

Prepared by:
Dredged Material Management Office
Seattle District, US Army Corps of Engineers

Memorandum for Record

October 19, 2023

**Subject: Characterization of the Post-Dredge Sediment Surface at the Port of Seattle Terminal 5
Following Overdredging During Berth Deepening (NWS-2015-0269-WRD).**

Introduction

This memorandum documents the results of sediment characterization conducted for the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington Departments of Ecology and Natural Resources, and the U.S. Environmental Protection Agency) to assess post-dredge conditions at the Port of Seattle Terminal 5 and determine compliance with the State of Washington Anti-degradation standard.

Project Summary

Waterbody	West Waterway, Elliott Bay
Project rank	High
Overdredge volume (cy)	2,730 CY
DMMO tracking number	POST51AO453
EIM Study ID	POST523
USACE Regulatory Reference Number	NWS-2015-0269-WRD
Sampling and Analysis Plan (SAP) Approval Date	April 2023
Sampling Date(s)	April 19 and 21, 2023
Testing Parameters	DMMP standard marine COCs, TBT and dioxins/furans
Antidegradation Outcome	Placement of clean sand cover required throughout project DMMUs 1-5 and 7 to restore project to authorized depth of -58 ft MLLW or a minimum of 12 inches, whichever is greater.

Initial DMMP characterization of the Terminal 5 berth deepening project occurred in 2014, followed by a second characterization in 2020 to extend the recency and add two additional areas. The results of the second characterization were documented in two suitability determinations, DMMP 2020, and DMMP 2021a. The initial characterization evaluated dredged material to a depth of -58 ft MLLW.

DMMP 2021a described a patchwork of suitable and unsuitable DMMUs in the southern portion of Terminal 5. Both vertical and horizontal buffers were applied between unsuitable and suitable DMMUs to ensure that all unsuitable material was taken upland.

The dredging and disposal work plan (Orion, 2022) called for dredging to -55 ft MLLW plus one foot of overdredge, to a total dredge depth of -56 ft MLLW throughout the project area and included the appropriate boundaries between suitable and unsuitable DMMUs.

Deepening of Terminal 5 occurred over two dredge seasons. The northern portion of Terminal 5 (Phase 1) was dredged between January 18, 2022 and February 15, 2022, with 11,726 CY of material disposed at the Elliott Bay disposal site. The second dredge season included deepening dredging in the southern Phase 2 portion of the terminal (DMMUs 1-4) and additional high-spot dredging in the northern Phase 1

portion of the terminal (DMMUs 5-8). Dredging occurred between December 5, 2022 and February 15, 2023, with 24,781 CY of disposed at Elliott Bay.

The Port of Seattle notified the DMMP agencies on February 16, 2023 that overdredging deeper than -58 ft MLLW had occurred throughout the Terminal 5 berth area. They also described specific areas within DMMUs 2, 3, and 4 where oil sheen was visible on the water surface during dredging; dredged material from the sheen areas was disposed of upland. In response to DNR's Request for Information letter, the Port and Orion provided a response identifying the areas with dredging deeper than -58 ft MLLW and an explanation of the cause of overdredging.

The DMMP agencies reviewed the dredging and disposal records from the berth deepening and determined that the material from below -58 ft MLLW was uncharacterized. The DMMP agencies were concerned that there was no information about the quality of the overdredged material taken to the disposal site, nor information about the quality of leave surface in areas deeper than -58 ft MLLW. Additionally, a small amount of overdredge material from the unsuitable buffer area in DMMU 1 was taken to the Elliott Bay disposal site.

In response to the overdredge and concern about the quality of the leave surface and the quality of the overdredge material taken to the Elliott Bay disposal site, the DMMP agencies required the Port of Seattle to characterize conditions at the Terminal 5 berth. This memorandum documents the results of that sediment characterization effort.

Sampling and Analysis Description

Sample locations were chosen to be in specific areas based on the level of concern and dredging history in that area:

DMMU 1	Individual grab locations from within each of the four overdredge locations impinging on the DMMU 1 buffer area, analyzed individually.
DMMU 2	One individual grab sample from the single overdredge area and three grab samples composited for one analysis from the sheen area close to the berth face
DMMU 3/4	Three grab samples composited into one analysis from the sheen area close to the berth face
DMMU 4	Two grab samples from the overdredge areas composited for one analysis
DMMU 5	Two grab samples from the overdredge areas composited for one analysis
DMMU 6	Two grab samples from the overdredge areas composited for one analysis

Seventeen grab samples were collected from the Terminal 5 berth area by power grab sampler on April 19 and 21, 2023. Figures 1-6 show the target and actual sampling locations along with the post-dredge bathymetry and DMMU outlines. Table 1 gives sample location summary information. It should be noted that two of the actual grab locations from DMMU 1 were not within the overdredge area; one of two actual grabs from DMMU 5 was not within the overdredge area; one of two actual grabs from DMMU 7 was not within the overdredge area.

Samples were submitted to Analytical Resources, Inc (ARI) in Tukwila, Washington, for analysis. Analyses were performed by ARI and Am Test Inc. in Kirkland, Washington.

Data Validation

A data quality assurance/quality control review comparable to an EPA Stage 2A data validation was performed by Haley & Aldrich on all chemistry data and a review comparable to an EPA Stage 1 was performed on all conventionals data. Only minor issues were documented; no analytical results were rejected; and all data were considered usable, as qualified, by the data validator.

Analytical Testing Results

Analytical results are shown in Table 2. There were no detected or non-detected exceedances for metals in any of the samples. PCB Aroclors were detected in all samples at levels less than the DMMP SL, and less than the PCB levels seen in the unsuitable material from DMMU 3. There were no detected or non-detected exceedances of pesticides in any of the samples.

Benzyl alcohol was detected at estimated concentrations above the SL in all samples and above the ML for 5 locations (DMMU 1 S1, DMMU 1 S2, DMMU 1 S3, DMMU 1 S4, and DMMU 3/4 S1). Benzyl alcohol was detected in the method blank, and all 8270D-SIM results were J-flagged since detected concentration were more than 5 times the method blank concentration. Butyl benzyl phthalate was detected above the SL in DMMU 7.

TBT – Dry weight TBT analysis was conducted. TBT was detected in all samples and exceeded the DMMP BT in DMMU 5.

Dioxin – Dioxin/furan concentrations were detected in all samples, with total TEQ results exceeding the DMMP site management objective of 4 ppqr TEQ in all but two samples (DMMU 2-S2 and DMMU 7). Dioxin/furan concentrations exceeded the DMMP bioaccumulation trigger in two of four individual grab samples in DMMU 1 and in the DMMU 3/4 composite.

Discussion

Suitability Determination

2,730 CY of dredged material that was either unsuitable or uncharacterized was disposed at the Elliott Bay open-water disposal site. The results of the overdredge leave surface characterization described above indicated there was the potential for unsuitable material to have been disposed at the Elliott Bay site. Fortunately, DMMP monitoring of the Elliott Bay disposal site was triggered in February 2023 due to cumulative volume of material disposed since the last monitoring. Monitoring occurred in May 2023.

Preliminary monitoring results indicate that the Elliott Bay disposal site is meeting site monitoring objectives. Five onsite samples were collected and compared to DMMP screening levels. Three locations required bioassays, all of which passed DMMP bioassay interpretive guidelines. Benzyl alcohol was non-detect in all five benthic grab samples. Dioxin/furan concentrations were analyzed on a composite of 20 grabs from the disposal site. The onsite dioxin/furan concentration was 3.6 ppqr TEQ and 4.6 ppqr TEQ in the onsite duplicate. These results indicate that the dioxin concentrations on the Elliott Bay disposal site are within range of the site management objective of 4 ppqr TEQ and are all less than Ecology's PQL of 5 ppqr TEQ.

Based on these results, the DMMP agencies determined that no additional follow-up measures were needed at the Elliott Bay disposal site.

Antidegradation Determination

The sediment to be exposed by dredging must either meet the State of Washington Sediment Management Standards (SMS) or the State's Antidegradation Standard (Ecology, 2013) as outlined by DMMP guidance (DMMP, 2008). Concentrations of at least one DMMP chemical of concern were above DMMP SLs in all DMMUs tested:

Area	Exceedances and reason for cover
DMMU 1	Only two locations are representative of overdredge area (S1 & S3). Dioxin above 10 ppqr TEQ (S1) and benzyl alcohol above ML (both). Leave surface not in compliance.
DMMU 2	Dioxin above 4 ppqr TEQ and benzyl alcohol above SL. Leave surface not in compliance.
DMMU 3/4	Dioxin above 10 ppqr TEQ and benzyl alcohol above ML. Leave surface not in compliance.
DMMU 4	Dioxin above 4 ppqr TEQ and benzyl alcohol above SL. Leave surface not in compliance.
DMMU 5	Dioxin above 4 ppqr TEQ and benzyl alcohol above SL. TBT above BT. Leave surface not in compliance.
DMMU 7	Dioxin above 4 ppqr TEQ and benzyl alcohol above SL. Leave surface not in compliance.

Based on these findings, placement of sand cover to bring the overdredged areas back to the authorized depth of -58 ft MLLW or placement of 12 inches of clean sand, whichever is more, is required.

Notes and Clarifications

A pre-construction meeting with DNR, Ecology and the Corps of Engineers is required at least 7 days prior to placement of sand cover. A sand placement plan must be developed and submitted to the USACE Seattle District's Regulatory Branch and Ecology. Refer to the USACE permit and Ecology 401 certification for project-specific submittal requirements and timelines.

References

- DMMP, 2008. *Quality of Post-Dredge Sediment Surfaces (Updated)*. A Clarification Paper Prepared by David Fox (USACE), Erika Hoffman (EPA) and Tom Gries (Ecology) for the Dredged Material Management Program, June 2008.
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- DMMP, 2020. *Suitability Determination Memorandum for Phase One of the Port of Seattle Terminal 5 Project on the East Waterway in Seattle, Washington (NWS-2015-0269-WRD)*. Prepared by the DMMP Agencies. December 15, 2020.
- DMMP, 2021a. *Suitability Determination Memorandum for Phase 2 of the Port of Seattle Terminal 5 Project on the East Waterway in Seattle, Washington (NWS-2015-0269-WRD)*. Prepared by the DMMP agencies. February 11, 2021.

Port of Seattle Terminal 5
Overdredge Characterization

DMMP, 2021b. *Dredged Material Evaluation and Disposal Procedures (User Manual)*. Dredged Material Management Program, updated July 2021.

Ecology, 2013. *Sediment Management Standards – Chapter 173-204 WAC*. Washington State Department of Ecology, February 2013.

Haley & Aldrich, 2023. *Technical memorandum: Terminal 5 Overdredge Sampling Summary*. File No. 0208336-000. Prepared for the Port of Seattle. 17 October 2023.

Orion, 2022. *Port of Seattle Terminal 5 Berth Modernization. MC-0318308. Work Project # UO0100. Submittal 649-3- Dredging Plan Phase 1 & 2 North and South Berth*. November 2022.

Agency Signatures

The signed version of this document is available in the Dredged Material Management Office, U.S. Army Corps of Engineers Seattle District

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DMMO File

TABLE 1 (from Haley & Aldrich, 2023)

SAMPLE IDENTIFICATION (ID), LOCATIONS, AND ELEVATION (FT MLLW)

PORT OF SEATTLE

Sample ID	Location Name	Latitude	Longitude	Date	Time	Water Depth (ft)	Water Elevation (ft MLLW)	Mudline Elevation (ft MLLW)
T5-DMMU1-S1	T5-DMMU1-S1_1_ACT	47.57410931	122.36095559	4/19/2023	8:59:07	62.8	3.5	-59.3
T5-DMMU1-S2	T5-DMMU1-S2_2_ACT	47.57421928	122.36092952	4/19/2023	9:38:24	63.3	2	-61.3
T5-DMMU1-S3	T5-DMMU1-S3_2	47.57444125	122.36093360	4/19/2023	10:11:12	61.4	1.1	-60.3
T5-DMMU1-S4	T5-DMMU1-S4_1_ACT	47.57460006	122.36094867	4/19/2023	10:34:24	62.7	0.7	-62
T5-DMMU2-S1	T5-DMMU2-S1_1_ACT	47.57488400	122.36101997	4/19/2023	10:53:55	59.3	0.4	-58.9
T5-DMMU2-S2	T5-DMMU2-S2A_1_ACT	47.57488860	122.36122251	4/19/2023	11:19:40	60.2	0.3	-59.9
	T5-DMMU2-S2B_1_ACT	47.57499595	122.36134880	4/19/2023	11:36:49	57.6	0.4	-57.2
	T5-DMMU2-S2C_1_ACT	47.57513387	122.36129227	4/19/2023	11:51:52	57.3	0.5	-56.8
T5-DMMU3/DMMU4-S1	T5-DMMU3/DMMU4-S1C_1_ACT	47.57623641	122.36131506	4/19/2023	12:36:23	58	1.3	-56.7
	T5-DMMU3/DMMU4-S1B_1_ACT	47.57609979	122.36131964	4/19/2023	12:51:47	57.6	1.7	-55.9
	T5-DMMU3/DMMU4-S1A_1_ACT	47.57595646	122.36125449	4/19/2023	13:06:04	57.6	2.2	-55.4
T5-DMMU4-S1	T5-DMMU4-S1A_1_ACT	47.57676814	122.36132544	4/19/2023	13:31:54	62.9	3.1	-59.8
	T5-DMMU4-S1B_1_ACT	47.57737662	122.36133961	4/19/2023	13:50:43	63.4	3.8	-59.6
T5-DMMU5-S1	T5-DMMU5-S1A_1_ACT	47.57759267	122.36136187	4/21/2023	8:13:21	68.9	7.7	-61.2
	T5-DMMU5-S1B_2_ACT	47.57837392	122.36133038	4/21/2023	8:44:25	64.5	6.2	-58.3
T5-DMMU7-S1	T5-DMMU7-S1A_1_ACT	47.58023704	122.36136528	4/21/2023	9:08:11	63.8	5	-58.8
	T5-DMMU7-S1B_2_ACT	47.58094824	122.36129785	4/21/2023	9:29:27	60.5	4	-56.5
Note:								
*WGS 1984								

TABLE II (from Haley & Aldrich, 2023)
SUMMARY OF SEDIMENT QUALITY DATA
POS TERMINAL 5 OVERDREDGE SAMPLING
SEATTLE, WASHINGTON

Location Name Sample Name Sample Date Lab Sample ID Sample Depth (bgs)	DMMP MARINE GUIDELINES			T5-DMMU1-S1 T5-DMMU1-S1 04/19/2023 23D0563-01	T5-DMMU1-S2 T5-DMMU1-S2 04/19/2023 23D0563-02	T5-DMMU1-S3 T5-DMMU1-S3 04/19/2023 23D0563-03	T5-DMMU1-S4 T5-DMMU1-S4 04/19/2023 23D0563-04	T5-DMMU2-S1 T5-DMMU2-S1 04/19/2023 23D0563-05	T5-DMMU2-S2 T5-DMMU2-S2 04/19/2023 23D0563-06	T5-DMMU3/DMMU4-S1 T5-DMMU3/DMMU4-S1 04/19/2023 23D0563-07	T5-DMMU4-S1 T5-DMMU4-S1 04/19/2023 23D0563-08	T5-DMMU5-S1 T5-DMMU5-S1 04/21/2023 23D0571-01	T5-DMMU7-S1 T5-DMMU7-S1 04/21/2023 23D0571-02	
	Screening Level	Bioaccumulation Trigger	Maximum Level	23D0563-01RE1 10 (cm)	23D0563-02RE1 10 (cm)	23D0563-03RE1 10 (cm)	23D0563-04RE1 10 (cm)	23D0563-05RE1 10 (cm)	23D0563-06RE1 10 (cm)	23D0563-07RE1 10 (cm)	23D0563-08RE1 10 (cm)	23D0571-01RE1 10 (cm)	23D0571-02RE1 10 (cm)	
Semi-Volatile Organic Compounds (ug/kg)														
1,2,4-Trichlorobenzene	31	NA	64	19.9 U	20 U	20.4 U	20 U	20 U	19.9 U	19.9 U	19.9 U	20 U	19.9 U	
1,2-Dichlorobenzene	35	NA	110	19.9 U	20 U	20.4 U	20 U	20 U	19.9 U	19.9 U	19.9 U	20 U	19.9 U	
1,4-Dichlorobenzene	110	NA	120	7.8 J	6.9 J	3.3 J	20 U	20 U	19.9 U	19.9 U	19.9 U	20 U	19.9 U	
2,4-Dimethylphenol	29	NA	210	99.6 R	99.9 R	102 R	99.9 R	99.9 R	99.6 R	99.6 R	99.5 R	99.8 R	99.7 R	
2-Methylphenol (o-Cresol)	63	NA	77	19.9 U	20 U	20.4 U	20 R	20 U	19.9 U	19.9 U	19.9 U	20 U	19.9 U	
4-Methylphenol	670	NA	3600	19.9 U	20 U	20.4 U	20 U	20 U	19.9 U	19.9 U	19.9 U	20 U	19.9 U	
Benzoic acid	650	NA	760	108 J+	68.3 J+	50.3 J+	200 U	78.3 J+	199 U	103 J+	103 J+	49.3 J+	43.2 J+	
Benzyl Alcohol	57	NA	870	948 J+	829 J+	879 J+	815 J+	654 J+	570 J+	961 J+	655 J+	701 J+	608 J+	
bis(2-Ethylhexyl)phthalate	1300	NA	8300	80.1	70.5	48.3 J	37.1 J	41.9 J	17.4 J	41 J	26 J	16.6 J	11.5 J	
Butyl benzylphthalate (BBP)	63	NA	970	10.2 J	20 U	11.3 J	9.7 J	20 U	19.9 U	19.9 U	20 U	20 U	226	
Dibenzofuran	540	NA	1700	24.6	35.8	34.8	30.3	18.9 J	26.7	35.8	26.5	20 U	19.9 U	
Diethyl phthalate	200	NA	1200	22.4 J+	20.5 J+	45.4 J+	50 U	21.5 J+	49.8 U	21.6 J+	24.7 J+	49.9 U	22.2 J+	
Dimethyl phthalate	71	NA	1400	19.9 U	20 U	20.4 U	20 U	5.4 J	19.9 U	19.9 U	19.9 U	20 U	19.9 U	
Di-n-butylphthalate (DBP)	1400	NA	5100	19.9 U	20 U	20.4 U	6.3 J	20 U	19.9 U	19.9 U	6.3 J	20 U	19.9 U	
Di-n-octyl phthalate (DnOP)	6200	NA	6200	19.9 U	20 U	20.4 U	20 U	20 U	19.9 U	19.9 U	20 U	19.9 U		
Hexachlorobenzene	22	168	230	19.9 U	20 U	20.4 U	20 U	20 U	19.9 U	19.9 U	19.9 U	20 U	19.9 U	
Hexachlorobutadiene	11	NA	270	19.9 U	20 U	20.4 U	20 U	20 U	19.9 U	19.9 U	19.9 U	20 U	19.9 U	
N-Nitrosodiphenylamine	28	NA	130	19.9 R	20 R	20.4 R	20 R	20 R	19.9 R	19.9 R	19.9 R	20 R	19.9 R	
Pentachlorophenol	400	504	690	99.6 U	99.9 UJ	102 U	99.9 U	99.9 U	99.6 U	99.6 U	99.5 U	99.8 U	99.7 U	
Phenol	420	NA	1200	24.7 U	20 U	20.4 U	20 U	20.1 U	12.8 U	25.6 U	33 U	25 U	16.3 U	
Pyrene	2600	11980	16000	271	275	328	133	160	133	361	248	112	69.7	
Total Benzofluoranthenes (No details)	NA	NA	NA	322	322	235	173	187	108	357	275	149	90.3	
Low-molecular-weight PAHs (ug/kg)														
2-Methylnaphthalene	670	NA	1900	16.1 J	19.2 J	15 J	25.3	15 J	6.3 J	12.8 J	14.1 J	5 J	19.9 U	
Acenaphthene	500	NA	2000	28.6	46	77.4	21.7	20.3	17.4 J	57.9	27.1	10.6 J	6.8 J	
Acenaphthylene	560	NA	1300	10.5 J	8.9 J	7.4 J	20 U	7.5 J	19.9 U	12 J	8.5 J	20 U	19.9 U	
Anthracene	960	NA	13000	45.7	80.4	37.7	35.1	28.7	11.8 J	54.2	27.2	15.6 J	12.5 J	
Fluorene	540	NA	3600	25.7	39.3	45.5	26.8	22.2	20.7	51.8	30.9	20 U	19.9 U	
Naphthalene	2100	NA	2400	38.7	47.1	61.3	97.5	36.4	23 U	43.2 J+	37.4 J+	243	91.8	59
Phenanthrene	1500	NA	21000	111	148	159	87.2	69.2	46.9	221	162	58.1	35.7	
Total LPAH (7 of 16) (U = 0)	5200	NA	29000	276.3	388.9	403.3	293.6	199.3	103.1	452.9	307.2	89.3	55	
High-molecular-weight PAHs (ug/kg)														
Benzo(a)anthracene	1300	NA	5100	92.8	117	86	70.6	66.4	41	138	92.7	54.9	25.8	
Benzo(a)pyrene	1600	NA	3600	101	90.5	80.2	60.6 J	60.7	39.6	122	81.7	43.3	31	
Benzo(b)fluoranthene	3200	NA	9900	186	181	142	86.9	120	55.7	197	130	78.4	49.4	
Benzo(g,h,i)perylene	670	NA	3200	64.2	58.8	44.6	33.7	34.5	27.1	60.6	46.1	24.8 J	18.5 J	
Benzo(k)fluoranthene	3200	NA	9900	150	154	108	95.2	74.7	57.1	171	160	77.2	45	
Chrysene	1400	NA	21000	140	241	106	136	101	51.6	203	153	91.8	46.1	
Dibenz(a,h)anthracene	230	NA	1900	24.8	23.9	18.7 J	20 U	20 U	19.9 U	24.7	18.4 J	20 U	19.9 U	
Fluoranthene	1700	4600	30000	168	173	214	90.7 J	114	82.1	285	243	91.8	59	
Indeno(1,2,3-cd)pyrene	600	NA	4400	62.8	57.3	42.7	33.6	34.8	23.8	60.7	46.2	25.2 J	17.5 J	
Total HPAH (9 of 16) (U = 0)	12000	NA	69000	989.6	1097	842.2	607.3	606.1	378	1262	971.1	487.4	292.3	
Semi-Volatile Organic Compounds (SIM) (ug/kg)														
1,2,4-Trichlorobenzene	31	NA	64	5 U	5 U	5.1 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
1,2-Dichlorobenzene	35	NA	110	1.3 J	5 U	5.1 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
1,4-Dichlorobenzene	110	NA	120	8.7	6.7	3.7 J	2.6 J	3.2 J	1.7 J	2.4 J	2.4 J	5 U	5 U	
2,4-Dimethylphenol	29	NA	210	19.9 R	20 R	20.4 R	20 R	20 R	19.9 R	19.9 R	19.9 R	20 R	19.9 R	
2-Methylphenol (o-Cresol)	63	NA	77	5 U	5 U	5.1 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
4-Methylphenol	670	NA	3600	7	5 U	4.8 J	7.5 J	5 J	2 J	5 U	5 U	5 U	5 U	
Benzoic acid	650	NA	760	124 J+	90.8 J+	58.3 J+	38 J+	88 J+	46.9 J+	122 J+	124 J+	64 J+	57.3 J+	
Benzyl Alcohol	57	NA	870	1070 J+	916 J+	960 J+	908 J+	747 J+	643 J+	1070 J+	744 J+	795 J+	705 J+	
Butyl benzylphthalate (BBP)	63	NA	970	9.4	7.5	9.8	9	4.3 J	4.4 J	3.7 J	4.1 J	5 U	226	
Dibenz(a,h)anthracene	230	NA	1900	27.4	25.4	18.6	15.3	15.4	8.9	25.9	19.8	10.8	7.7	
Diethyl phthalate	200	NA	1200	23.9 U	16.2 U	37.6 J+	15.5 U	20.7 U	11.7 U	20.6 U	22.8 U	15.3 U	19.4 U	
Dimethyl phthalate	71	NA	1400	3.9 J	2.7 J	5.1 U	5 U	4.6 J	5 U	1.9 J	1.9 J	5 U	5 U	
Hexachlorobenzene	22	168	230	1.8 J	5 U	5.1 U	5 U	1.5 J	5 U	5 U	5 U	5 U	5 U	
Hexachlorobutadiene	11	NA	270	5 U	5 U	5.1 U	5 U	1.2 J	5 U	5 U	5 U	5 U	5 U	
N-Nitrosodiphenylamine	28	NA	130	5 U	5 U	5.1 U	5 R	5 U	5 U	5 U	5 U	5 U	5 U	
Pentachlorophenol	400	504	690	7.6 J+	20 U	2.6 J+	20 U	4.7 J+	19.9 U	5.7 J+	4.1 J+	20 U	19.9 U	
Phenol	420	NA	1200	27.4 J+	13.5 U	11.7 U	12 U	22.9 J+	14.4 U	28.6 J+	36.6 J+	28.6 J+	19 U	
TetraButyltin	NA	NA	NA	NA	4.95 U	4.97 U	4.96 U	5 U	4.99 U	5 U	4.97 U	4.99 U	5.46 U	
Tri-n-butyltin Cation	NA	73	NA	60.1	40	19.3	28.8	43.6	34.6	70.7	51.6	108	29.6	

TABLE II
SUMMARY OF SEDIMENT QUALITY DATA
POS TERMINAL 5 OVERDREDGE SAMPLING
SEATTLE, WASHINGTON

Location Name Sample Name Sample Date Lab Sample ID Sample Depth (bgs)	DMMP MARINE GUIDELINES			T5-DMMU1-S1 T5-DMMU1-S1 04/19/2023 23D0563-01 23D0563-01RE1	T5-DMMU1-S2 T5-DMMU1-S2 04/19/2023 23D0563-02 23D0563-02RE1	T5-DMMU1-S3 T5-DMMU1-S3 04/19/2023 23D0563-03 23D0563-03RE1	T5-DMMU1-S4 T5-DMMU1-S4 04/19/2023 23D0563-04 23D0563-04RE1	T5-DMMU2-S1 T5-DMMU2-S1 04/19/2023 23D0563-05 23D0563-05RE1	T5-DMMU2-S2 T5-DMMU2-S2 04/19/2023 23D0563-06 23D0563-06RE1	T5-DMMU3/DMMU4-S1 T5-DMMU3/DMMU4-S1 04/19/2023 23D0563-07 23D0563-07RE1	T5-DMMU4-S1 T5-DMMU4-S1 04/19/2023 23D0563-08 23D0563-08RE1	T5-DMMU5-S1 T5-DMMU5-S1 04/21/2023 23D0571-01 23D0571-01RE1	T5-DMMU7-S1 T5-DMMU7-S1 04/21/2023 23D0571-02 23D0571-02RE1
	Screening Level	Bioaccumulation Trigger	Maximum Level	10 (cm)	10 (cm)	10 (cm)	10 (cm)						
	Inorganic Compounds (mg/kg)												
Antimony	150	NA	200	0.28 R	0.29 R	0.26 R	0.26 R	0.28 R	0.26 R	0.28 R	0.26 R	0.28 R	0.26 R
Arsenic	57	507.1	700	5.6 J	5.25 J	3.51 J	3.7 J	4.82 J	3.46 J	6.43 J	4 J	5.14	3.98
Cadmium	5.1	NA	14	0.3	0.3	0.19	0.14	0.17	0.12 J	0.18	0.15	0.1 J	0.05 J
Chromium	260	NA	NA	18.4	17.1	15.4	11.4	13.8	12.4	17	14.3	14.6	12.1
Copper	390	NA	1300	42.5	39.9	24.4	27.5	32.7	24.6	41.8	30.4	31	21.5
Lead	450	975	1200	29.2	29.2	18.2	12.7	14	7.49	17.5	12.9	10.1	6.9
Mercury	0.41	1.5	2.3	0.141	0.141	0.0687	0.0788	0.15	0.051	0.139	0.096	0.192	0.0633
Selenium	NA	3	NA	0.95 J	0.99 J	0.73 J	0.8 J	0.68 J	0.79 J	0.92 J	0.62 J	0.75	0.9
Silver	6.1	NA	8.4	0.19 J	0.16 J	0.1 J	0.1 J	0.12 J	0.11 J	0.18 J	0.12 J	0.11 J	0.08 J
Zinc	410	NA	3800	77.5	75.5	49.8	44.9	51.3	40.3	62	45.9	43	33.1
PCBs (ug/kg)													
Aroclor-1016 (PCB-1016)	NA	NA	NA	4 U	4 U	4 UJ	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Aroclor-1221 (PCB-1221)	NA	NA	NA	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Aroclor-1232 (PCB-1232)	NA	NA	NA	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Aroclor-1242 (PCB-1242)	NA	NA	NA	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Aroclor-1248 (PCB-1248)	NA	NA	NA	28.1	27.6	18.4 J	14.4	13	9.2	23	17.3	14	13.7
Aroclor-1254 (PCB-1254)	NA	NA	NA	32.8	30.7	19.8	18.1	19.9	13.7	36.9	26.7	20.3	23.4
Aroclor-1260 (PCB-1260)	NA	NA	NA	36.7	34.8	16.5	16.3	23.9	13	38.4	25.4	18.1	11.4
Aroclor-1262 (PCB-1262)	NA	NA	NA	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Aroclor-1268 (PCB-1268)	NA	NA	NA	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Total PCBs	130	NA	3100	97.6	93.1	36.3	48.8	56.8	35.9	98.3	69.4	52.4	48.5
Dioxins/Furans (ng/kg)													
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	NA	NA	NA	289	237	100	108	165	57.8	503	135	106 J	49.5 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	NA	NA	NA	2830	2360	1080	832	1480	558	3030	1410	1370 J	434 J
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	NA	NA	NA	58.3	53.6	24.7	24.4	40.7	13.1	94	30.4	21.1	11
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	NA	NA	NA	318	270	128	105	168	65.8	339	152	149 J	49.8 J
1,2,3,4,7,8-Heptachlorodibenzofuran (HpCDF)	NA	NA	NA	4.45	3.97	1.9	1.33 U	4.19	1.03 J	6.03	2.61	1.74	1.27 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	NA	NA	NA	5.11 J	4.8 J	1.89 J	3.27 J	3.52 J	1.37 UJ	6.36 J	3.06 J	1.78	0.871 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NA	NA	NA	2.27	2.44	0.906 J	1.33 U	1.9	0.534 J	1.73	0.835 J	0.639 J	1.33 UJ
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	NA	NA	NA	2.43	2.19	0.948 J	1.33 U	1.68	1.37 UJ	2.01	1.03 J	0.717 J	0.302 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NA	NA	NA	9.25	8.19	3.67	3.24	5.4	1.84	9.16	3.97	3.15 J	1.21 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	NA	NA	NA	1.22 J	1.5 UJ	1.36 UJ	1.33 U	1.46	1.37 UJ	1.49 UJ	0.621 J	1.36 UJ	1.33 UJ
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	NA	NA	NA	4.91 J	5.31 J	1.92 J	2.46 J	3.45 J	1.2 J	4.77 J	2.24 J	1.49	0.756 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	NA	NA	NA	1.84	1.32 J	0.664 J	1.33 U	0.934 J	1.37 UJ	1.49 UJ	1.37 UJ	1.36 UJ	1.33 UJ
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	NA	NA	NA	2.26	2.4	0.933 J	1.33 U	1.45	0.492 J	1.68	0.891 J	0.698 J	1.33 UJ
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	NA	NA	NA	3.39	3.27	1.57	1.33 U	2.64	0.676 J	1.27 J	1.67	0.505 J	0.378 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	NA	NA	NA	2.43 J	2	0.899 J	1.33 U	1.36 J	1.37 UJ	1.73	1.08 J	0.927 J	1.33 UJ
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	NA	NA	NA	2.44	2.31	1.73	1.33 U	1.16 J	0.53 J	1.33 J	1.37 UJ	0.817 J	0.286 J
2,3,7,8-Tetrachlorodibenzofuran (TCDD)	NA	NA	NA	1.54 UJ	1.5 UJ	1.36 U	1.33 U	1.43 UJ	1.37 UJ	1.49 UJ	1.37 UJ	1.36 U	1.33 U
Total Heptachlorodibenzofuran (HpCDF)	NA	NA	NA	220	193	87.7	84.8	143	48.3	396	115	90.8	44.9
Total Heptachlorodibenzo-p-dioxin (HpCDD)	NA	NA	NA	812	677	358	240	474	168	806	397	565	126
Total Hexachlorodibenzofuran (HxCDF)	NA	NA	NA	76.7	74.5	32.9	25	47.7	13.8	104	36.9	27.3	9.83
Total Hexachlorodibenzo-p-dioxin (HxCDD), Mixture	NA	NA	NA	76	76.8	33.6	13.3	49.7	18.6	78.1	36	44.2	11.5
Total Pentachlorodibenzofuran (PeCDF)	NA	NA	NA	47.8	35.6	17.9	1.33 U	19.4	5.42	15.8	8.86	7.34	1.57
Total Pent													

TABLE II
SUMMARY OF SEDIMENT QUALITY DATA
POS TERMINAL 5 OVERDREDGE SAMPLING
SEATTLE, WASHINGTON

Location Name Sample Name Sample Date Lab Sample ID Sample Depth (bgs)	DMMP MARINE GUIDELINES			T5-DMMU1-S1 T5-DMMU1-S1 04/19/2023 23D0563-01	T5-DMMU1-S2 T5-DMMU1-S2 04/19/2023 23D0563-02	T5-DMMU1-S3 T5-DMMU1-S3 04/19/2023 23D0563-03	T5-DMMU1-S4 T5-DMMU1-S4 04/19/2023 23D0563-04	T5-DMMU2-S1 T5-DMMU2-S1 04/19/2023 23D0563-05	T5-DMMU2-S2 T5-DMMU2-S2 04/19/2023 23D0563-06	T5-DMMU3/DMMU4-S1 T5-DMMU3/DMMU4-S1 04/19/2023 23D0563-07	T5-DMMU4-S1 T5-DMMU4-S1 04/19/2023 23D0563-08	T5-DMMU5-S1 T5-DMMU5-S1 04/21/2023 23D0571-01	T5-DMMU7-S1 T5-DMMU7-S1 04/21/2023 23D0571-02	
	Screening Level	Bioaccumulation Trigger	Maximum Level	10 (cm)	10 (cm)	10 (cm)	10 (cm)	10 (cm)						
Other														
<-2.5 Phi Gravel (%)	NA	NA	NA	0.2	0.4	1.8	4.1	0.2	0.6	0.1 U	0.2	0.1		
>10 Phi Clay (%)	NA	NA	NA	5.1	5.5	3.8	3.8	4.6	4	4.6	3.2	7.6	4.5	
0-1 Phi Sand (%)	NA	NA	NA	2.4	1.4	3.1	2.5	1.2	0.6	1.8	1.5	1.4	2.1	
-1-0 Phi Granule (%)	NA	NA	NA	1.9	0.5	1	0.9	0.5	0.4	1	0.1	0.4	0.5	
1-2 Phi Sand (%)	NA	NA	NA	7.4	10.5	26.6	20.1	25	7.9	28.6	28.4	20.4	24.4	
-2.25 to -2 Phi Gravel (%)	NA	NA	NA	0.6	0.1	0.3	1.8	0.1	0.3	0.3	0.1 U	0.3	0.1 U	
2-3 Phi Sand (%)	NA	NA	NA	19.9	20.2	26.5	26.4	29.1	29.7	19.4	32.8	23.3	34.8	
-2 to -1 Phi Gravel (%)	NA	NA	NA	2.4	0.3	0.7	2.7	0.1	0.5	1.1	0.1 U	0.3	0.1	
3-4 Phi Sand (%)	NA	NA	NA	15	24.2	10.7	11.7	8	31.2	18.3	14	21.2	17	
4-5 Phi Silt (%)	NA	NA	NA	11.9	7.6	11.4	9.7	9	9.6	5	6.3	5.6	7.1	
5-6 Phi Silt (%)	NA	NA	NA	12.9	13	4.7	6.1	8.5	6.4	6.3	4.7	9.8	3.3	
6-7 Phi Silt (%)	NA	NA	NA	9.7	8.3	4.1	4.8	6.2	3.1	5.7	3.9	5.5	2.6	
7-8 Phi Silt (%)	NA	NA	NA	5.7	3.2	3.3	3.3	3.6	3.5	3.1	2.9	3.4	1.4	
8-9 Phi Clay (%)	NA	NA	NA	3.1	2.8	1.4	1.5	2.4	1.6	2.6	1.4	0.5	1.2	
9-10 Phi Clay (%)	NA	NA	NA	1.7	2.1	0.7	0.7	1.6	0.7	1.6	0.7	0.1 U	0.7	
Clay (%)	NA	NA	NA	9.9	10.4	5.9	6	8.6	6.3	8.8	5.3	8.1	6.4	
Gravel (%)	NA	NA	NA	3.2	0.8	2.8	8.6	0.4	1.4	2	0.1 U	0.8	0.2	
Sand (%)	NA	NA	NA	46.6	56.8	67.9	61.6	63.8	69.8	69.1	76.8	66.7	78.8	
Silt (%)	NA	NA	NA	40.2	32.1	23.5	23.9	27.3	22.6	20.1	17.8	24.3	14.4	
Total Organic Carbon (TOC) (%)	NA	NA	NA	0.89 J	0.93 J	0.56 J	0.49 J	0.65 J	0.4 J	0.74 J	0.57 J	0.71	0.34 J	
Total Solids (%) by SM 2540 G-97	NA	NA	NA	68.22 J	67.27 J	76.04 J	77.72 J	71.38 J	74.28 J	68.96	74.18	69.3	70.06	
Total Solids (%) by ASTM D2216	NA	NA	NA	64.88 J	66.5 J	73.3 J	75.13 J	69.99 J	73.21 J	67.13 J	73.13 J	73.77	75.28	
Ammonia (as N) (mg/kg)	NA	NA	NA	3.93 J	1.32 J	1.13 J	4.54 J	4.65 J	5.7 J	1.56 J	5.38 J	-	-	

Notes and Abbreviations:

-: Not analyzed

bgs: below ground surface

cm: centimeter

DMMP: Dredged Material Management Program

J: value is estimated

J+: value is estimated, biased high

mg/kg: milligram per kilogram.

NA: Not Available

ng/kg = nanogram per kilogram

R: data is unusable, results are rejected

Total Chlordane is the sum of cis-chlordane and trans-chlordane

U: Not detected above the indicated laboratory reporting limit.

ug/kg: microgram per kilogram.

All results validated to at a level of EPA2A except grain size analysis of sediment which was validated to an EPA1 level.

Bold denotes a detected concentration.

Blue shading denotes a detected analyte concentration exceeding a DMMP Cleanup Level.



- LEGEND**
- PROPOSED COMPOSITE SURFACE GRAB SAMPLE
 - PROPOSED INDIVIDUAL SURFACE GRAB SAMPLE
 - ATTEMPTED INDIVIDUAL SAMPLE - OVERRDREDGED
 - COMPOSITE SAMPLE - SHEEN
 - INDIVIDUAL SAMPLE - OVERRDREDGED

- NOTES**
- ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
 - DMMU = DREDGE MATERIAL MANAGEMENT PROGRAM
 - BASEMAP OVERLAY DATA SOURCE: "PORT OF SEATTLE - TERMINAL 5 DREDGING PROGRESS SURVEY" ORION MARINE GROUP, MARCH 2023
 - AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

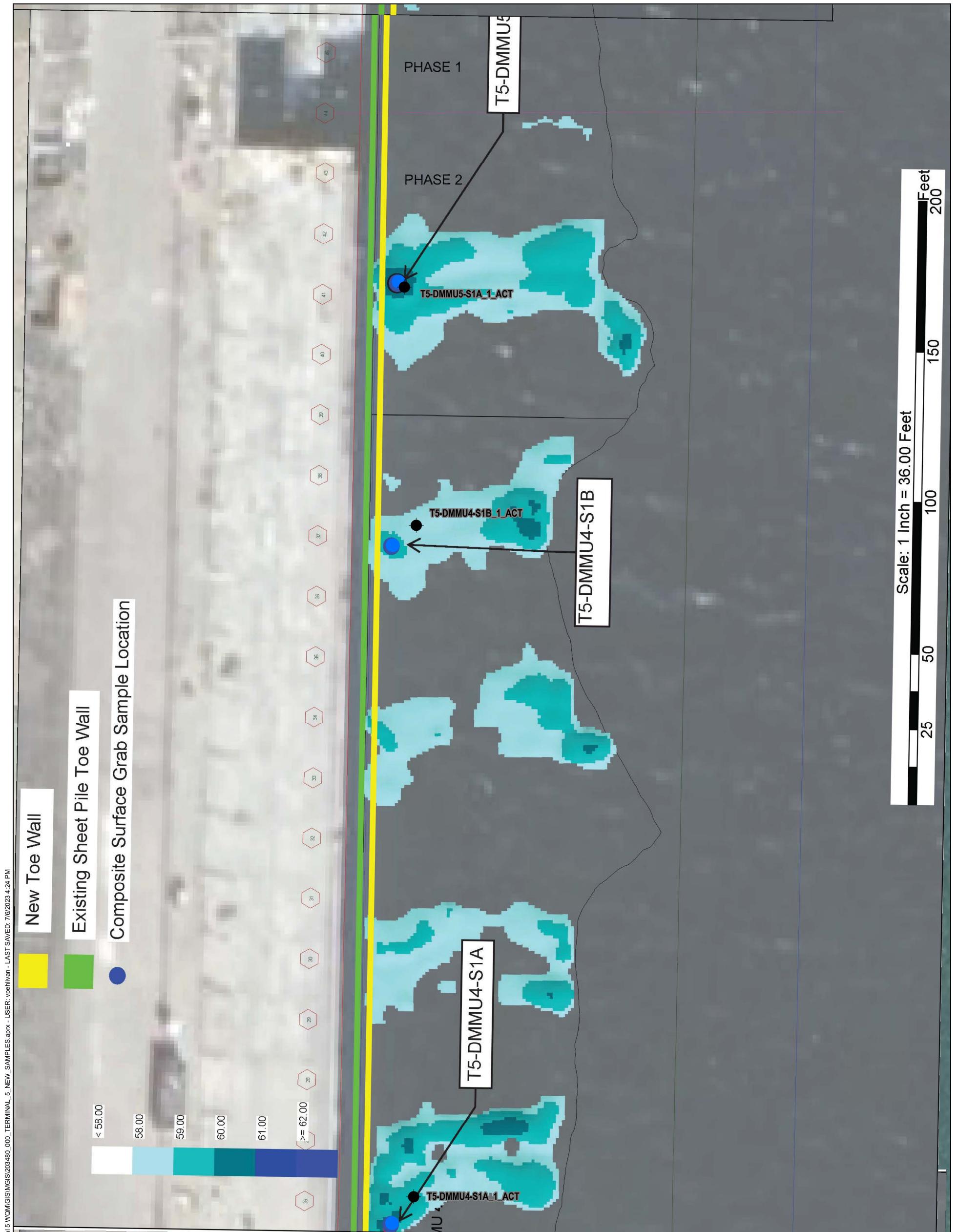
POS TERMINAL 5 OVERRDREDGE SAMPLING
SEATTLE, WASHINGTON

SITE PLAN SHOWING OVERRDREDGE
SAMPLING LOCATIONS
DMMU 1 AND 2

JULY 2023

FIGURE 1




LEGEND

- PROPOSED COMPOSITE SURFACE GRAB SAMPLE
- COMPOSITE SAMPLE – OVERTREDGED

NOTES

- ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
- DMMU = DREDGE MATERIAL MANAGEMENT PROGRAM
- BASEMAP OVERLAY DATA SOURCE: "PORT OF SEATTLE - TERMINAL 5 DREDGING PROGRESS SURVEY" ORION MARINE GROUP, MARCH 2023
- AERIAL IMAGERY SOURCE: ESRI


HALEY ALDRICH

 POS TERMINAL 5 OVERDREDGE SAMPLING
SEATTLE, WASHINGTON

 SITE PLAN SHOWING OVERTREDGE
SAMPLING LOCATIONS
DMMU 4 AND 5

JULY 2023

FIGURE 3


LEGEND

- PROPOSED COMPOSITE SURFACE GRAB SAMPLE (Blue circle)
- ATTEMPTED COMPOSITE SAMPLE – OVERRDREDGED (Crosshair symbol)
- COMPOSITE SAMPLE – OVERRDREDGED (Black circle)

NOTES

- ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
- DMMU = DREDGE MATERIAL MANAGEMENT PROGRAM
- BASEMAP OVERLAY DATA SOURCE: "PORT OF SEATTLE - TERMINAL 5 DREDGING PROGRESS SURVEY" ORION MARINE GROUP, MARCH 2023
- AERIAL IMAGERY SOURCE: ESRI

0 40 80
SCALE IN FEET

HALEY ALDRICH

POS TERMINAL 5 OVERRDREDGE SAMPLING
SEATTLE, WASHINGTON

SITE PLAN SHOWING OVERRDREDGE
SAMPLING LOCATIONS
DMMU 5

JULY 2023

FIGURE 4



LEGEND

- PROPOSED COMPOSITE SURFACE GRAB SAMPLE
- COMPOSITE SAMPLE – OVERTREDGED

NOTES

- ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
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- BASEMAP OVERLAY DATA SOURCE: "PORT OF SEATTLE - TERMINAL 5 DREDGING PROGRESS SURVEY" ORION MARINE GROUP, MARCH 2023
- AERIAL IMAGERY SOURCE: ESRI



0 40 80
SCALE IN FEET

HALEY ALDRICH

POS TERMINAL 5 OVERTREDGE SAMPLING
SEATTLE, WASHINGTON

SITE PLAN SHOWING OVERTREDGE
SAMPLING LOCATIONS
DMMU 6 AND 7

JULY 2023

FIGURE 5



**HALEY
ALDRICH**

POS TERMINAL 5 OVERDREDGE SAMPLING
SEATTLE, WASHINGTON

SITE PLAN SHOWING OVERDREDGE
SAMPLING LOCATIONS
DMMU 7 AND 8

JULY 2023

FIGURE 6