Prepared by:
Dredged Material Management Office
Seattle District, U.S. Army Corps of Engineers

MEMORANDUM FOR RECORD **November 14, 2019**

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF PROPOSED DREDGED MATERIAL FROM AND RE-RANKING OF THE DES MOINES MARINA ENTRANCE CHANNEL (NWS-2019-478) IN PUGET SOUND, EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT FOR UNCONFINED OPEN-WATER DISPOSAL AT THE COMMENCEMENT BAY OR ELLIOTT BAY OPEN-WATER DISPOSAL SITES.

1. **Introduction**. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington State Department of Ecology, Washington State Department of Natural Resources, and the Environmental Protection Agency) regarding the suitability of up to 8,000 cubic yards (CY) of proposed dredged material from the Des Moines Marina (Marina) in Des Moines, Washington (Figure 1) for disposal at the Commencement Bay or Elliott Bay non-dispersive site and compliance of the sediment surface to be exposed by this dredging with the State of Washington's antidegradation standard.

2. **Background.** The Des Moines Marina ("Marina"), located in the City of Des Moines (City), provides berthing facilities for recreational boats in the lower Puget Sound. The Marina is located on the eastern shore of Puget Sound, approximately midway between Seattle and Tacoma. The Marina has slips to accommodate 840 boats and is full at all times due to the demand for boat moorage in the Puget Sound area.

   The marina was constructed in 1970 with a depth of -15 ft MLLW in the entrance channel, interior channels, and berthing areas. Maintenance dredging subsequently occurred in 1983, 1994, and 2009. The 1983 maintenance dredging removed accumulated sediment in the entrance channel to a depth of -15 ft MLLW.

   The 1994 maintenance dredging removed sediment that had accumulated in the entrance channel and adjacent to the breakwater at the south end of the Marina. Approximately 4,700 cy of sediment were removed from the entrance channel and placed at the Commencement Bay open-water disposal site.

   The 2009 maintenance dredging removed sediment from four areas within the Marina, including the entrance channel, two areas along the eastern shore of the marina, and the area adjacent to the breakwater at the south end of the Marina (DMMP, 2007). A total of 8,250 cy of sediment were removed from the four areas and placed at the Commencement Bay open-water disposal site.

   For both the 1994 and 2009 dredging events, the sediment was sampled and analyzed beforehand, and the results indicated that the sediment was suitable for unconfined open-water disposal (PSDDA, 1993; DMMP, 2007). Because the 1983 dredging event occurred pre-PSDDA/DMMP, no

sampling and testing documentation was located.

In April 2019, Anchor QEA notified the DMMP agencies on behalf of the City of Des Moines that maintenance dredging of the entrance channel was needed. The City is planning to conduct maintenance dredging within the entrance channel to allow for safe passage of vessels into and out of the Marina. Sediment associated with discharge from the adjacent Des Moines Creek has caused shoaling within the entrance channel. The target dredge elevation for the entrance channel is -13 feet MLLW (plus 2 ft of overdredge to -15 ft MLLW).

This memorandum documents the evaluation of the shoaled sediment for open-water disposal and the new surface to be exposed by dredging for compliance with the State of Washington's anti-degradation standard.

3. **Project Summary**. Table 1 provides project summary and tracking information.

Table 1. Project Summary

Former Project ranking	Moderate
Conceptual design target depth	-13 ft MLLW (plus 2 ft of overdepth)
Calculated volume to -15 ft (-13 ft plus 2 ft overdepth)	7500 CY
Characterized volume (based on rank and sampling frequency)	8,000 CY
1st draft SAP received	May 8, 2019
Comments provided on 1st draft SAP	May 16, 2019
2nd draft SAP received	May 28, 2019
Comments provided on 2nd draft SAP	May 31, 2019
Final SAP received	June 3, 2019
SAP approved	June 4, 2019
Sampling dates	July 24, 2019
Draft Sediment Characterization Report (SCR) received	October 1, 2019
DMMP comments provided on draft SCR	October 15, 2019
Final SCR received	October 2019
DMMO tracking number	DESMM-1-A-F-408
EIM Study ID	DESMM19
USACE Permit Application Number	NWS-2019-478
New Project Rank for the Entrance Channel	Low
New Recency Expiration Date for the Entrance Channel (low rank = 6 years)	July 2025

4. **Project Ranking and Sampling Requirements**. The Marina is ranked "moderate" by the DMMP

agencies for concern for potential contamination. The project rank remained unchanged from the 2007 Suitability Determination (DMMP, 2007).

For a moderate-ranked project, the requirements for the number of field samples and dredged material management units (DMMUs) are as follows (DMMP, 2018):

- Maximum volume of sediment represented by each field sample = 4,000 cubic yards
- Maximum volume of sediment represented by each DMMU in homogeneous sediment = 20,000 cubic yards

Since the material is infill from Des Moines Creek that has accumulated since the last maintenance dredge event, the material is assumed to be well-mixed, homogenous sediment. No subsurface DMMUs were required.

The estimated volume in the project area using the original conceptual dredging design (-13 ft + 2 ft OD) was 7,500 CY. A single DMMU was allocated to characterize this material. Two core locations were selected within the DMMU.

Based on the maximal volume allowed per DMMU and the maximum volume allowed per field sample, the total characterized volume for the single DMMU tested is 8,000 CY.

The 2007 sampling and testing event had shown the likelihood of poor core penetration due to core refusal. Thus, the approved sampling procedure included a contingency plan for z-sample collection in the event that coring didn't reach the z-layer depth. In this event, the plan was to archive excess material from the bottom one foot of each core to be used as a pseudo-z-sample, should depth-related contaminant trends need to be investigated.

5. **Sampling and Analysis**. Sediment cores were collected by vibracorer on July 24, 2019 aboard the *Tieton*, operated by Gravity Marine Services. Figure 2 shows the proposed and actual coring locations and Table 2 lists the location coordinates.

   Due to the sand and gravel nature of the dredged material, a total of 6 coring attempts was required to collect acceptable cores from sample location C-1 and C-2. Although 15-foot core tubes were initially proposed and deployed, shorter 10-foot cores were found to be ultimately more successful in penetrating the sand and gravel mixture. Core percent recovery for the accepted cores varied from 75% to 90% for locations C-1 and C-2, respectively (Table 2).

   At location C-1, the dredge design elevation (-15 ft MLLW) was not reached. For this core, the entire available core length (-3.5 to -10.4 ft MLLW) was sampled and included in the DMMU composite (DU-1-A). The bottom one foot of the core was subsampled and retained as a representative Z-layer archive (C-1-Z).

   At location C-2, the location shifted to a slope and therefore the design elevation was reached (-8.7 to -17.7 ft MLLW). However, the field team accidentally sampled the entire length of the core for the DU-1-A composite sample. Thus the two foot Z-layer (-15 to -17 ft MLLW) and some additional material below the Z-layer (-17 to -17.7 ft MLLW) was incorrectly included in the DU-1-A composite. Similarly, the bottom one foot of the core (-16.7 to -17.7 ft MLLW) was incorrectly subsampled and

retained as the representative Z-layer archive; the Z-layer archive should have been -15 to -17 ft MLLW. The impact of this sampling deviation on the final analytical results is discussed in further detail in the next section.

Sample processing occurred on the same day as collection. All samples were submitted to Analytical Resources Inc. of Tukwila, WA, for analysis.

Data Validation. Data validation (Stage 2B) was conducted by Laboratory Data Consultants, Inc. Only minor issues were documented and all data were considered usable, as qualified, by the data validator.

6. **Analytical Results**. The conventional and chemistry results for the single DMMU composite (sample DU1-A-20190724) are presented alongside the DMMP marine guidelines in Table 4.

   Grain Size and Sediment Conventionals. All samples were analyzed for the conventional sediment parameters of total organic carbon (TOC), total solids, total volatile solids, ammonia, sulfides, and grain size. TOC was low (0.45%), and grain size analysis indicated that the material was primarily composed of sand (71.5%) and gravel (24%). .

   Standard DMMP Chemicals of Concern. No chemistry results (detects and non-detects) exceeded the DMMP Screening Level (SL) or Bioaccumulation Trigger (BT) for the chemicals of concern (COCs).

   Dioxins/furans. Dioxin/furan analysis was not required for this project due to a lack of historical or current source of dioxins/furans in the vicinity of the site.

   TBT. Tributyltin (TBT) analyses were not required for this project based on previous non-detect results from the 2007 marina sampling and given the source of the dredged material (Des Moines Creek discharge).

   Impact of sampling errors. As noted in the previous section, material deeper than the design elevation (-15 ft MLLW) from location C-2 was accidentally included in the sample composite. After considering the grain-size, the homogeneity of the sand and gravel as indicated in the core logs, and the very low concentrations measured in the DMMU composite (see next section), the DMMP agencies have determined that the sampling deviation at location C-2 is unlikely to significantly impact the sample concentrations. Even if all the measured concentrations in the DMMU composite sample were double the measured concentrations, there would still have been no exceedances of the DMMP SLs.

7. **Biological Testing**. Biological testing was not required; concentrations of all detected and non-detected chemicals of concerns were below DMMP screening levels.

8. **Sediment Exposed by Dredging**. 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 all DMMP chemicals of concern were below the DMMP SLs; therefore, this project is in compliance with the State of Washington anti-degradation standard.

9. **Debris Management**. The DMMP agencies implemented a debris screening requirement following the 2015 SMARM in order to prevent the disposal of solid waste and large debris at open-water disposal sites in Puget Sound (DMMP, 2015).

   Geographically, the entrance channel is located adjacent to the mouth of Des Moines Creek and receives significant sediment input from the creek. The marina is used for recreational use and the entrance channel has been previously dredged twice to maintain navigational access. No debris was encountered during sediment sampling in July 2019. Based on the above information, the DMMP agencies concur that the entrance channel dredge area is of low concern for debris and a debris screening grid is not required for this proposed dredging project. However, if any large debris is encountered, it must be segregated and disposed of in an upland landfill or other appropriate use. At no time may any debris greater than one foot in any dimension be disposed at an open-water disposal site.

10. **Downranking**. The DMMP guidelines allow down-ranking of a project after two testing cycles, based on the results from those testing events and the use of best professional judgment (DMMP, 2018). The definitions of the various ranks must be considered:

    - High = many known chemical sources, high concentration of COCs and/or significant acute toxicity
    - Moderate = chemical and biological data are not available or are incomplete, and some sources of chemicals of concern exist nearby
    - Low-moderate = available data indicate a low rank, but there are insufficient data to confirm the ranking
    - Low = few or no sources of COCs, data are available to verify low chemical concentrations.

    Currently, the Des Moines Marina is ranked moderate by the DMMP agencies. However, with the conclusion of the July 2019 sampling event summarized in this document, the entrance channel has undergone two consecutive cycles of sampling and testing as summarized below:

    - 2007. Four areas within the Marina, including the entrance channel, were sampled and tested for standard DMMP CoCs. In the entrance channel, no CoC were detected or not detected above DMMP screening levels. Grain size analysis indicated that the Entrance Channel material was predominantly sand (83%) and gravel (12%).
    - 2019. No CoCs were detected or not detected above DMMP screening levels in the Entrance Channel. Grain size was again found to be predominantly sand (72%) and gravel (24%).

    Based on the above information, the DMMP agencies **have determined that a re-ranking of the Entrance Channel area of the Des Moines Marina from moderate to low** is supported by the available data.

    The ranking of the rest of the Marina (moderate) remains unchanged.

    The new ranking for the Entrance channel is based on information available at this time. Any

significant future changes in condition in the regions, such as spills or new contaminant sources, may prompt the DMMP agencies to perform a re-evaluation of project rank.

12. <u>Suitability and Antidegradation Determination</u>. This memorandum documents the evaluation of the suitability of sediment proposed for dredging from the Des Moines Marina for open-water disposal at the Commencement Bay or Elliott Bay DMMP disposal site. The data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP program.

In summary, based on the results of the previously described testing, the DMMP agencies have concluded that **all 8,000 CY of characterized material from the Des Moines Marina entrance channel DMMU are suitable** for open-water disposal at the Commencement Bay or Elliott Bay non-dispersive disposal site.

With regard to antidegradation, the DMMP agencies have determined that the sediment to be exposed by dredging **meets the state antidegradation standard.**

Dredged material proposed for beneficial use must be approved by the entity receiving the material. Additional coordination with resource agencies may be required.

This suitability determination does ***<u>not</u>*** constitute final agency approval of the project. During the public comment period that follows a public notice, the resource agencies will provide input on the overall project. A final decision will be made after full consideration of agency input, and after an alternatives analysis is done under section 404(b)(1) of the Clean Water Act.

A pre-dredge meeting with DNR, Ecology and the Corps of Engineers is required at least 7 days prior to dredging. A dredging quality control plan must be developed and submitted to the Regulatory Branch of the Seattle District Corps of Engineers at least 7 days prior to the pre-dredge meeting.

9. <u>References</u>.

Anchor, 2019a. Sampling and Analysis Plan, City of Des Moines Marina, Entrance Channel Maintenance Dredging. Prepared for City of Des Moines by Anchor QEA, June 2019.

Anchor, 2019b. City of Des Moines Marina, Entrance Channel Maintenance Dredging, Sediment Characterization Sediment Characterization Data Report. Prepared for City of Des Moines by Anchor QEA, October 2019.

DMMP, 2007. Determination on the Suitability of Dredged Material Characterized at the City of Des Moines Marina (NWS-2007-1762-NO) under Section 404 of the Clean Water Act for the Purpose of Determining the Suitability of the Dredged Material for Open-Water Disposal at the DMMP Non-Dispersive Disposal Site. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program, December 27, 2007.

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.

DMMP, 2018. *Dredged Material Evaluation and Disposal Procedures (User Manual)*. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program, December 2018.

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

Hartman Associates, Inc. and Pentec Environmental, Inc., 1993. Des Moines Marina Maintenance Dredging PSDDA Sampling and Analysis Results. Prepared for the City of Des Moines. December 27, 1993.

PSDDA, 1993. Determination on the Suitability of Maintenance Dredged Material Tested for the Des Moines Marina, City of Des Moines, Washington (93-2-00006) for Disposal at a PSDDA Unconfined Open-Water Disposal Site.

10. Agency Signatures.

signed copy on file in DMMO - Seattle District office

Concur:

_____ _____
Date Heather Whitney Fourie – Seattle District Corps of Engineers, Seattle District

_____ _____
Date Erika Hoffman - Environmental Protection Agency

_____ _____
Date Laura Inouye, Ph.D. - Washington Department of Ecology

_____ _____
Date Shannon Soto - Washington Department of Natural Resources

Copies furnished:
DMMP signatories
Joy Dunay, Anchor QEA
Kristin McDermott, USACE Regulatory Project Manager

Table 2

Core Collection Data

Station ID	Date	Location[1]		Distance (feet) from Target	Measured Water Depth (feet)	Water Level (feet MLLW)[2]	Mudline Elevation (feet MLLW)	Drive Penetration (feet)	Recovery Measurement (feet)	Recovery (%)
		X Coordinate	Y Coordinate							
C-1	7/24/2019	1269347	150303	19.2	9.6	6.1	-3.5	9.75	7.3[3]	75
C-2	7/24/2019	1269392	150240	18.7	16	7.3	-8.7	10.0	9	90

Notes:

1. Coordinates are in North American Datum of 1983 Washington State Plane North, US feet.
2. Real-time kinematic global positioning system used.
3. During core extrusion, 0.4 feet of gravel was lost from the bottom of the core.

MLLW: mean lower low water

Source: Table 1 of Sediment Characterization Data Report (Anchor, 2019b)
City of Des Moines Marina Entrance Channel Maintenance Dredging

Table 3
Core Sampling Intervals and Analysis

DMMU	Stations	Design Elevation (feet MLLW)	Dredged Material Surface Sample[1]	Sample Composite Analyses[1]	Z-Sample Archive[2]
DU-1-A	C-1	-15	C-1-A-20190724 (-3.5 to -10.4 feet MLLW)	DU1-A-20190724: Marine DMMP[3]	C-1-Z-20190724 (-9.4 to -10.4 feet MLLW)
	C-2		C-2-A-20190724 (-8.7 to -17.7 feet MLLW)[2]		C-2-Z-20190724 (-16.7 to -17.7 feet MLLW)[3]

Notes:

1. The C-2-A interval accidentally included deeper material from the z-layer.
2. Marine DMMP testing parameters include semivolatile organic compounds, polycyclic aromatic hydrocarbons, pesticides, polychlorinated biphenyls, metals, sulfide, ammonia, total organic carbon, grain size, total volatile solids, and total solids.
3. The C-2-Z interval accidentally included deeper material.

DMMP: Dredged Material Management Program

DMMU: Dredged Material Management Unit

MLLW: mean lower low water

Source: Table 2 of Sediment Characterization Data Report (Anchor, 2019b)

City of Des Moines Marina Entrance Channel Maintenance Dredging

Table 4. Sample Results Summary

Sample ID Sample Date Sample Type Matrix Analytes	**Method**	**DMMP SL**	**DMMP BT**	**DMMP ML**	**DU1-A-20190724 7/24/2019 N SE --**
Conventional Parameters (mg/kg)					
Ammonia as nitrogen	SM4500NH3H				**6.1**
Sulfide	SM4500S2D				**237**
Conventional Parameters (%)					
Total organic carbon	SW9060A				**0.45 J**
Total solids	SM2540G				**78**
Total volatile solids	PSEP-TVS				**2.3**
Grain Size (%)					
Gravel	PSEP				**24**
Sand, very coarse	PSEP				**7.3**
Sand, coarse	PSEP				**14**
Sand, medium	PSEP				**27**
Sand, fine	PSEP				**19**
Sand, very fine	PSEP				**4.2**
Total sands	PSEP				**71.5**
Silt, coarse	PSEP				4.6 U
Silt, medium	PSEP				4.6 U
Silt, fine	PSEP				4.6 U
Silt, very fine	PSEP				4.6 U
Clay, coarse	PSEP				4.6 U
Clay, medium	PSEP				4.6 U
Clay, fine	PSEP				4.6 U
Total fines (silts and clay)	PSEP				4.6 U
Metals (mg/kg)					
Antimony	SW6020A	150		200	0.25 UJ
Arsenic	SW6020A	57	507.1	700	**1.87**
Cadmium	SW6020A	5.1		14	**0.11 J**
Chromium	SW6020A	260			**15.5 J**
Copper	SW6020A	390		1300	**8.35 J**
Lead	SW6020A	450	975	1200	**5.78**
Mercury	SW7471B	0.41	1.5	2.3	**0.0166 J**
Selenium	SW6020A		3		0.64 U
Silver	SW6020A	6.1		8.4	**0.04 J**
Zinc	SW6020A	410		3800	**38.8**
Polycyclic Aromatic Hydrocarbons (µg/kg)					
2-Methylnaphthalene	SW8270D	670		1900	20 U
Acenaphthene	SW8270D	500		2000	20 U
Acenaphthylene	SW8270D	560		1300	20 U
Anthracene	SW8270D	960		13000	**9.2 J**
Benzo(a)anthracene	SW8270D	1300		5100	**28**
Benzo(a)pyrene	SW8270D	1600		3600	**36**
Benzo(b,j,k)fluoranthenes	SW8270D	3200		9900	**73**
Benzo(g,h,i)perylene	SW8270D	670		3200	**24**
Chrysene	SW8270D	1400		21000	**40**
Dibenzo(a,h)anthracene	SW8270D	230		1900	**7.1 J**
Fluoranthene	SW8270D	1700	4600	30000	**92 J**
Fluorene	SW8270D	540		3600	20 U
Indeno(1,2,3-c,d)pyrene	SW8270D	600		4400	**21**
Naphthalene	SW8270D	2100		2400	20 U
Phenanthrene	SW8270D	1500		21000	**31**

Table 4. Sample Results Summary

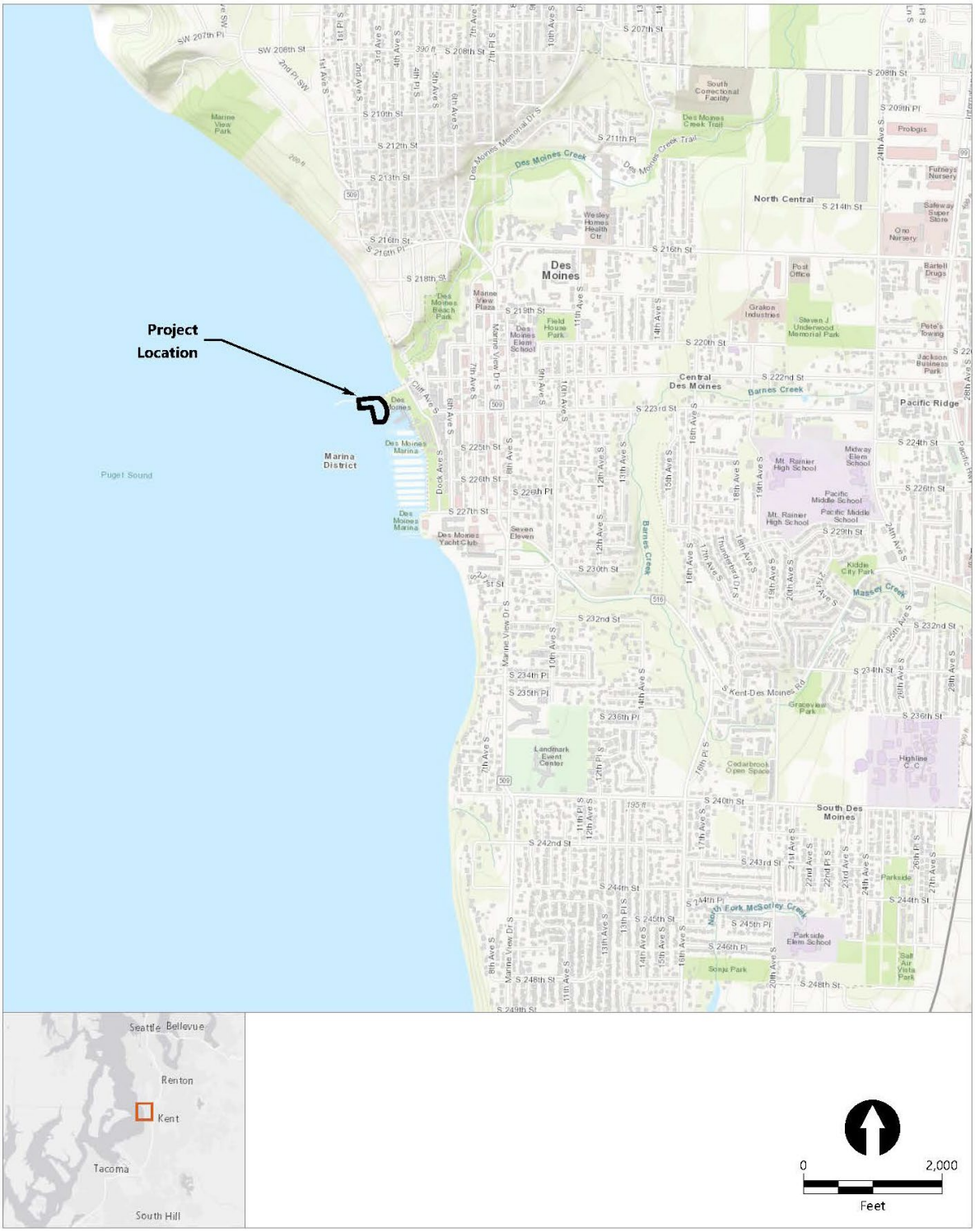
Sample ID Sample Date Sample Type Matrix Analytes	**Method**	**DMMP SL**	**DMMP BT**	**DMMP ML**	**DU1-A-20190724 7/24/2019 N SE --**
Pyrene	SW8270D	2600	11980	16000	**129 J**
Total LPAH (SMS) (U = 0)	SW8270D	5200		29000	**40 J**
Total HPAH (SMS) (U = 0)	SW8270D	12000		69000	**450 J**
Semivolatile Organics (µg/kg)					
1,2,4-Trichlorobenzene	SW8270DSIM	31		64	5 U
1,2-Dichlorobenzene	SW8270DSIM	35		110	5 U
1,4-Dichlorobenzene	SW8270DSIM	110		120	5 U
2,4-Dimethylphenol	SW8270DSIM	29		210	20 U
2-Methylphenol (o-Cresol)	SW8270DSIM	63		77	**3.5 J**
4-Methylphenol (p-Cresol)	SW8270DSIM	670		3600	**5.5 J**
Benzoic acid	SW8270DSIM	650		760	**32 J**
Benzyl alcohol	SW8270DSIM	57		870	20 U
bis(2-Ethylhexyl)phthalate	SW8270D	1300		8300	50 U
Butylbenzyl phthalate	SW8270D	63		970	20 U
Diethyl phthalate	SW8270DSIM	200		1200	20 U
Dimethyl phthalate	SW8270DSIM	71		1400	5 U
Di-n-butyl phthalate	SW8270D	1400		5100	20 U
Di-n-octyl phthalate	SW8270D	6200		6200	20 U
Hexachlorobenzene	SW8270DSIM	22	168	230	5 U
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	SW8270DSIM	11		270	5 U
Indeno(1,2,3-c,d)pyrene	SW8270D	600		4400	**21**
n-Nitrosodiphenylamine	SW8270DSIM	28		130	5 U
Pentachlorophenol	SW8270DSIM	400	504	690	**3.2 J**
Phenol	SW8270DSIM	420		1200	10 UJ
Pesticides (µg/kg)					
4,4'-DDD (p,p'-DDD)	SW8081B	16			1 UJ
4,4'-DDE (p,p'-DDE)	SW8081B	9			1 U
4,4'-DDT (p,p'-DDT)	SW8081B	12			1 UJ
Aldrin	SW8081B	9.5			0.5 U
Chlordane, alpha- (Chlordane, cis-)	SW8081B				0.5 U
Chlordane, beta- (Chlordane, trans-)	SW8081B				0.5 U
Dieldrin	SW8081B	1.9		1700	1 U
Heptachlor	SW8081B	1.5		270	0.5 UJ
Nonachlor, cis-	SW8081B				1 U
Nonachlor, trans-	SW8081B				1 U
Oxychlordane	SW8081B				1 U
Sum 4,4 DDT, DDE, DDD (U = 0)	SW8081B		50	69	1 UJ
Total DMMP Chlordane (U = 0)	SW8081B	2.8	37		1 U
PCB Aroclors (µg/kg)					
Aroclor 1016	SW8082A				4 U
Aroclor 1221	SW8082A				4 U
Aroclor 1232	SW8082A				4 U
Aroclor 1242	SW8082A				4 U
Aroclor 1248	SW8082A				4 U
Aroclor 1254	SW8082A				**2.8 J**
Aroclor 1260	SW8082A				4 U
Aroclor 1262	SW8082A				4 U
Aroclor 1268	SW8082A				4 U
Total DMMP PCB Aroclors (U = 0)	SW8082A	130		3100	**2.8 J**

Notes:
All results are reported in dry weight.
Detected concentration is greater than DMMP screening level
Detected concentration is greater than DMMP bioaccumulation trigger
Detected concentration is greater than DMMP maximum level

Bold = Detected result
µg/kg: microgram per kilogram
BT: bioaccumulation trigger
DMMP: Dredged Material Management Program
J: estimated value
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
LPAH: low-molecular-weight polycyclic aromatic hydrocarbon
mg/kg: milligram per kilogram
ML: maximum level
PCB: polychlorinated biphenyl
SL: screening level
SMS: Sediment Management Standards
U: Compound analyzed, but not detected above detection limit
UJ: Compound analyzed, but not detected above estimated detection limit
Sediment Characterization
Total HPAH consists of the sum of fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b,j,k)fluoranthenes, benzo(a)pyrene, indeno(1,2,3,-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
Total DDT consists of the sum of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT.

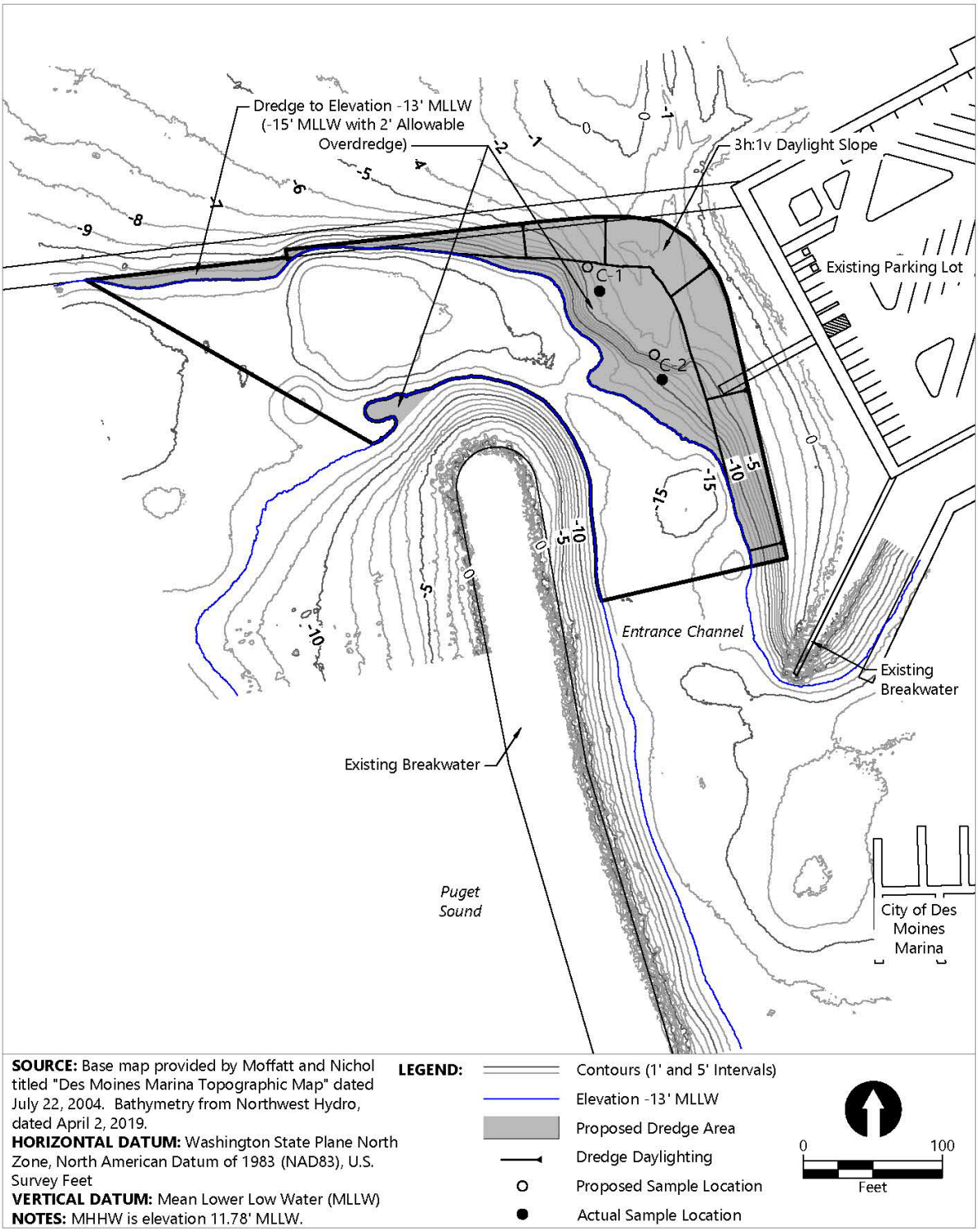
Source: Table 3 of Sediment Characterization Data Report (Anchor, 2019b)
City of Des Moines Marina Entrance Channel Maintenance Dredging

Figure 1. Project Location Map



Source: Figure 1 of Sampling and Analysis Plan (Anchor, 2019a)
City of Des Moines Marina Entrance Channel Maintenance Dredging

Figure 2. Proposed and Actual Sampling Locations



Source: Figure 2 of Sediment Characterization Data Report (Anchor, 2019b)
City of Des Moines Marina Entrance Channel Maintenance Dredging