Silt (aquitard) Thickness

0.12 Dry Wt. - mg/kg

ENR-UL - 1.23 mg/kg

Exceeds or Likely Exceeds ENR-UL

2' — Assumed Excavation Thickness

Buildings to Remove

NA — Not Available

Mercury Dry Wt. Concentrations

- ≤ 0.59 mg/kg
- > 0.59 to 1.0 mg/kg
- > 1.0 to 4.0 mg/kg
- > 4.0 mg/kg

0 40
Scale in Feet

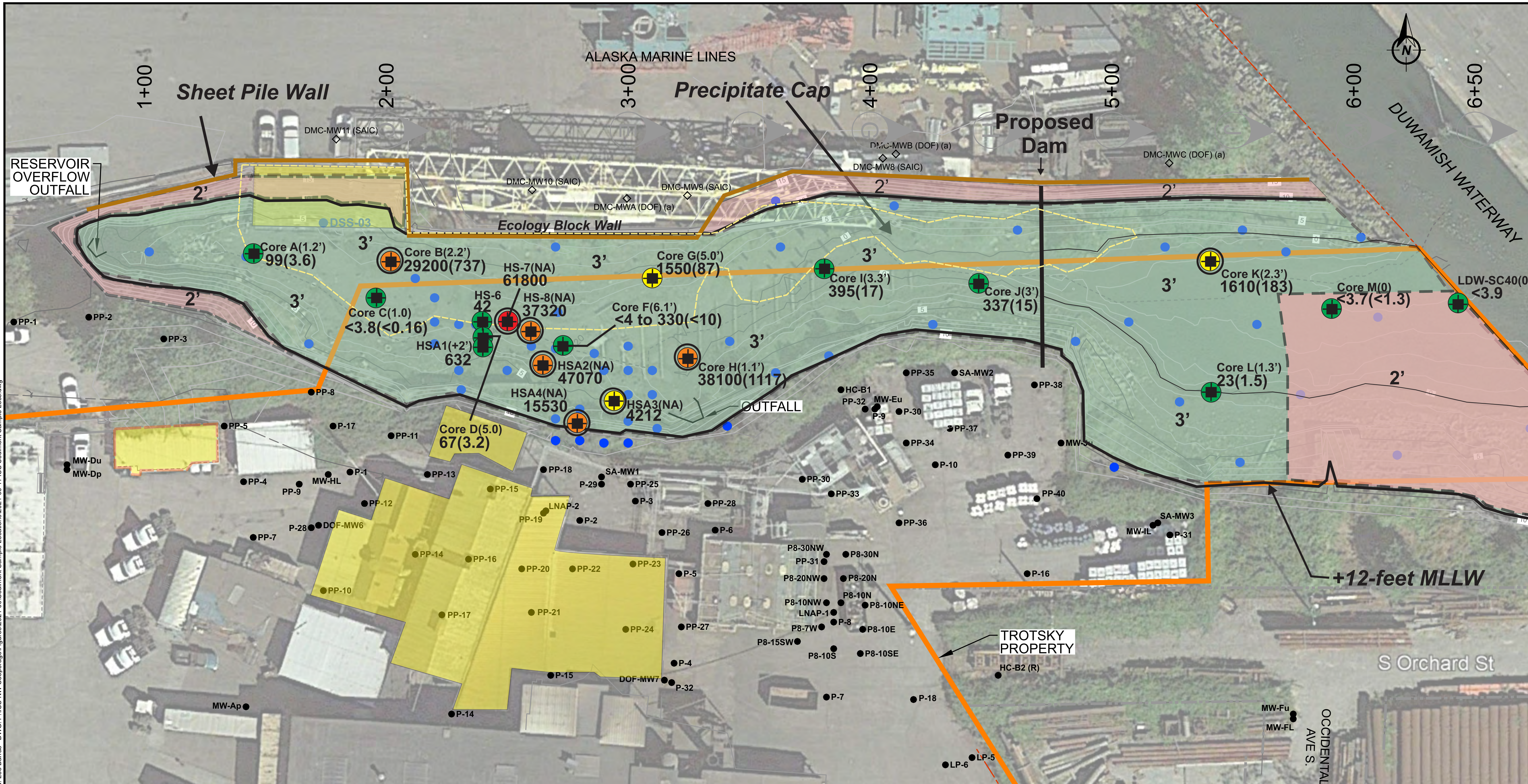
ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

Mercury Concentrations
Two-Foot Removal Surface

DOF DALTON OLMSTED FUGLEVAND

FIGURE
7-2d

SUM-008-03FS 10/25/2022



PLOT TIME: 6/11/2021 1:14 PM MOD TIME: 6/11/2021 1:13 PM USER: Lee Barras DWG: P:\ICS-NW Cooperage\Figures\2021-06\Sediment Sample Locations\2021-06-11 ICS Sediment Sample Locs.dwg

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3. Vertical Datum: NAVD88 (feet). Difference from NAVD 88 to MLLW = 2.39'
4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations 3 ft 10-25-22

LEGEND

- Surface Sediment Sample Location
- Core J — Sediment Core Location
- DMC-MW10 — Well Location
- P-7 — Push-Probe Location
- Existing Contours (2018)
- Core J(1.2') — Core Designation & Remaining Silt (aquitard) Thickness
- 330(10) — Dry Wt. - ug/kg (OCN Conc. - mg/kg)
- ENR-UL - 97 mg/kg-OCN
- Exceeds or Likely Exceeds ENR-UL
- 3' — Assumed Excavation Thickness
- Buildings to Remove
- NA — Not Available

PCB Dry Wt. Concentrations

- ≤ - 1,000 ug/kg
- > - 1,000 to 10,000 ug/kg
- > - 10,000 to 50,000 ug/kg
- > - 50,000 ug/kg

0 40
Scale in Feet

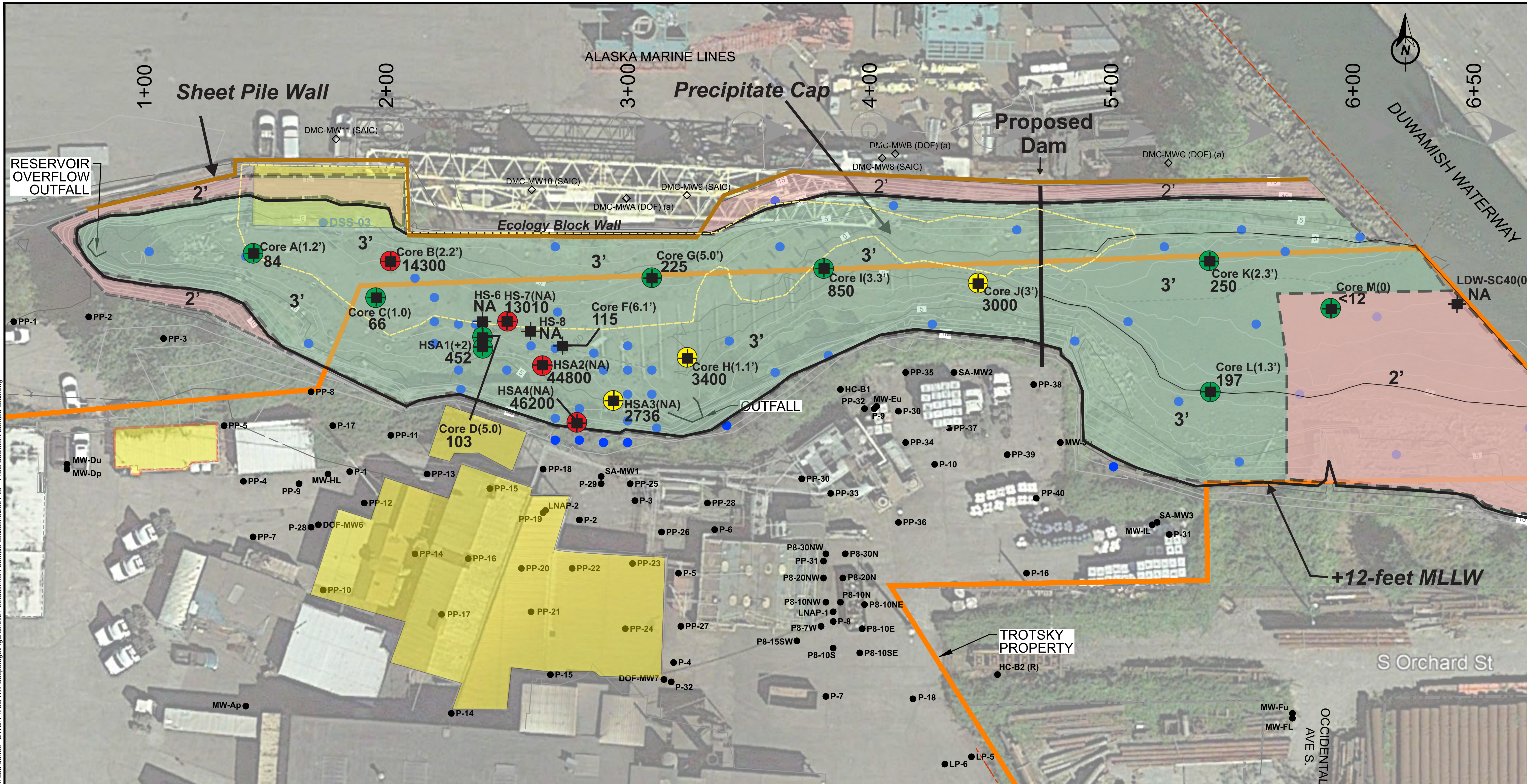
ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

PCB Concentrations
Three-Foot Removal Surface

DOF DALTON OLMSTED FUGLEVAND

FIGURE
7-3a

SUM-008-03FS 10/25/2022



NOTES

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3. Vertical Datum: NAVD88 (feet). Difference from NAVD 88 to MLLW = 2.39'
4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations 3 ft 10-25-22

LEGEND

- Surface Sediment Sample Location
- Core J — Sediment Core Location
- DMC-MW10 — Well Location
- P-7 — Push-Probe Location
- Existing Contours (2018)
- Core J(1.2') — Core Designation & Remaining Silt (aquitard) Thickness
- 330 — Dry Wt. - mg/kg)
- ENR-UL - Not available
- 3' — Assumed Excavation Thickness
- Buildings to Remove
- NA — Not Available

DRO+RRO Dry Wt. Concentrations

- ≤ - 2,000 mg/kg
- > - 2,000 to 4,000 mg/kg
- > - 4,000 to 10,000 mg/kg
- > - 10,000 mg/kg

0 40
Scale in Feet

ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

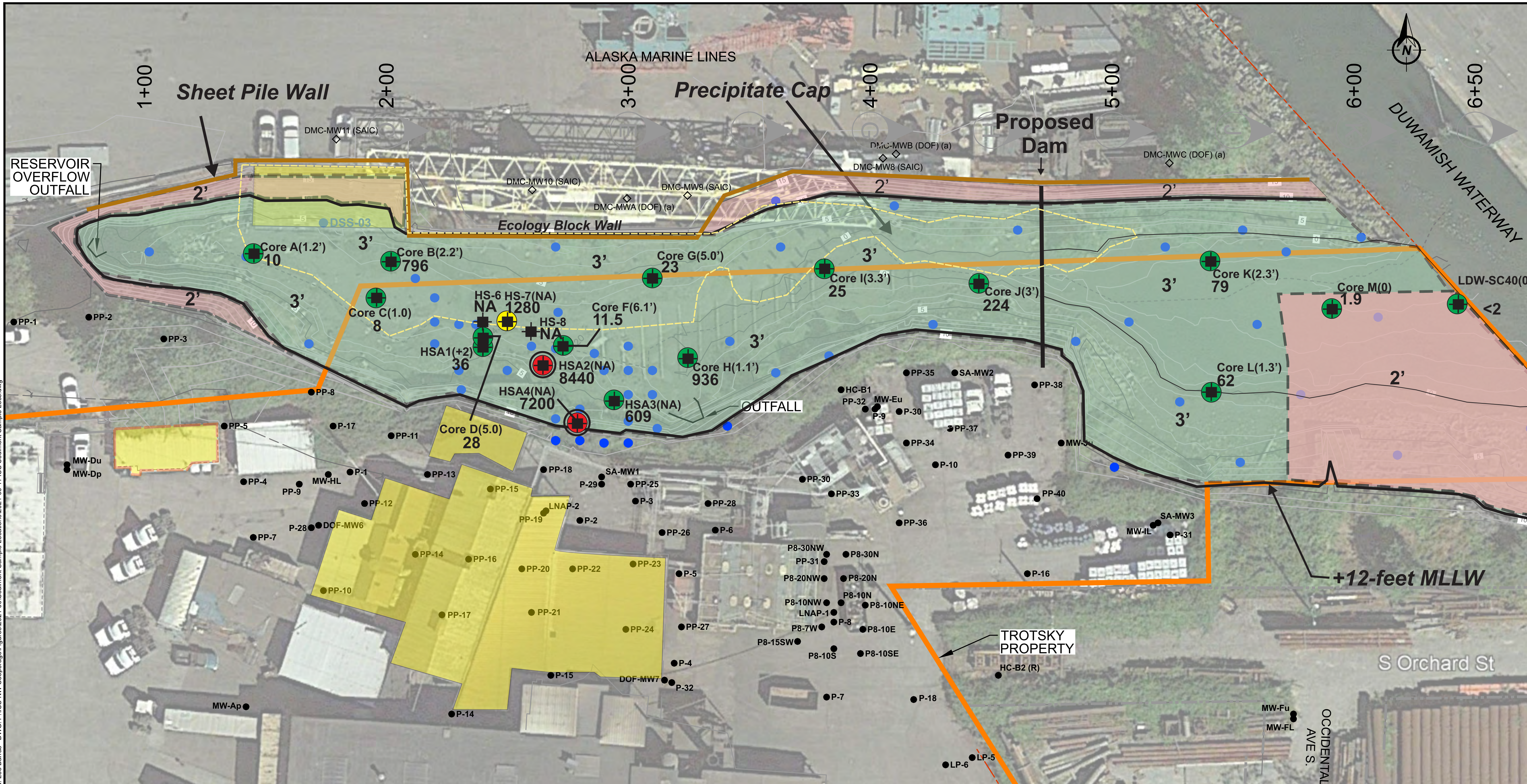
DRO+RRO Concentrations
Three-Foot Removal Surface

DOF DALTON OLMSTED FUGLEVAND

FIGURE
7-3b

SUM-008-03FS 10/25/2022

PLOT TIME: 6/11/2021 1:14 PM MOD TIME: 6/11/2021 1:13 PM USER: Lee Barras DWG: P:\ICS-NW Cooperage\Figures\2021-06\Sediment Sample Locations\2021-06-11 ICS Sediment Sample Locs.dwg



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4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations 3 ft Surface 10-25-22

LEGEND

- Surface Sediment Sample Location
- Core J — Sediment Core Location
- DMC-MW10 — Well Location
- P-7 — Push-Probe Location
- Existing Contours (2018)
- Core J(1.2') — Core Designation & Remaining Silt (aquitard) Thickness
- 330(10) Dry Wt. - ug/kg
- ENR-UL - 1350 mg/kg
- Exceeds or Likely Exceeds ENR-UL
- 3' — Assumed Excavation Thickness
- Buildings to Remove
- NA — Not Available

Lead Dry Wt. Concentrations

- ≤ - 1,000 mg/kg
- > - 1,000 to 2,000 mg/kg
- > - 2,000 to 5,000 mg/kg
- > - 5,000 mg/kg

0 40
Scale in Feet

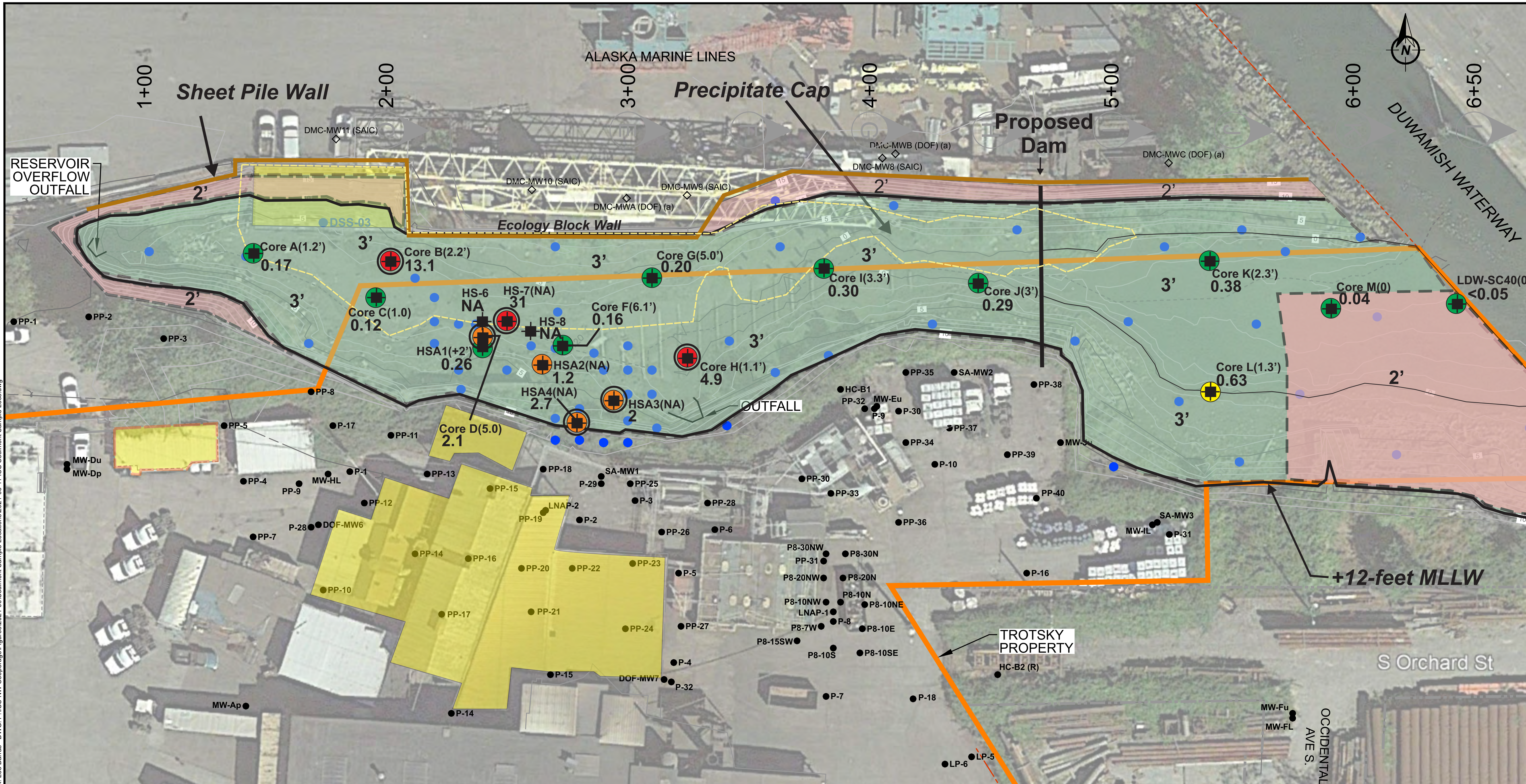
ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

Lead Concentrations
Three-Foot Removal Surface

DOF DALTON OLMSTED FUGLEVAND

FIGURE
7-3c

SUM-008-03FS 10/25/2022



NOTES

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3. Vertical Datum: NAVD88 (feet). Difference from NAVD 88 to MLLW = 2.39'
4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations 3 ft Surface 10-25-22

LEGEND

Surface Sediment Sample Location	330(10) Dry Wt. - ug/kg
Core J — Sediment Core Location	ENR-UL - 1.23 mg/kg
DMC-MW10 — Well Location	Exceeds or Likely Exceeds ENR-UL
P-7 — Push-Probe Location	3' — Assumed Excavation Thickness
Existing Contours (2018)	Buildings to Remove
Core J(1.2') — Core Designation & Remaining Silt (aquitard) Thickness	NA — Not Available

Mercury Dry Wt. Concentrations

- < - 0.59 mg/kg
- > - 0.59 to 1.0 mg/kg
- > - 1.0 to 4.0 mg/kg
- > - 4.0 mg/kg

0 — 40 Scale in Feet

ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

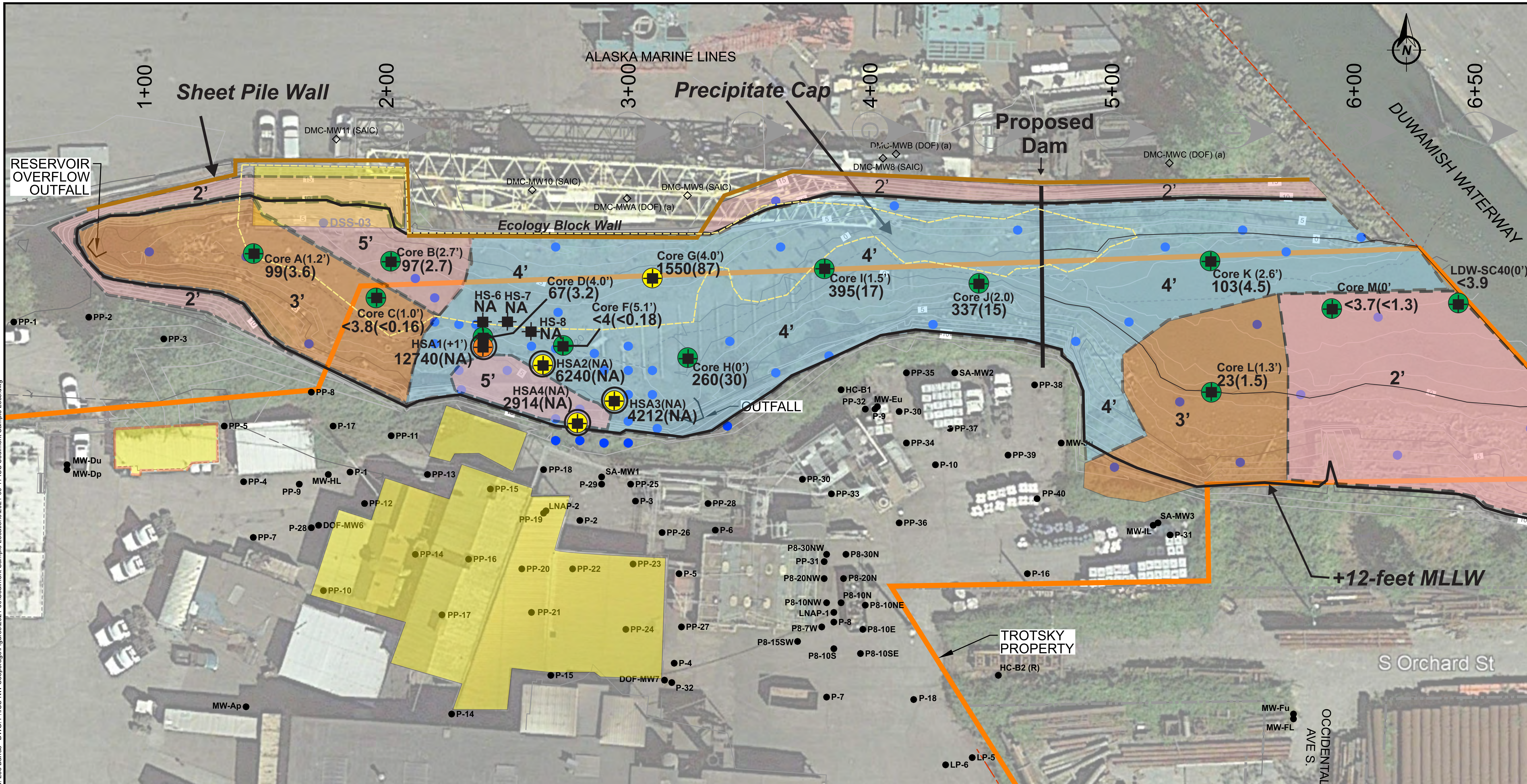
Mercury Concentrations Three-Foot Removal Surface

DOF DALTON OLMSTED FUGLEVAND

FIGURE 7-3d

SUM-008-03FS 10/25/2022

PLOT TIME: 6/11/2021 1:14 PM MOD TIME: 6/11/2021 1:13 PM USER: Lee Barras DWG: P:\ICS-NW Cooperage\Figures\2021-06\Sediment Sample Locations\2021-06-11 ICS Sediment Sample Locs.dwg



NOTES

1. Topographic and feature survey performed by Bush, Roed & Hitchings, Inc. - July 2018
2. Horizontal Datum: NAD 83/91 Washington State Plane Coordinates, North Zone (US feet).
3. Vertical Datum: NAVD88 (feet). Difference from NAVD 88 to MLLW = 2.39'
4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations 4 ft 10-25-22

LEGEND

- Surface Sediment Sample Location
- Core J — Sediment Core Location
- DMC-MW10 — Well Location
- P-7 — Push-Probe Location
- Existing Contours (2018)
- Core J(1.2') — Core Designation & Remaining Silt (aquitard) Thickness
- 330(10) — Dry Wt. - ug/kg (OCN Conc. - mg/kg)
- ENR-UL - 97 mg/kg-OCN
- Exceeds or Likely Exceeds ENR-UL
- 4' — Assumed Excavation Thickness
- Buildings to Remove
- NA — Not Available

PCB Dry Wt. Concentrations

- ≤ - 1,000 ug/kg
- > - 1,000 to 10,000 ug/kg
- > - 10,000 to 50,000 ug/kg
- > - 50,000 ug/kg

0 40
Scale in Feet

ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

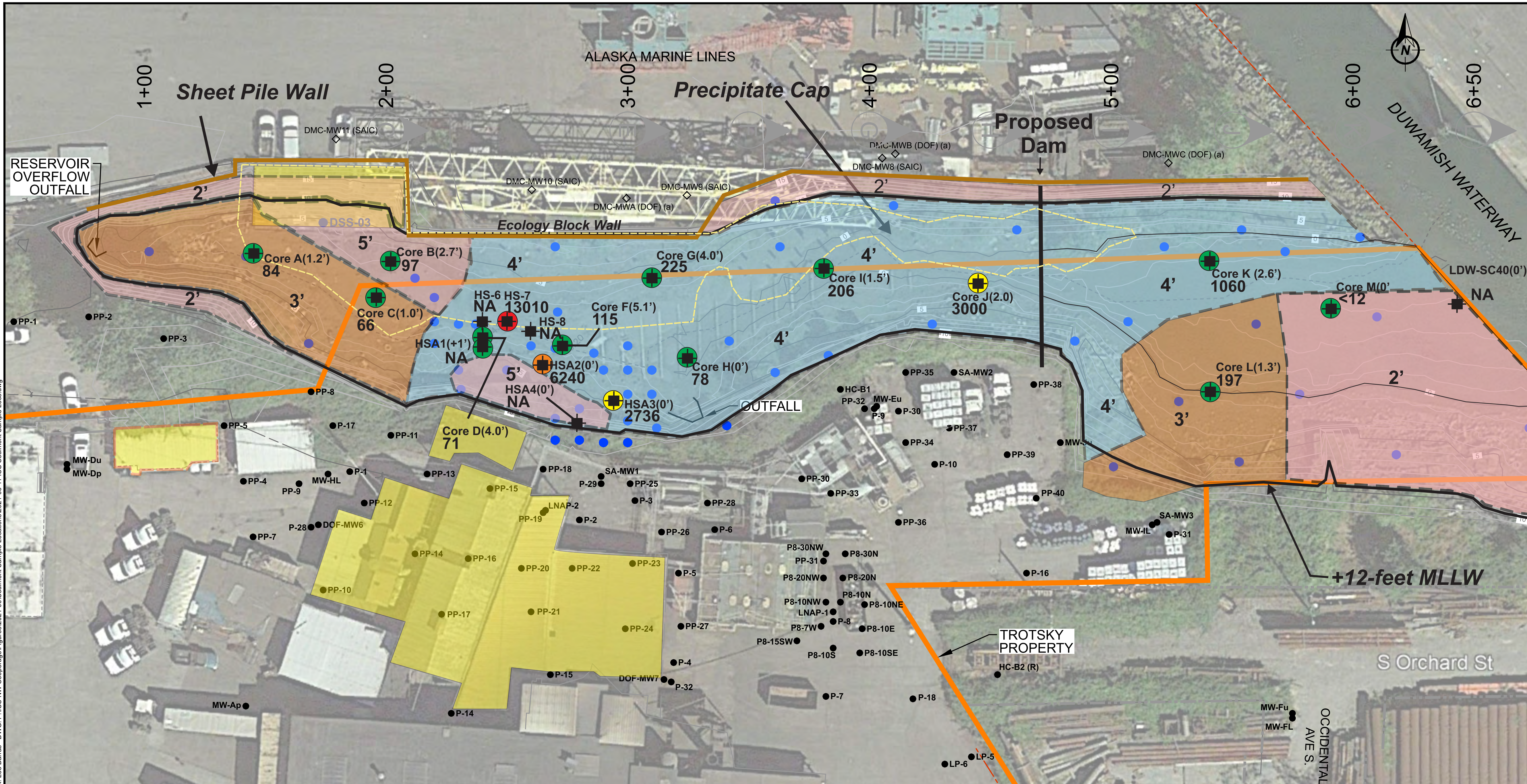
PCB Concentrations
Two to Five-Foot Removal Surface

DALTON OLMSTED FUGLEVAND

FIGURE
7-4a

SUM-008-03FS 10/25/2022

PLOT TIME: 6/11/2021 1:14 PM MOD TIME: 6/11/2021 1:13 PM USER: Lee Barras DWG: P:\ICS-NW Cooperage\Figures\2021-06\Sediment Sample Locations\2021-06-11 ICS Sediment Sample Locs.dwg



NOTES

1. Topographic and feature survey performed by Bush, Roed & Hitchings, Inc. - July 2018
2. Horizontal Datum: NAD 83/91 Washington State Plane Coordinates, North Zone (US feet).
3. Vertical Datum: NAVD88 (feet). Difference from NAVD 88 to MLLW = 2.39'
4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations 4 ft 10-25-22

LEGEND

- Surface Sediment Sample Location
- Core J — Sediment Core Location
- DMC-MW10 — Well Location
- P-7 — Push-Probe Location
- Existing Contours (2018)
- Core J(1.2') — Core Designation & Remaining Silt (aquitard) Thickness
- 330 Dry Wt. - mg/kg)
- ENR-UL - Not available
- 4' — Assumed Excavation Thickness
- Buildings to Remove

DRO+RRO Dry Wt. Concentrations

- ≤ - 2,000 mg/kg
- > - 2,000 to 4,000 mg/kg
- > - 4,000 to 10,000 mg/kg
- > - 10,000 mg/kg

0 40
Scale in Feet

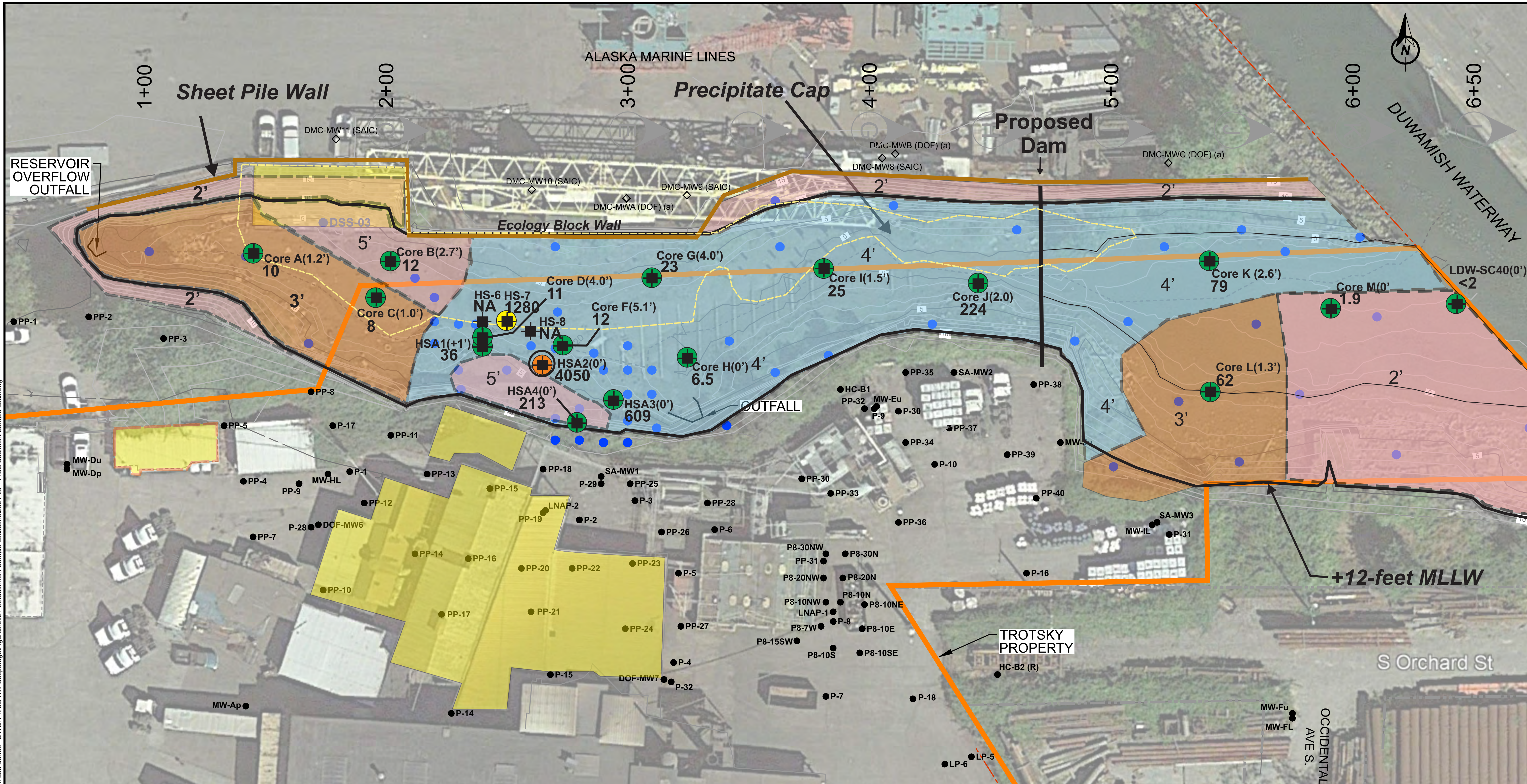
ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

DOF DALTON OLMSTED FUGLEVAND

DRO+RRO Concentrations
Two to Five-Foot Removal Surface

FIGURE
7-4b

SUM-008-03FS 10/25/2022



NOTES

1. Topographic and feature survey performed by Bush, Roed & Hitchings, Inc. - July 2018
2. Horizontal Datum: NAD 83/91 Washington State Plane Coordinates, North Zone (US feet).
3. Vertical Datum: NAVD88 (feet). Difference from NAVD 88 to MLLW = 2.39'
4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations 4 ft Surface 10-25-22

LEGEND

- Surface Sediment Sample Location
- Core J — Sediment Core Location
- DMC-MW10 — Well Location
- P-7 — Push-Probe Location
- Existing Contours (2018)
- Core J(1.2') — Core Designation & Remaining Silt (aquitard) Thickness
- 224 — Dry Wt. - mg/kg
- ENR-UL - mg/kg
- Exceeds or Likely Exceeds ENR-UL
- 4' — Assumed Excavation Thickness
- Buildings to Remove
- NA — Not Available

Lead Dry Wt. Concentrations

- ≤ - 1,000 mg/kg
- > - 1,000 to 2,000 mg/kg
- > - 2,000 to 5,000 mg/kg
- > - 5,000 mg/kg

0 40
Scale in Feet

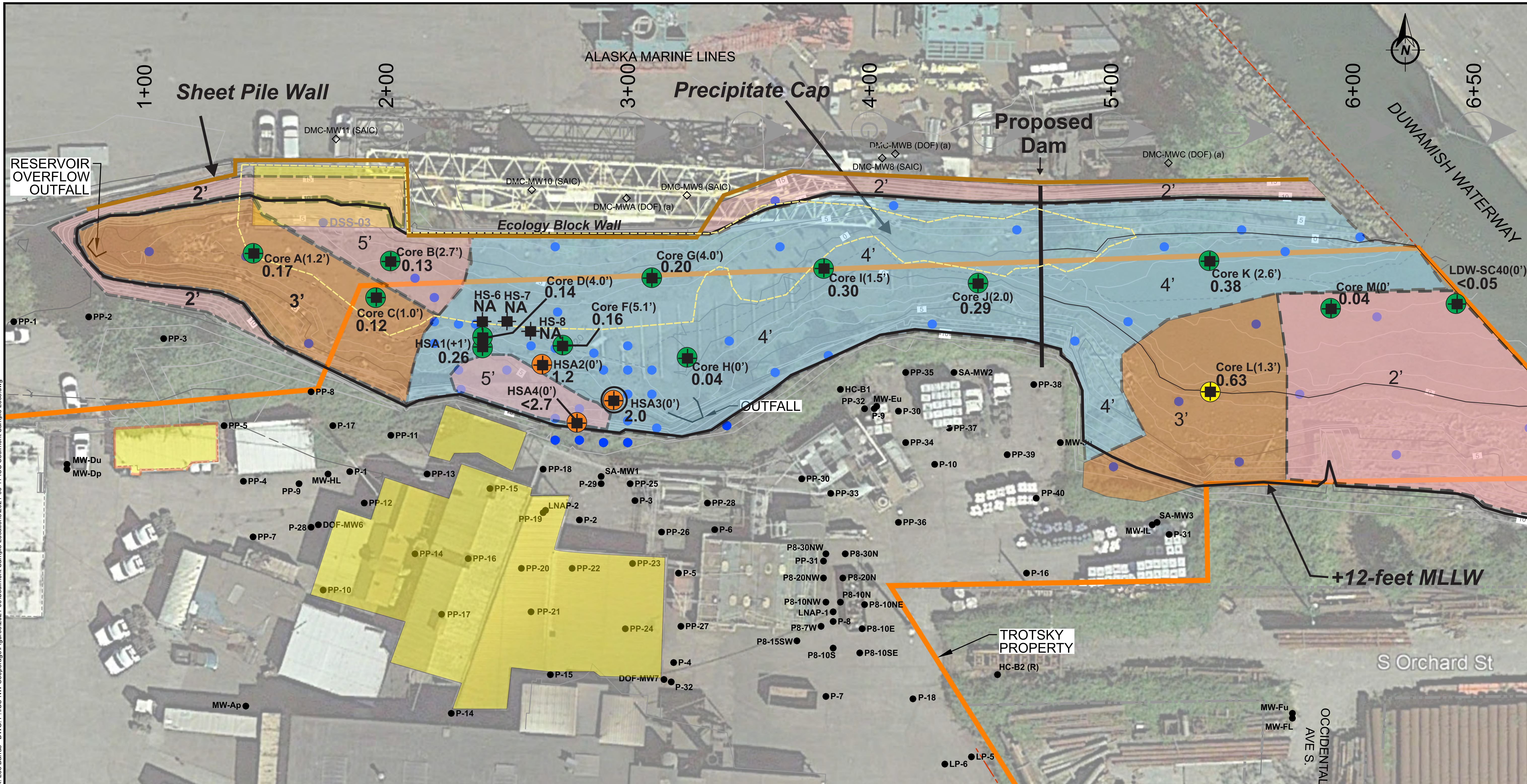
ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

Lead Concentrations
Two to Five-Foot Removal Surface

DOF DALTON OLMSTED FUGLEVAND

FIGURE
7-4c

SUM-008-03FS 10/25/2022



NOTES

1. Topographic and feature survey performed by Bush, Roed & Hitchings, Inc. - July 2018
2. Horizontal Datum: NAD 83/91 Washington State Plane Coordinates, North Zone (US feet).
3. Vertical Datum: NAVD88 (feet). Difference from NAVD 88 to MLLW = 2.39'
4. Background image source: Google Earth Pro 2020. Use for visual reference only.

Embayment Concentrations 4 ft Surface 10-25-22

LEGEND

- Surface Sediment Sample Location
- Core J — Sediment Core Location
- DMC-MW10 — Well Location
- P-7 — Push-Probe Location
- Existing Contours (2018)
- Core J(1.2') — Core Designation & Remaining Silt (aquitard) Thickness
- 0.12 — Dry Wt. - mg/kg
- ENR-UL - 1.23 mg/kg
- Exceeds or Likely Exceeds ENR-UL
- 4' — Assumed Excavation Thickness
- Buildings to Remove
- NA — Not Available

Mercury Dry Wt. Concentrations

- < - 0.59 mg/kg
- > - 0.59 to 1.0 mg/kg
- > - 1.0 to 4.0 mg/kg
- > - 4.0 mg/kg

0 40 Scale in Feet

ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

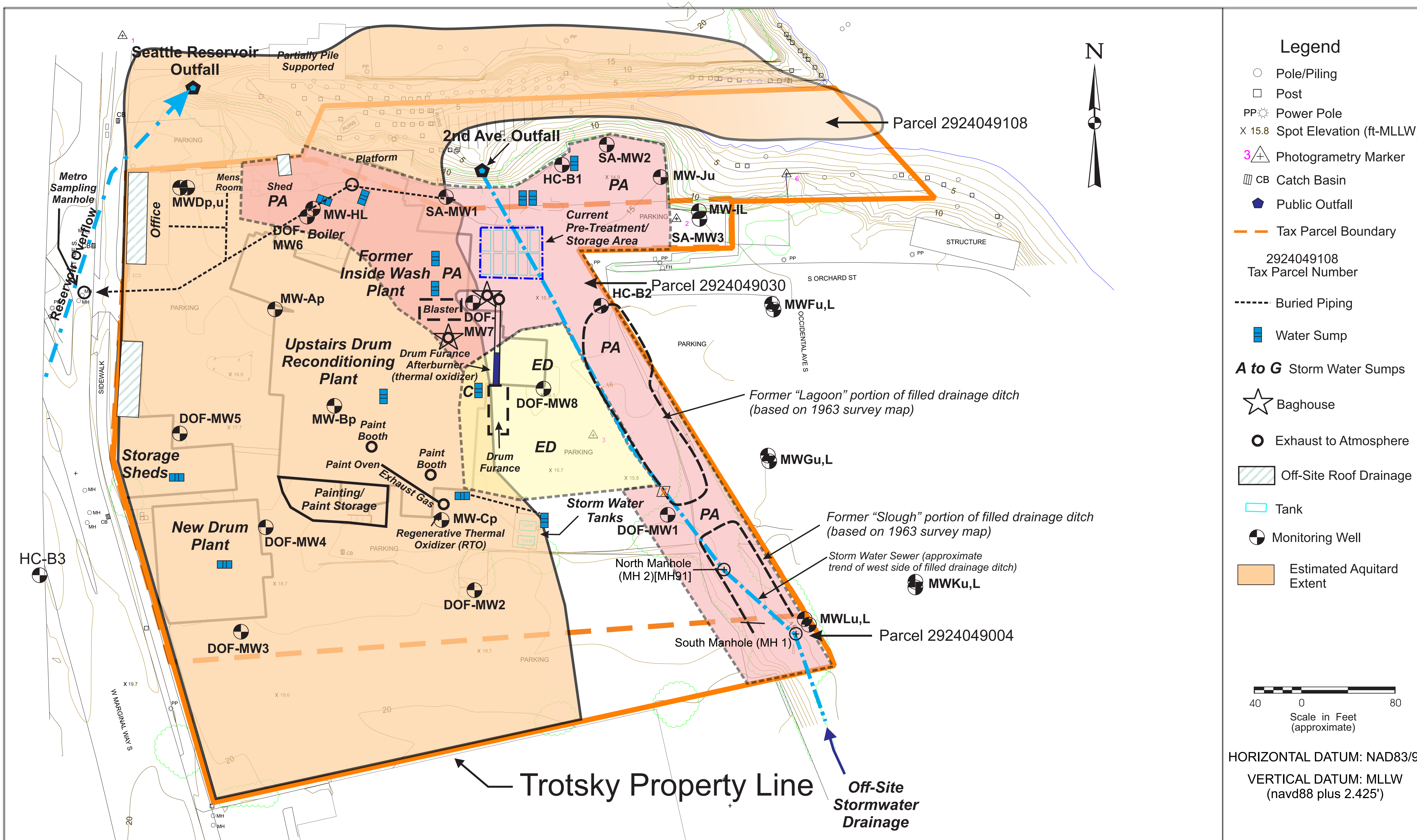
Mercury Concentrations Two to Five Foot Removal Surface

DOF DALTON OLMSTED FUGLEVAND

FIGURE 7-4d

SUM-008-03FS 10/25/2022

PLOT TIME: 6/11/2021 1:14 PM MOD TIME: 6/11/2021 1:13 PM USER: Lee Barras DWG: P:\ICS-NW Cooperage\Figures\2021-06\Sediment Sample Locations\2021-06-11 ICS Sediment Sample Locs.dwg



Notes:
1) Property Survey by Continental Survey Co. (12-15-09)
2) Topography by David C. Smith Associates (Flown 3-18-10)
3) Buried pipe, Metro sampling points, and sump locations have not been surveyed
4) All sump connections are above ground except near stormwater tanks

Ref: ICS Upland Remedial Areas FS 4-29-22.cdr

Upland Remedial (Focus) Areas

- **PA** Peripheral Area
- **ED** East Drum Plant Area

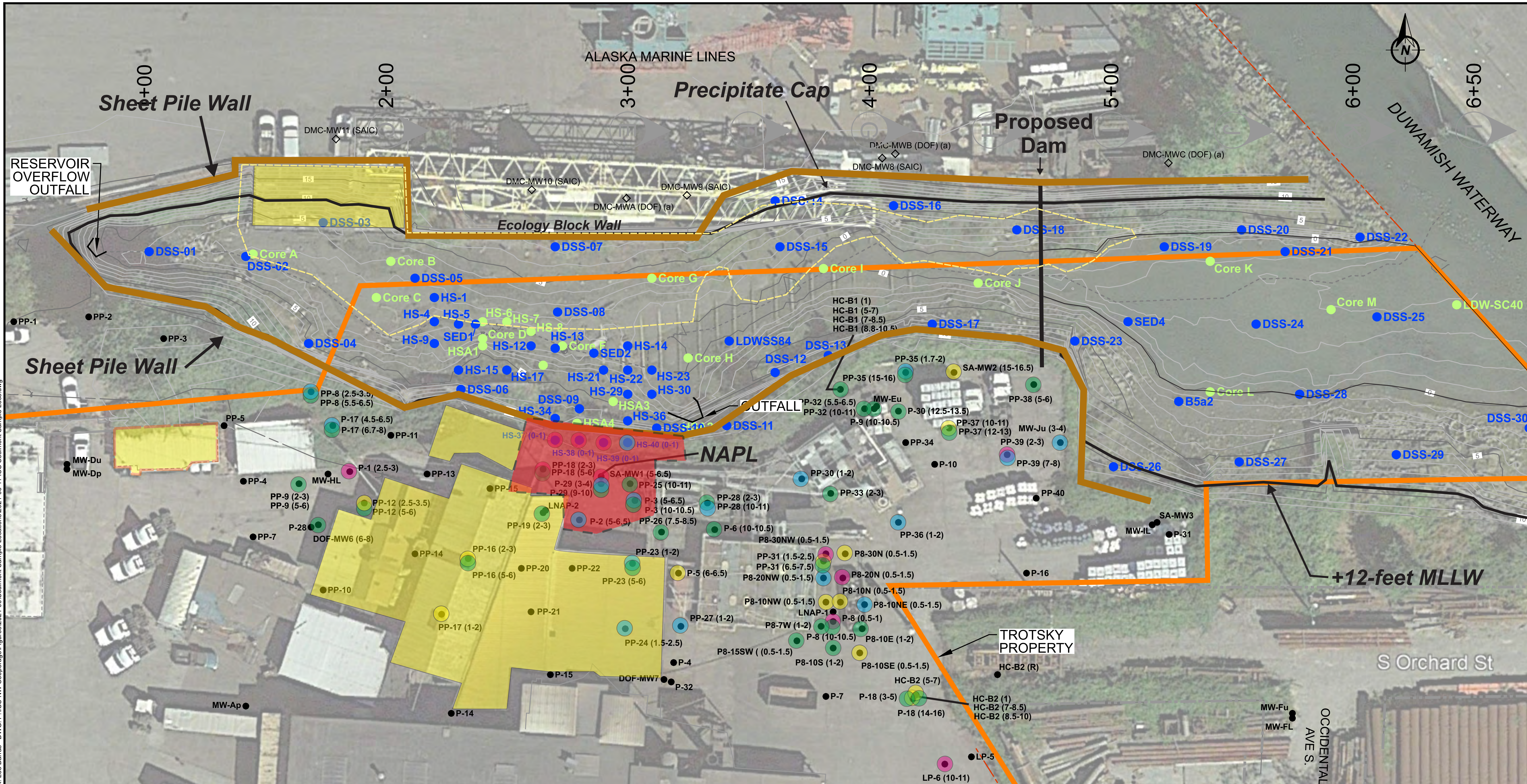
ICS/NW Cooperage Site

Upland Remedial (Focus) Areas

SUM-008 (ICS) *April. 2022*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 8-1



USER: Lee Barras DWG: P:\ICS-NW Cooperage\Figures\2021-06\Sediment Sample Locations\2021-06-11 ICS Sediment Sample Locs.dwg

LEGEND

- DSS-26 Surface Sediment Sample Location
- Core J Sediment Core Location
- DMC-MW10 Well Location
- P-7 Push-Probe Location
- Existing Contours (2018)

- Buildings to Remove
- Vertical Containment
- Location - Soil Sample PCB >50 ppm (mg/kg)/Depth (ft)
- Location - Soil Sample PCB >20 to 50 ppm (mg/kg)/Depth (ft)
- Location - Soil Sample PCB >10 to 20 ppm (mg/kg)/Depth (ft)
- Location - Soil Sample PCB >1 to 10 ppm (mg/kg)/Depth (ft)

0 40
Scale in Feet

PLOT TIME:

Upland Alternatives 11-16-22

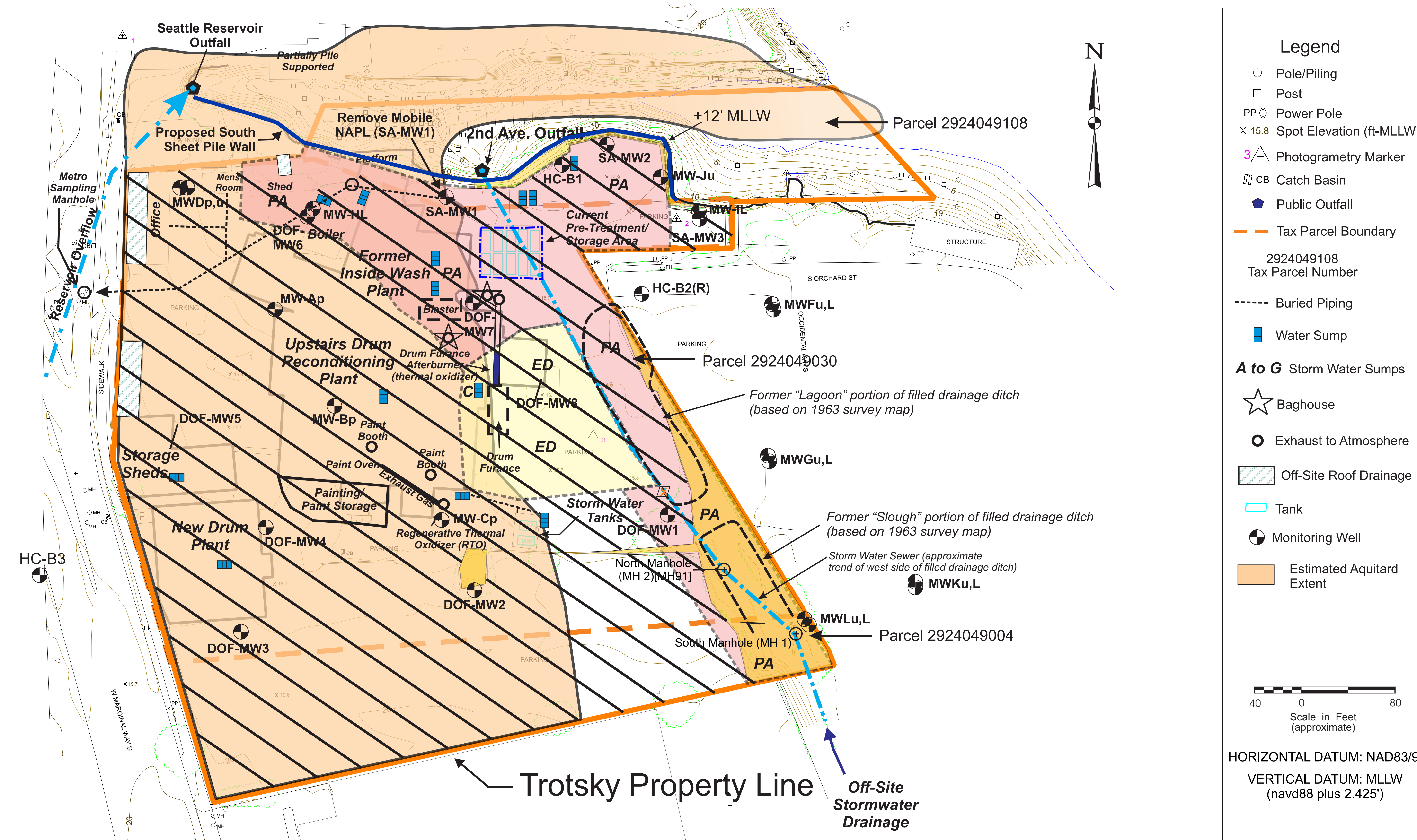
ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

Upland Alternative 1
Containment

DOF DALTON OLMSTED FUGLEVAND

FIGURE
9-1a

SUM-008-03FS 11/16/2022



Upland Remedial (Focus) Areas

- PA Peripheral Area
- ED East Drum Plant Area

Remedial Cover

- Maintain Existing Cover (Buildings and Paving)
- Pave Unpaved Area

Ref: ICS Upland Alternatives 11-16-22 .cdr

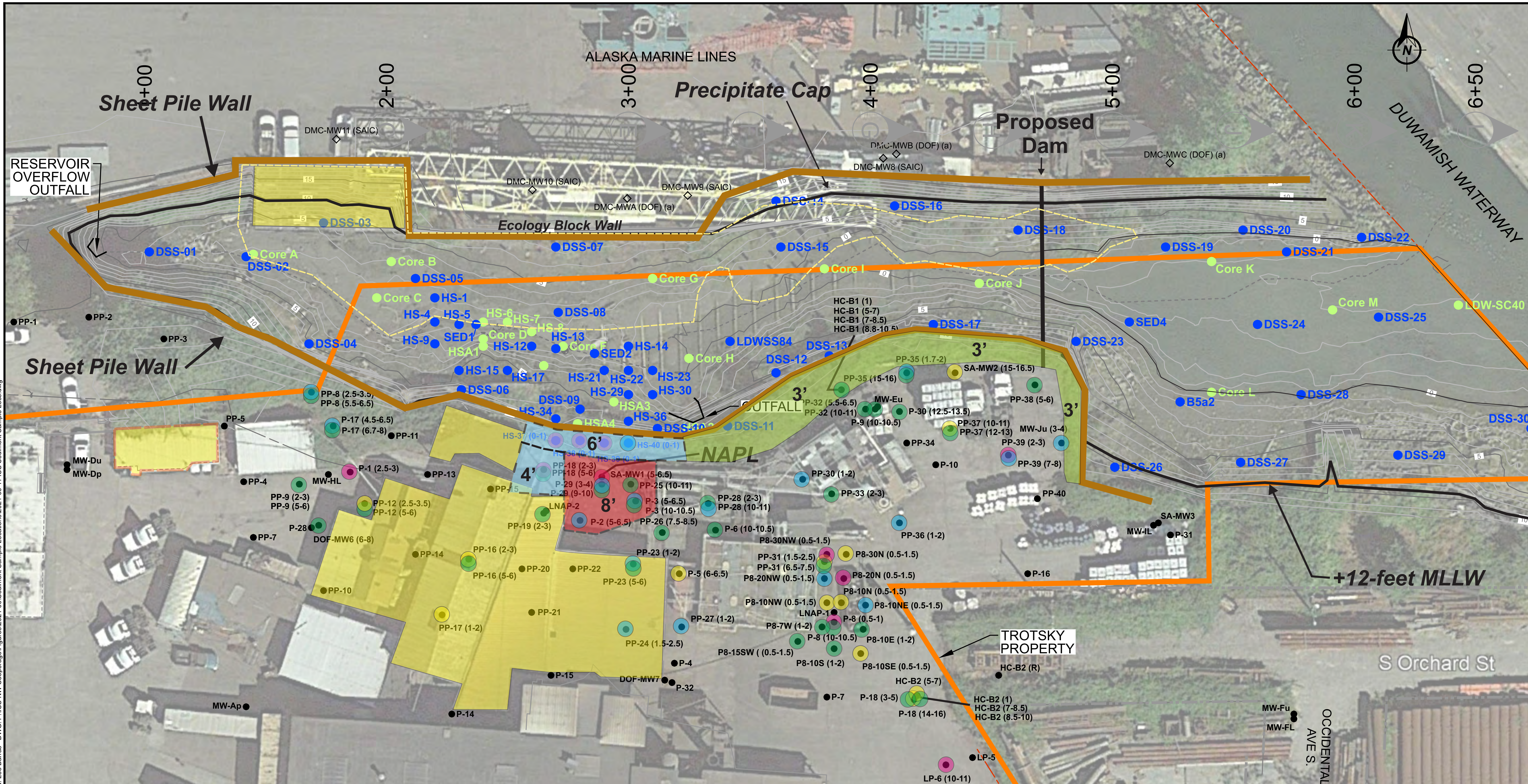
ICS/NW Cooperage Site

Upland Alternative No. 1 Cover

SUM-008 (ICS) *Nov. 2022*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 9-1b



LEGEND

- DSS-26 Surface Sediment Sample Location
- Core J Sediment Core Location
- DMC-MW10 Well Location
- P-7 Push-Probe Location
- Existing Contours (2018)
- Buildings to Remove
- 8' Excavate 8'
- Excavate 4'-6'
- Excavate 3'
- Location - Soil Sample PCB >50 ppm (mg/kg)/Depth (ft)
- Location - Soil Sample PCB >20 to 50 ppm (mg/kg)/Depth (ft)
- Location - Soil Sample PCB >10 to 20 ppm (mg/kg)/Depth (ft)
- Location - Soil Sample PCB >1 to 10 ppm (mg/kg)/Depth (ft)

Upland Alternatives 11-16-22

ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

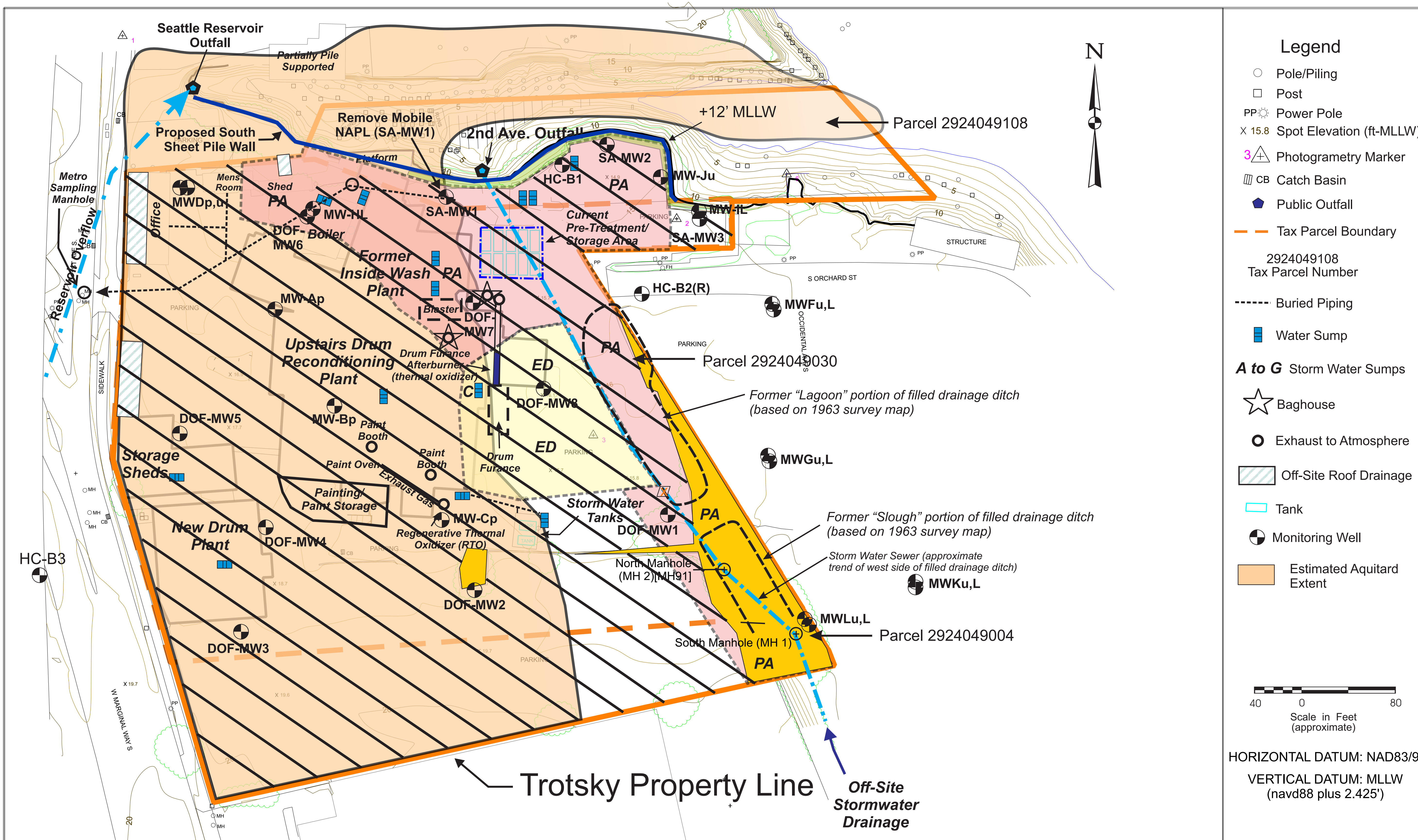
Upland Alternative 2 Removal

DOF DALTON OLMSTED FUGLEVAND

FIGURE
9-2a

SUM-008-03FS 11/16/2022

USER: Lee Barras DWG: P:\ICS-NW Cooperage\Figures\2021-06\Sediment Sample Locations\2021-06-11 ICS Sediment Sample Locs.dwg PLOT TIME:



Upland Remedial (Focus) Areas

PA Peripheral Area

ED East Drum Plant Area

Remedial Cover

Maintain Existing Cover (Buildings and Paving)

Pave Unpaved Area

Soil Backfill w/ vegetation planting

Ref: ICS Upland Alternatives 11-16-22 .cdr

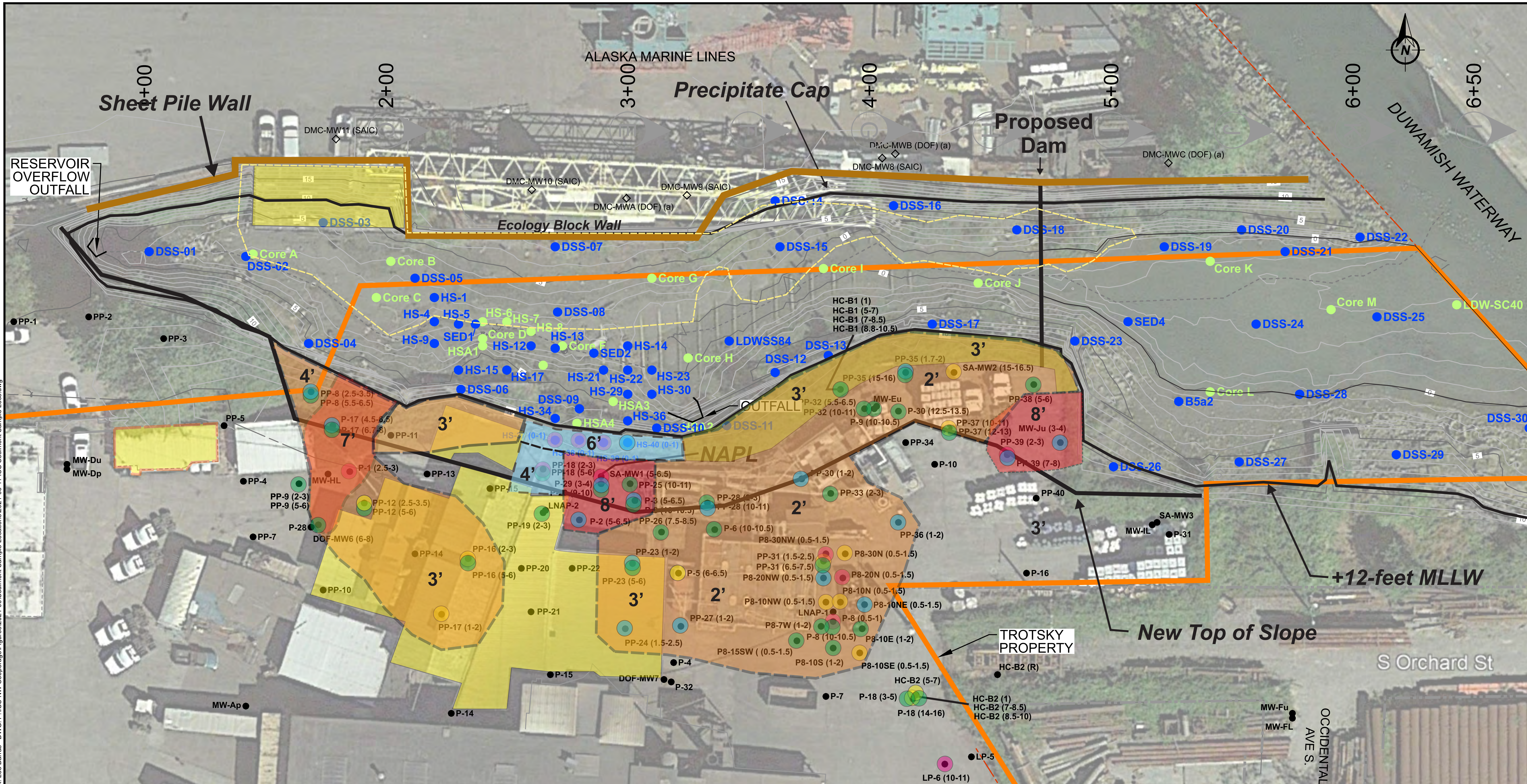
ICS/NW Cooperage Site

Upland Alternative No. 2 Cover

SUM-008 (ICS) *Nov. 2022*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 9-2b



LEGEND

DSS-26 Surface Sediment Sample Location

Core J Sediment Core Location

DMC-MW10 Well Location

P-7 Push-Probe Location

Existing Contours (2018)

Buildings to Remove

8' Assumed Excavation Depth (feet)

Location - Soil Sample PCB >50 ppm (mg/kg)/Depth (ft)

Location - Soil Sample PCB >20 to 50 ppm (mg/kg)/Depth (ft)

Location - Soil Sample PCB >10 to 20 ppm (mg/kg)/Depth (ft)

Location - Soil Sample PCB >1 to 10 ppm (mg/kg)/Depth (ft)

0 40
Scale in Feet

Upland Alternatives 11-16-22

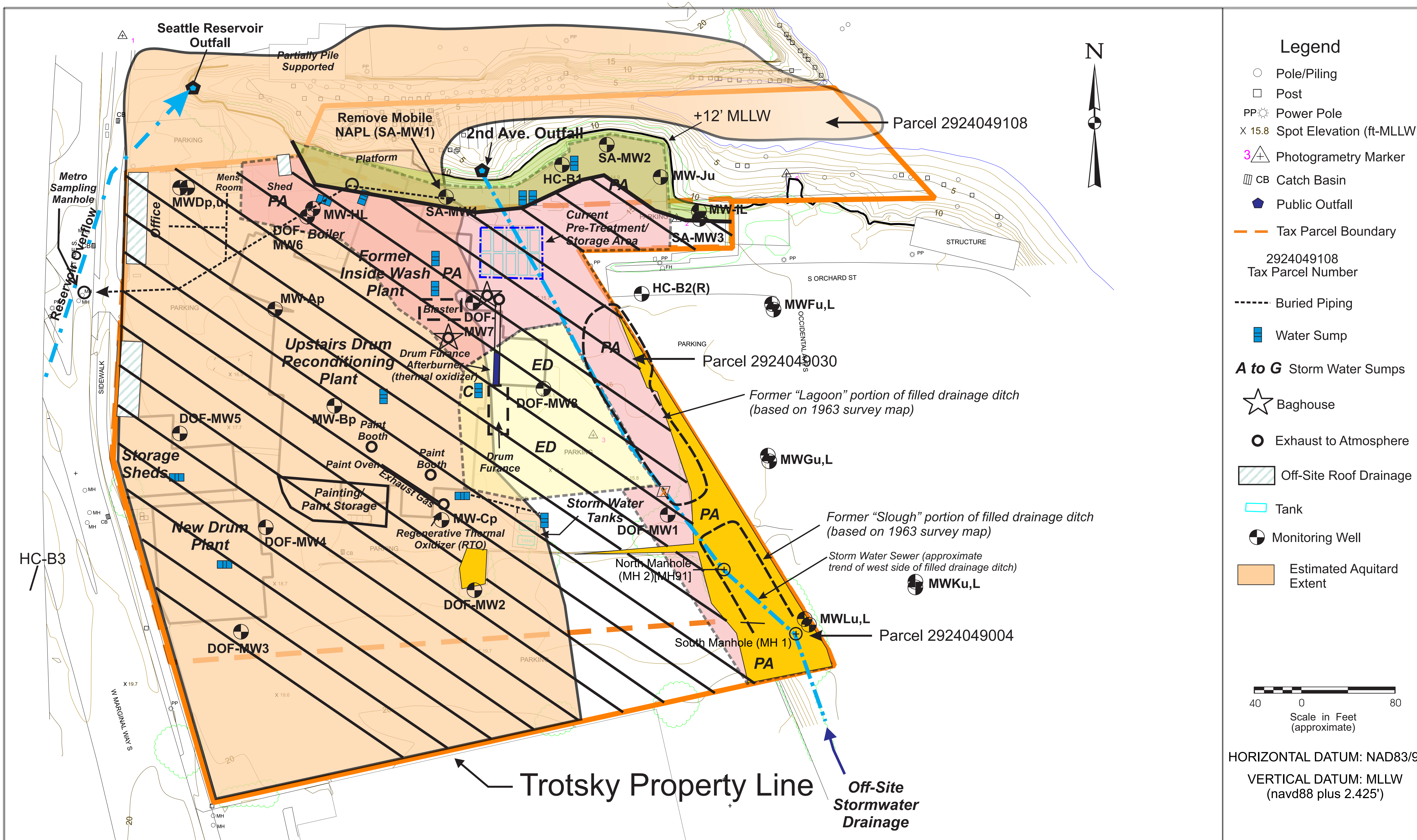
ICS/NW Cooperage Site
Seattle, Washington
Feasibility Study

Upland Alternative 3 Removal

DOF DALTON OLMSTED FUGLEVAND

FIGURE
9-3a

SUM-008-03FS 11/16/2022



Upland Remedial (Focus) Areas

- PA Peripheral Area
- ED East Drum Plant Area

Remedial Cover

- Maintain Existing Cover (Buildings and Paving)
- Pave Unpaved Area
- Soil Backfill w/ Riparian Planting

Ref: ICS Upland Alternative 11-16-22.cdr

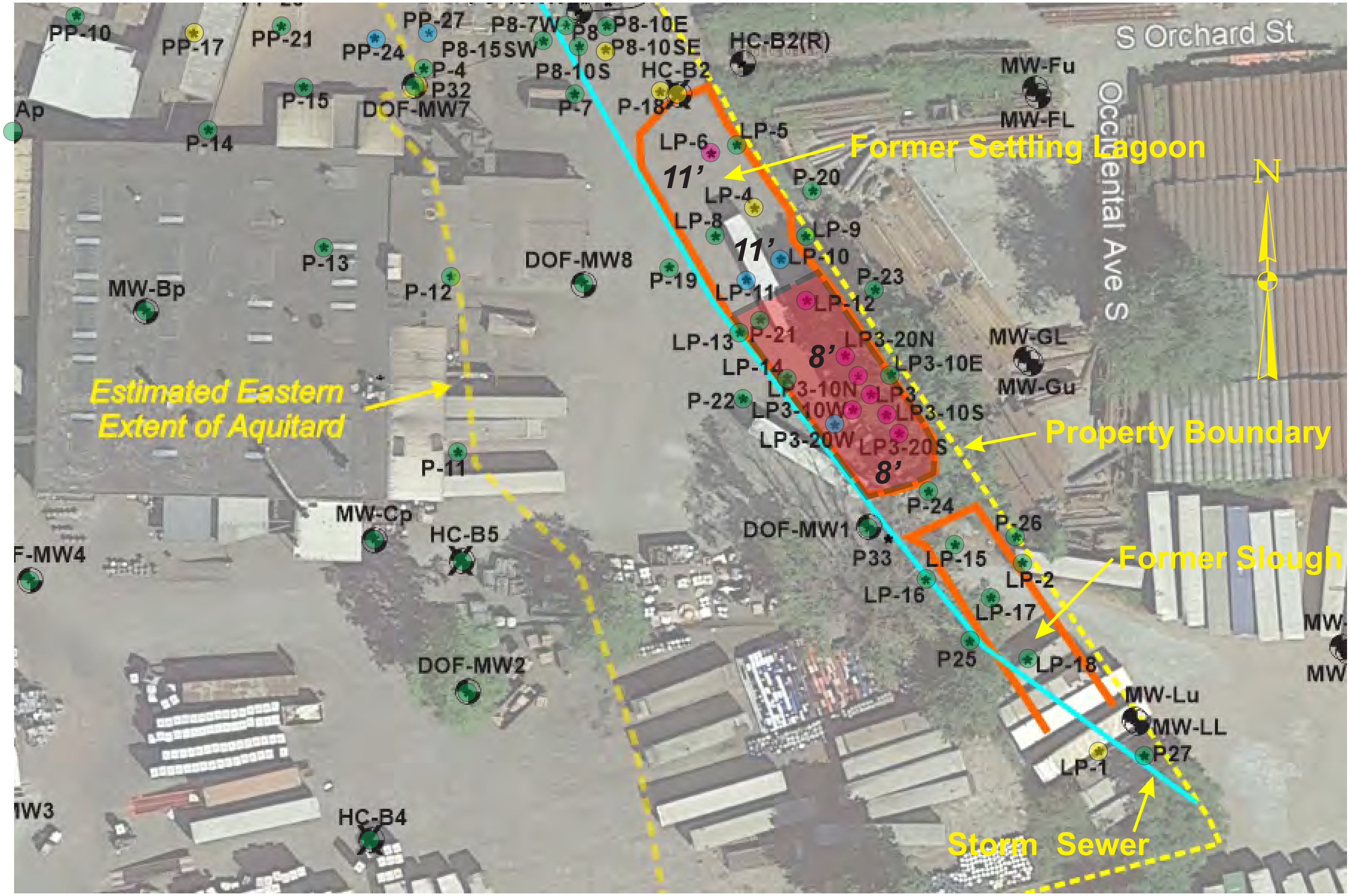
ICS/NW Cooperage Site

Upland Alternative No. 3 Cover

SUM-008 (ICS) *Nov. 2022*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 9-3b



Location - Soil Sample >50 ppm (mg/kg)
Location - Soil Sample >20 to 50 ppm (mg/kg)
Location - Soil Sample >10 to 20 ppm (mg/kg)
Location - Soil Sample >1 to 10 ppm (mg/kg)
8' Assumed Excavation Depth (feet)

Monitoring Well
Monitoring Well (abandoned)
* Push-Probe

30 0 60
Scale in Feet
(approximate)

ICS/NW Cooperage Site

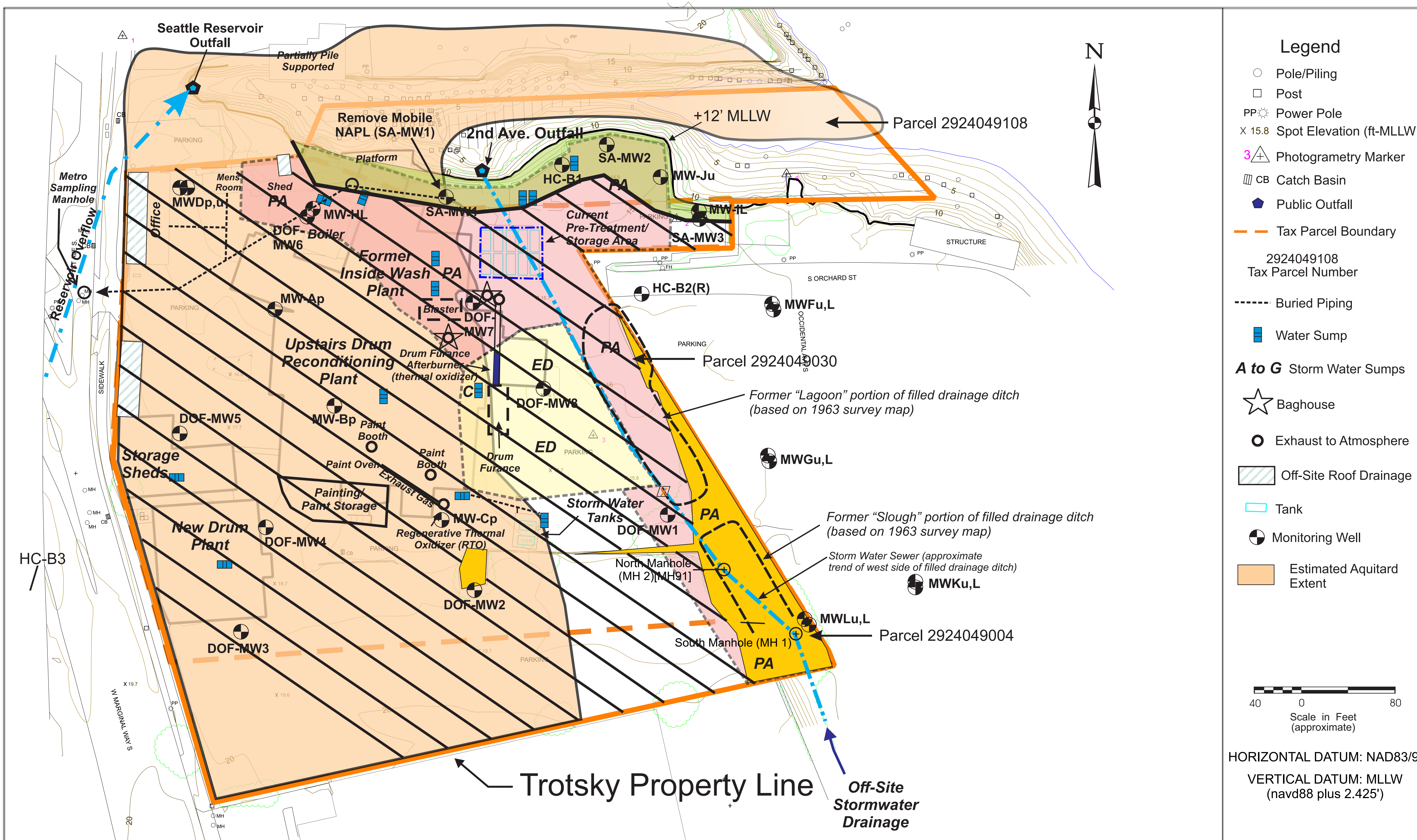
Upland Alternative 4
(Addition to Other Alternatives)

SUM-008 (ICS) *Oct. 2022*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE
9-4a

Re: Upland Alternative 4.cdr



Upland Remedial (Focus) Areas

- PA Peripheral Area
- ED East Drum Plant Area

Remedial Cover

- Maintain Existing Cover (Buildings and Paving)
- Pave Unpaved Area
- Soil Backfill w/ Riparian Planting

Ref: ICS Upland Alternative 11-16-22.cdr

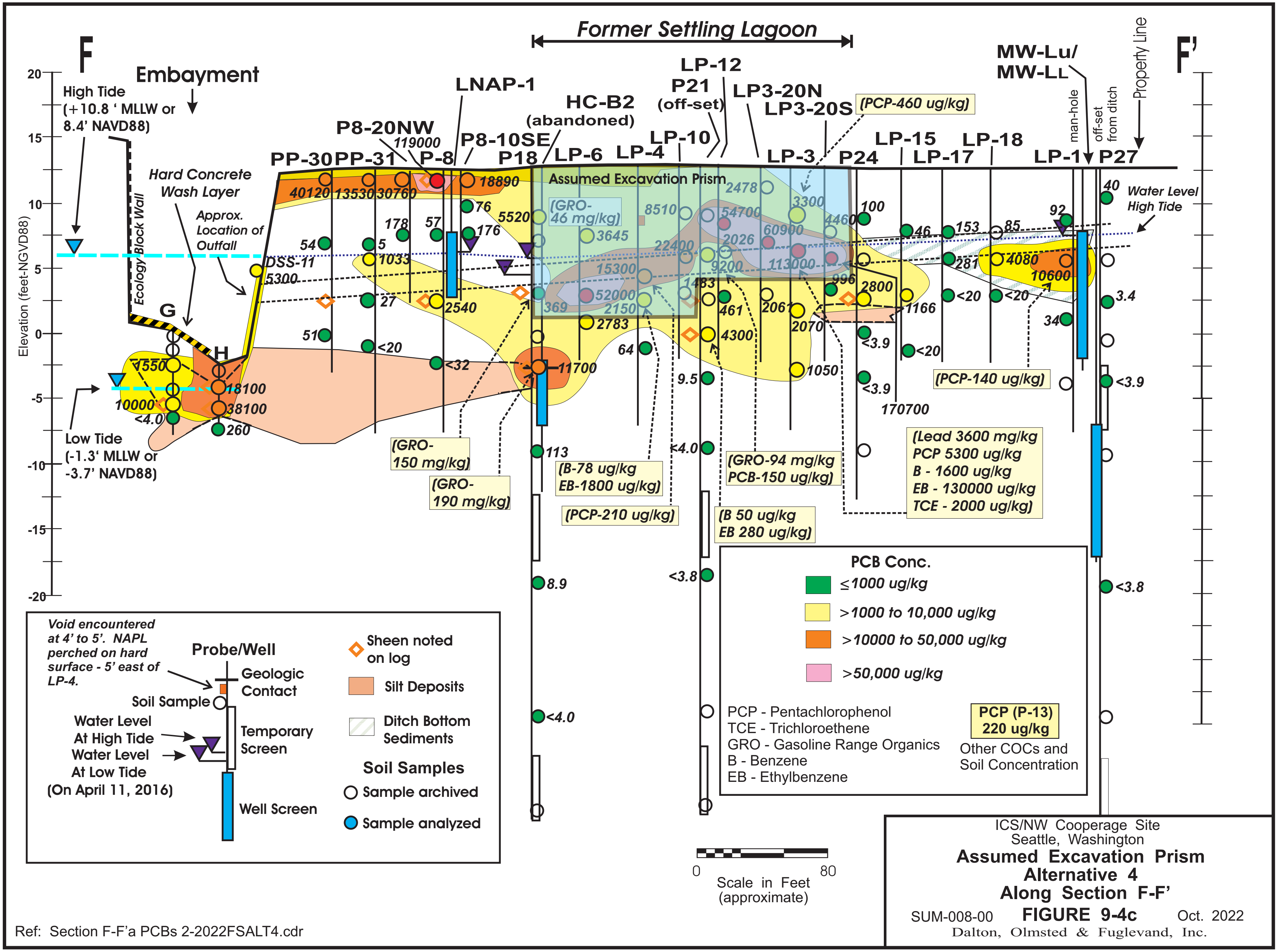
ICS/NW Cooperage Site

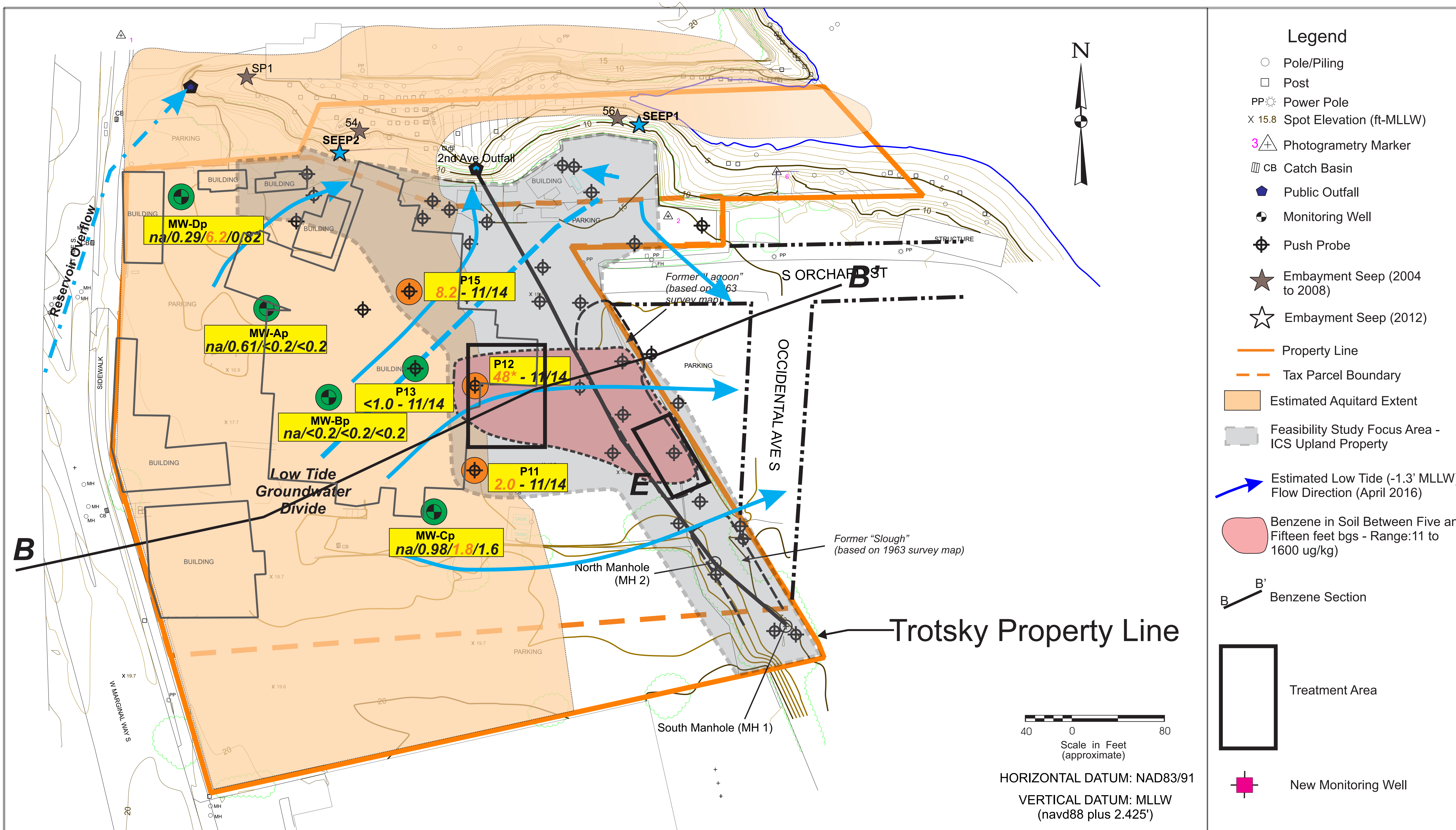
Upland Alternative No. 4 Cover

SUM-008 (ICS) *Nov. 2022*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 9-4b


Former Settling Lagoon
F
F'
Embayment
High Tide
(+10.8 ' MLLW or
8.4' NAVD88)
Low Tide
(-1.3' MLLW or
-3.7' NAVD88)
Elevation (feet-NGVD88)
Ecology Block Wall
Hard Concrete
Wash Layer
Approx.
Location of
Outfall
DSS-11
5300
G
H
Property Line
man-hole
off-set
from ditch
Water Level
High Tide
MW-Lu/
MW-LL
LNAP-1
HC-B2
(abandoned)
LP-12
P21
(off-set)
LP3-20N
LP3-20S
P8-20NW
PP-30
PP-31
P-8
P8-10SE
P18
LP-6
LP-4
LP-10
LP-3
P24
LP-15
LP-17
LP-18
LP-1
P27
Assumed Excavation Prism
(PCP-460 ug/kg)
(GRO-
46 mg/kg)
(GRO-
150 mg/kg)
(GRO-
190 mg/kg)
(B-78 ug/kg
EB-1800 ug/kg)
(PCP-210 ug/kg)
(GRO-94 mg/kg
PCB-150 ug/kg)
(B 50 ug/kg
EB 280 ug/kg)
(PCP-140 ug/kg)
(Lead 3600 mg/kg
PCP 5300 ug/kg
B - 1600 ug/kg
EB - 130000 ug/kg
TCE - 2000 ug/kg)
PCB Conc.
≤1000 ug/kg
>1000 to 10,000 ug/kg
>10000 to 50,000 ug/kg
>50,000 ug/kg
PCP - Pentachlorophenol
TCE - Trichloroethene
GRO - Gasoline Range Organics
B - Benzene
EB - Ethylbenzene
PCP (P-13)
220 ug/kg
Other COCs and
Soil Concentration
Void encountered
at 4' to 5'. NAPL
perched on hard
surface - 5' east of
LP-4.
Probe/Well
Geologic
Contact
Soil Sample
Water Level
At High Tide
Water Level
At Low Tide
(On April 11, 2016)
Temporary
Screen
Well Screen
Sheen noted
on log
Silt Deposits
Ditch Bottom
Sediments
Soil Samples
Sample archived
Sample analyzed
0
80
Scale in Feet
(approximate)
ICS/NW Cooperage Site
Seattle, Washington
Assumed Excavation Prism
Alternative 4
Along Section F-F'
SUM-008-00
FIGURE 9-4c
Oct. 2022
Dalton, Olmsted & Fuglevand, Inc.
Ref: Section F-F'a PCBs 2-2022FSALT4.cdr



Concentration ≤ Screening Level (SL= 1.6* ug/l)

Concentration > Screening Level (SL= 1.6* ug/l)

2.0/5.3/6.0/0.61 Concentration - ug/l (11-12/11-15/3-16/10-16)

na - Not Available; * Surface Water

Ref: Benzene GW Plot R1-R3revFS ED Area.cdr

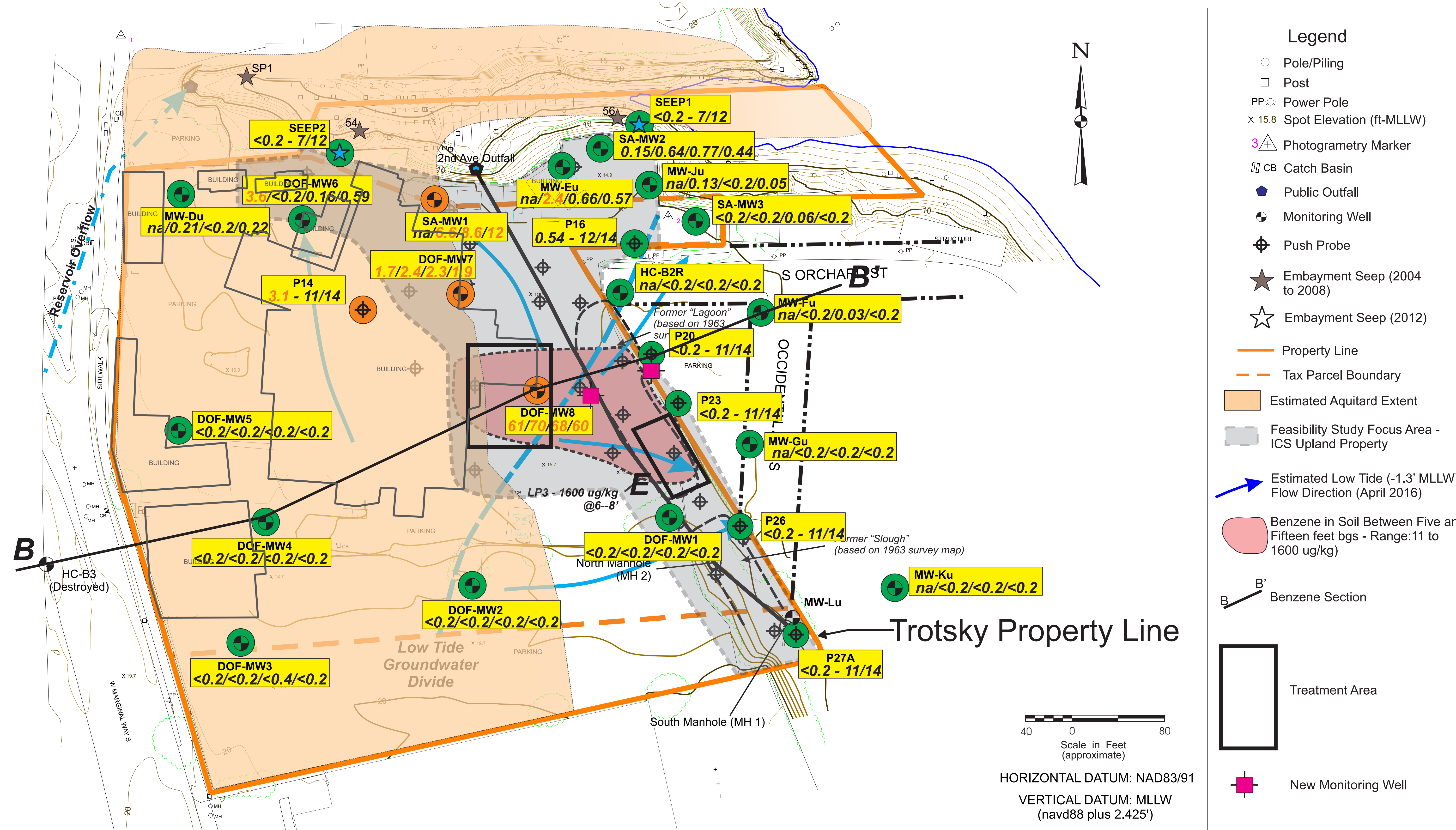
ICS/NW Cooperage Site

ED Area - Benzene Water Table Zone Above Aquitard

SUM-008-00 (ICS) ***Nov. 2022***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 9-5a



Concentration ≤ Screening Level (SL= 1.6* ug/l)

Concentration > Screening Level (SL= 1.6* ug/l)

2.0/5.3/6.0/0.61 Concentration - ug/l (11-12/11-15/3-16/9-16)

na - Not Available; * Surface Water

Ref: Benzene GW Plot R1-R3revFS ED Area.cdr

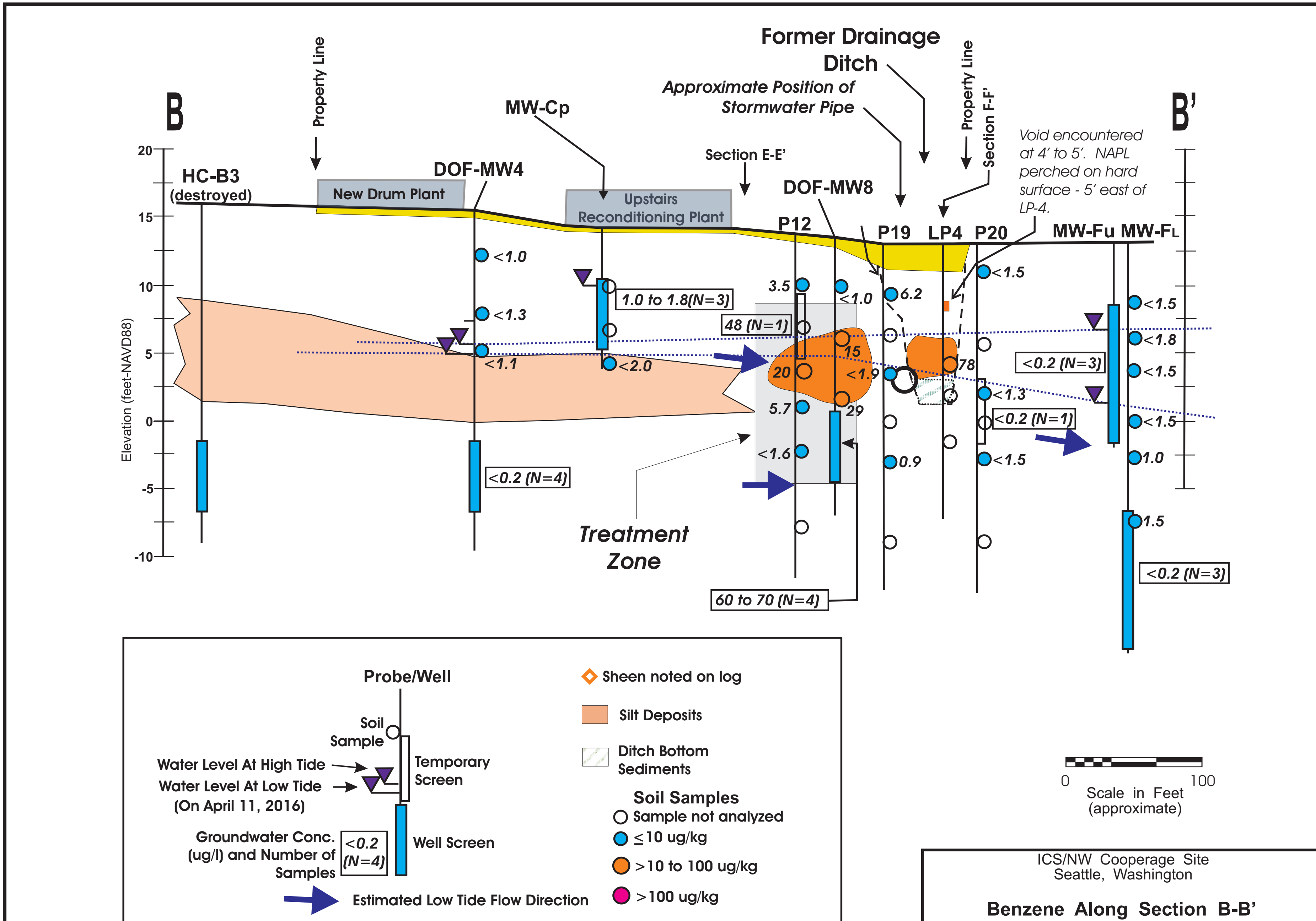
ICS/NW Cooperage Site

ED Area - Benzene Concentrations - Upper Zone

SUM-008-00 (ICS) ***Oct. 2022***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 9-5b



ICS/NW Cooperage Site
Seattle, Washington

Benzene Along Section B-B'

SUM-008-00 **FIGURE 9-5c** Oct. 2022

Dalton, Olmsted & Fuglevand, Inc.

Ref: Ben section B-B'7-2016FS Area ED.cdr

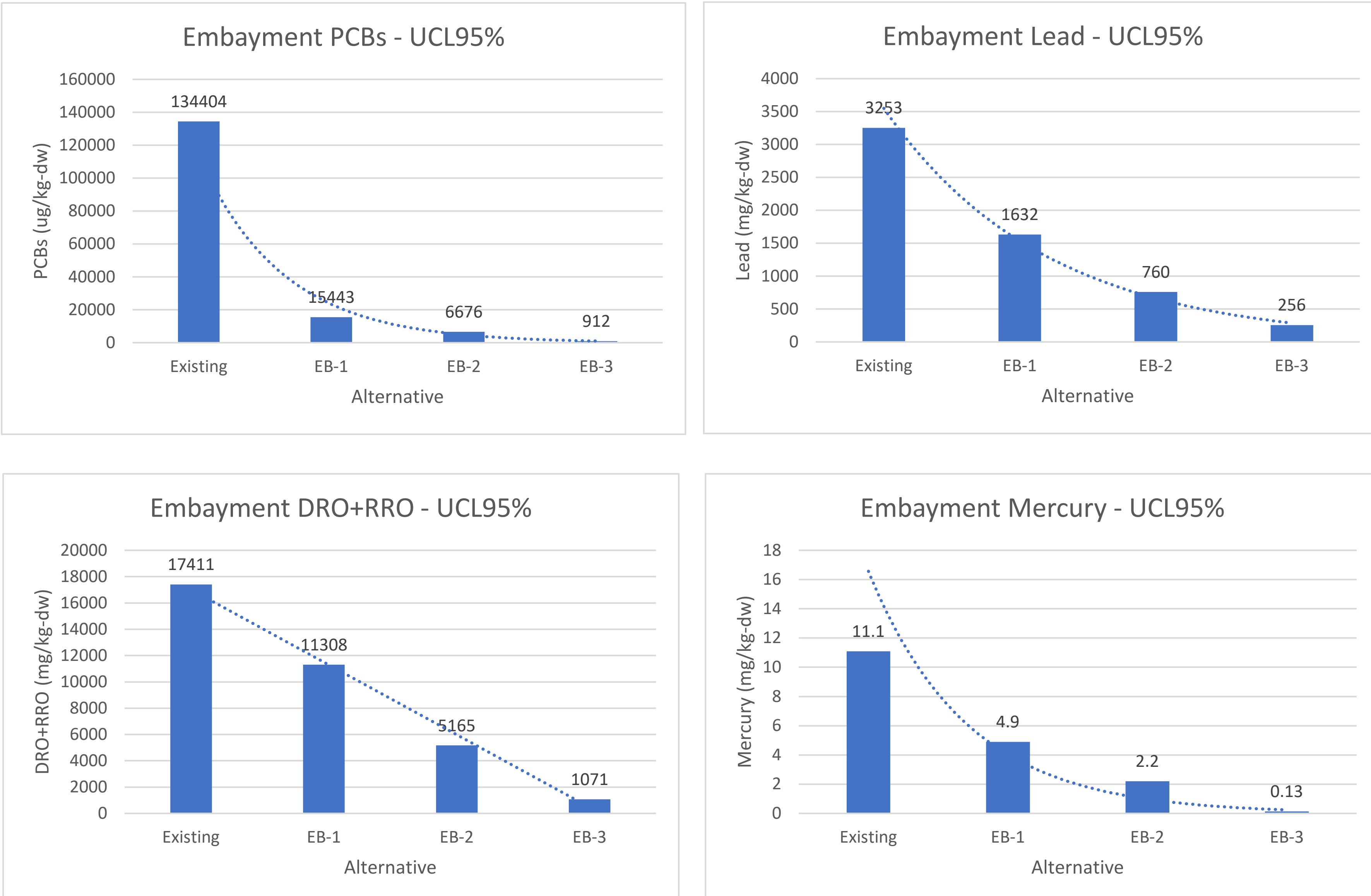
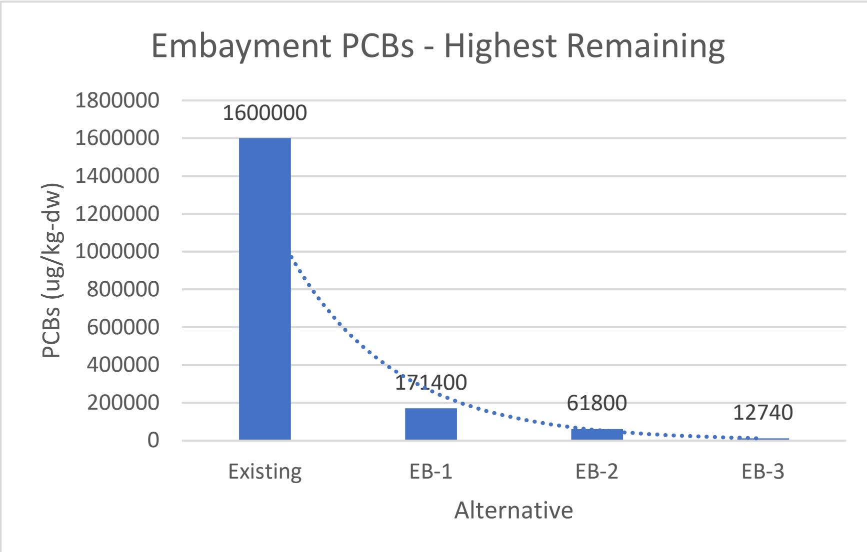
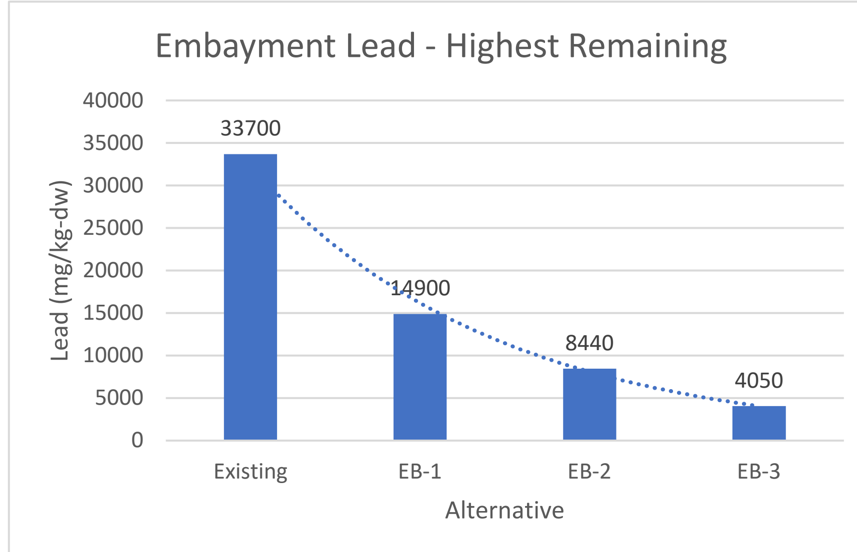
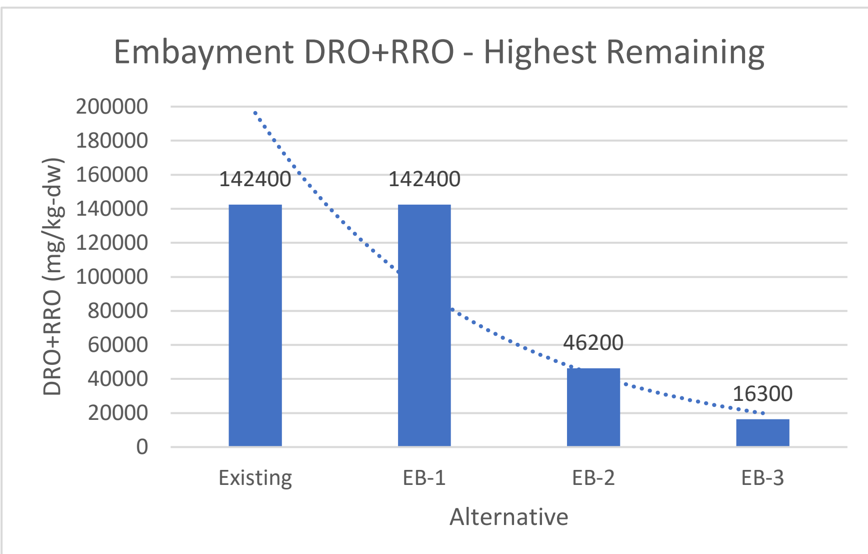


FIGURE 10-1a - Embayment Concentration Declines







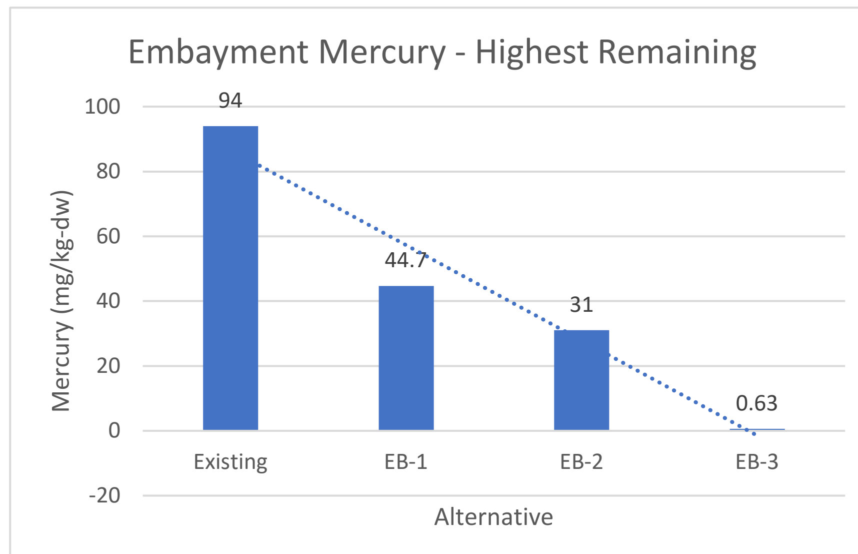
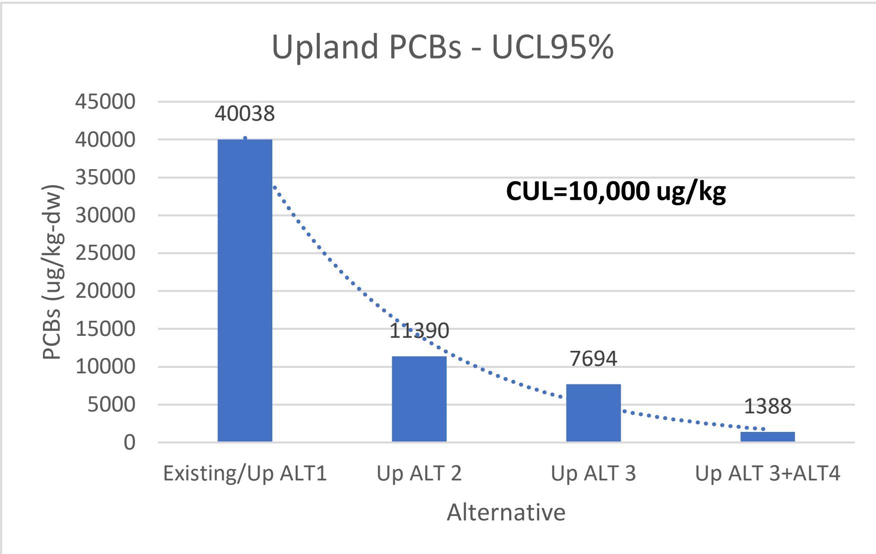
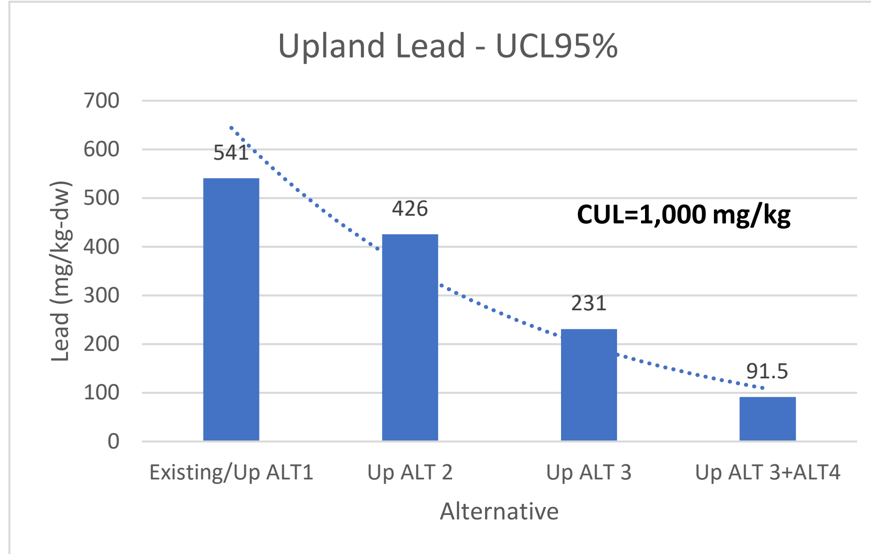
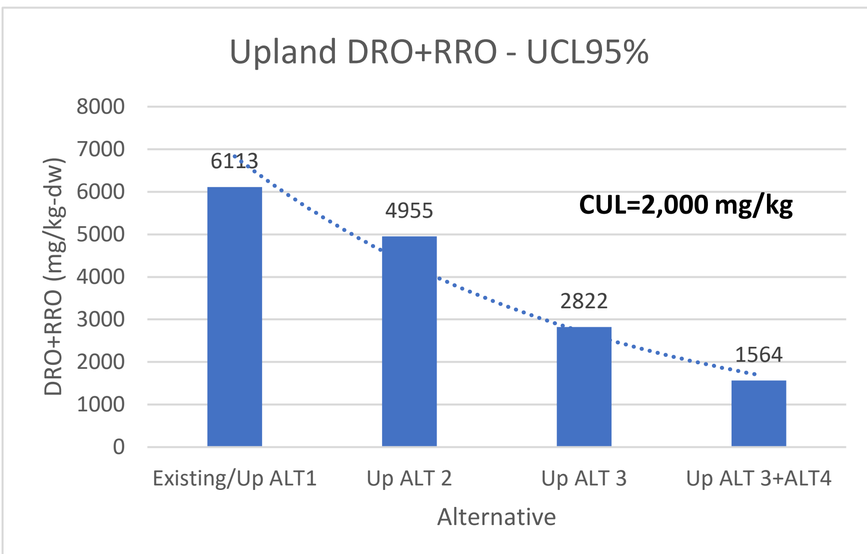


Figure 10-1b - Embayment Decline in Highest Concentrations







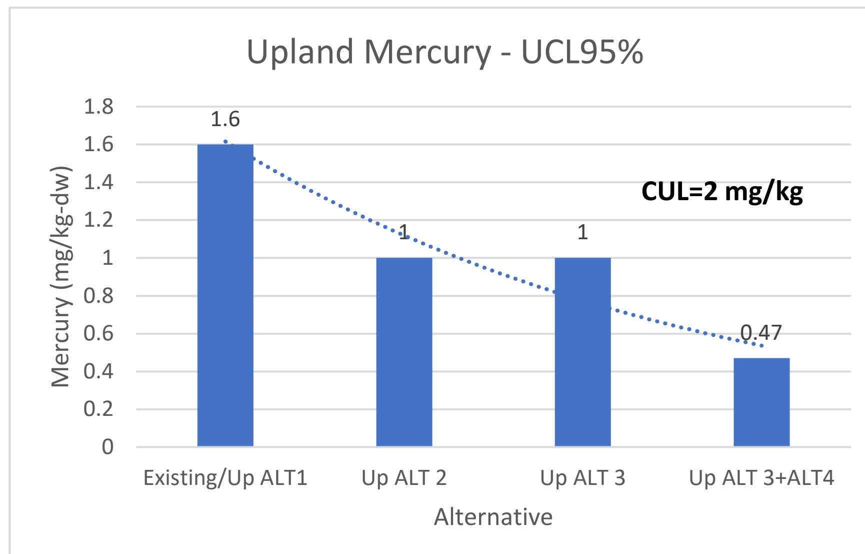
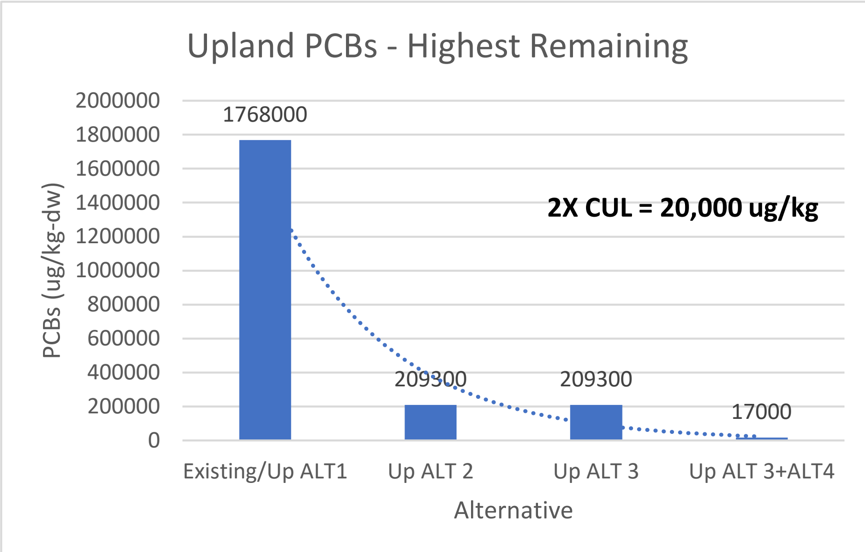
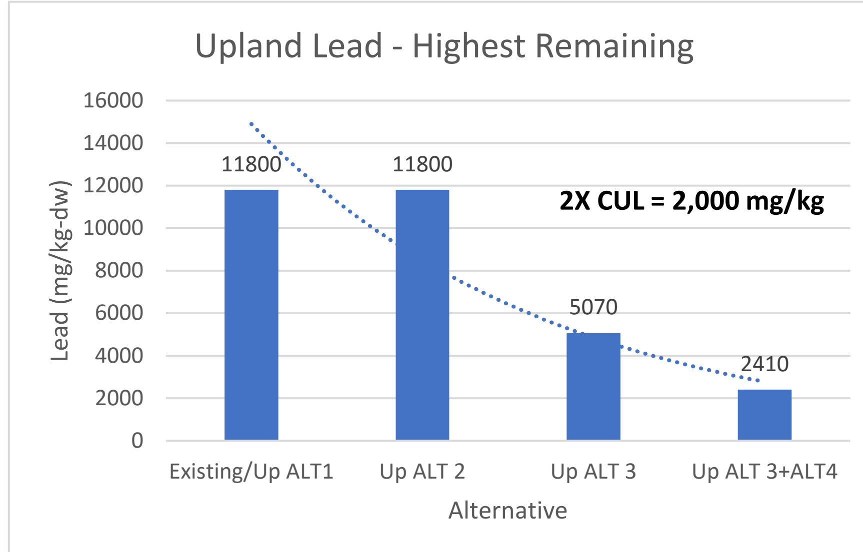
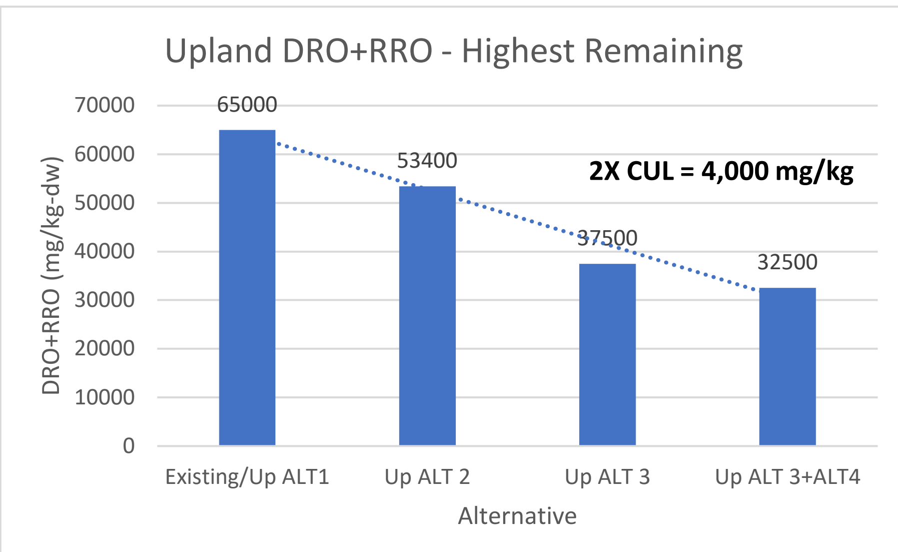


FIGURE 10-2a - Upland Concentration Declines







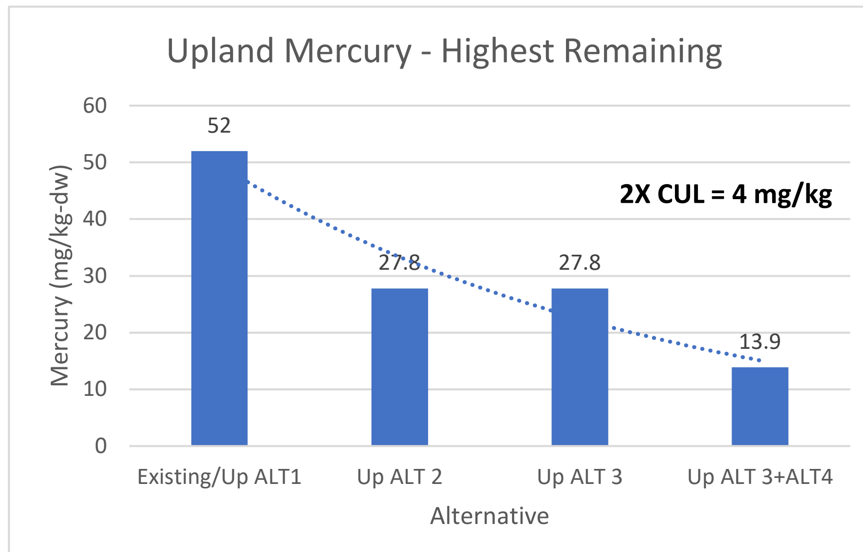


FIGURE 10-2b - Upland Highest Concentrations

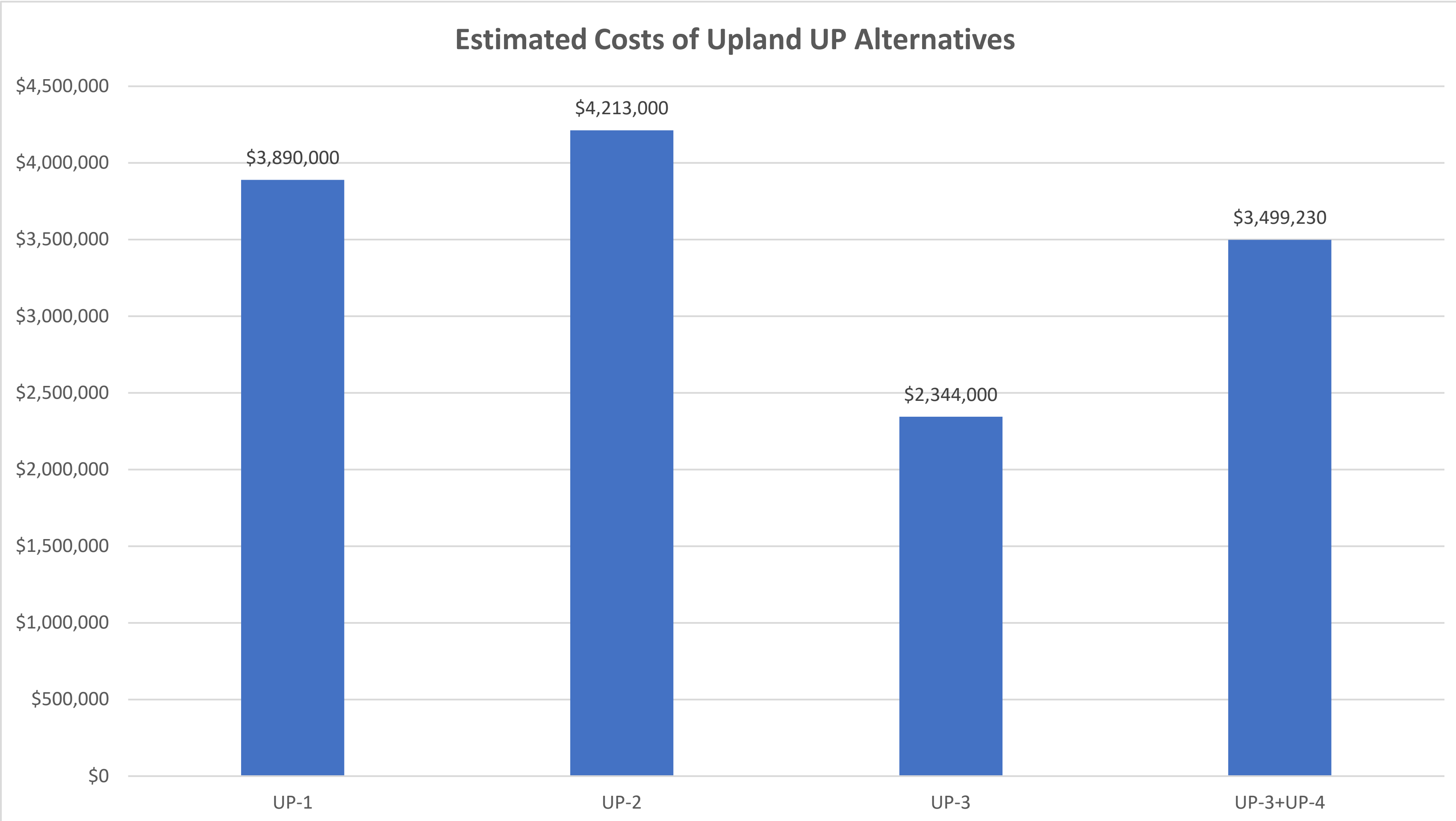


Figure 10-3a - Upland Costs UP Alternatives

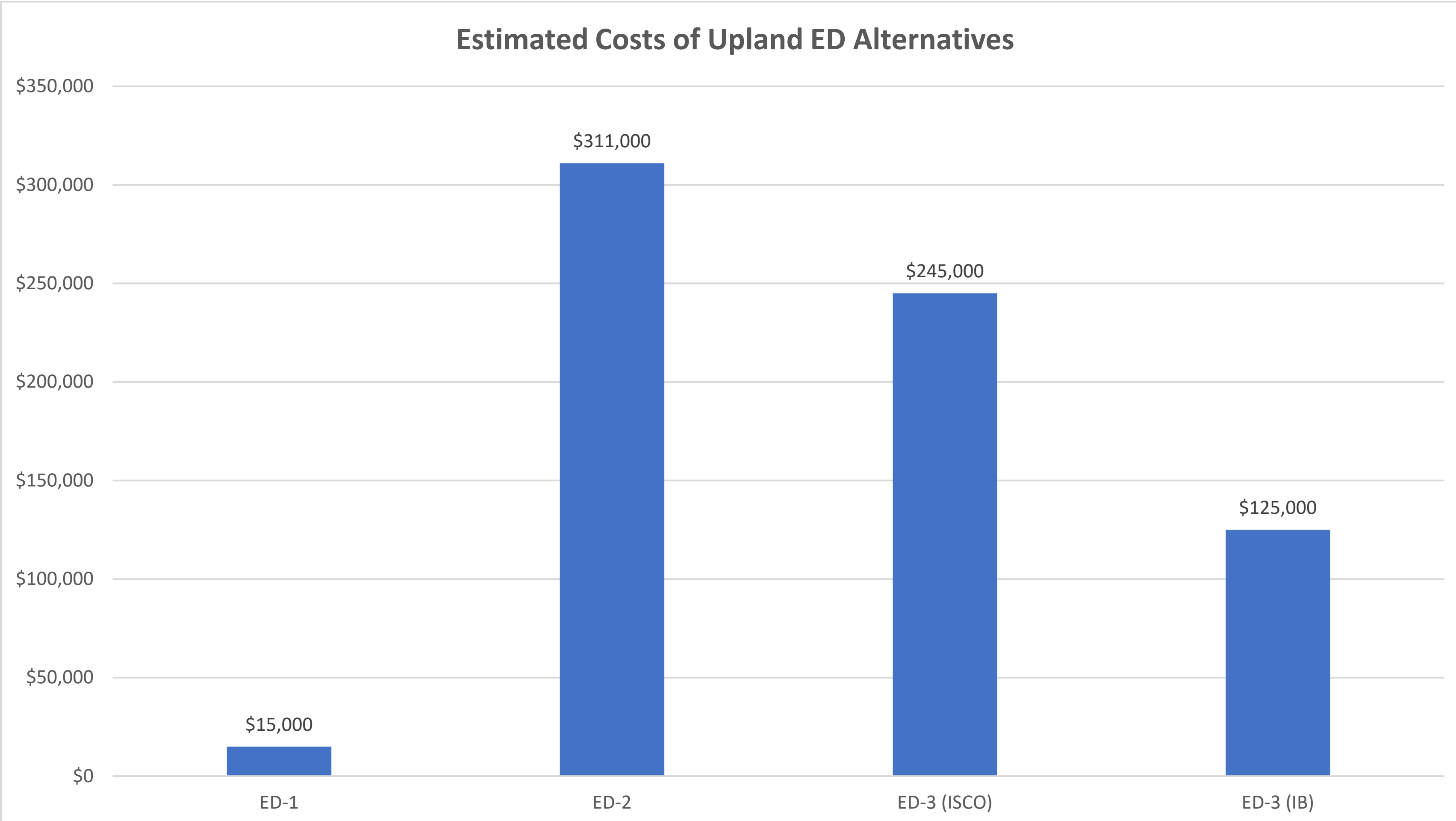


Figure 10-3b - Upland Costs - ED Alternatives