September 20, 2018

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

MEMORANDUM FOR: RECORD

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF PROPOSED DREDGED MATERIAL FROM CADMAN MATERIALS INC, EVERETT, WASHINGTON, EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT FOR UNCONFINED OPEN-WATER DISPOSAL AT THE PORT GARDNER OPEN-WATER DISPOSAL SITE.

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 21,458 cubic yards (cy) of dredged material from Cadman Materials Inc. for open-water disposal at the Port Gardner nondispersive site and for compliance with the State of Washington Antidegradation Policy.

2. Background. Cadman Materials Inc., which is owned by Lehigh Hanson Inc., is planning to co-locate a concrete batch plant with an asphalt plant at their North Everett facility (222 W Marine View Dr., Everett, Washington 98201) along the Snohomish River at Everett, Washington. The Site is located at the confluence of the Snohomish River to the north and the Port Gardner Bay (Possession Sound) to the west (Figure 1). The property is owned by W&W Everett Investments Inc. but is currently leased to Cadman Materials. To facilitate the ingress and egress of fully loaded barges to the facility, the berth area requires dredging to operational elevations.

   The Site is built upon fill material placed in the 1960s and 1970s (SLR and Anchor QEA, 2013), and has been operating as an asphalt batch plant since the mid-1960s. The site is bounded to the north by subtidal areas of the Snohomish River and to the east and southeast by two Model Toxics Control Act sites: the former Jeld Wen site and the former Bay Wood facility.

   A Freedom of Information Act request was submitted to the U.S. Army Corps of Engineers but no information regarding previous maintenance dredging was found. It is assumed that the site has not been dredged since the construction of the berth area in the 1970s.

3. Project Summary. Table 1 includes project summary and tracking information.

Table 1. Project Summary

Project ranking	Low-moderate
Proposed dredging volume	21,458 CY
Proposed dredging depth	-15 ft MLLW (including 2 feet of overdepth)
1st draft SAP received	May 11, 2018

Comments provided on 1st draft SAP	May 31, 2018
2nd draft SAP received	June 4, 2018
Comments provided on 2nd draft SAP	June 5, 2018
Final SAP received	June 8, 2018
SAP approved	June 8, 2018
Sampling dates	June 11, 2018
Draft data report received	August 16, 2018
Comments provided on draft report	August 20, 2018
Final data report received	August 29, 2018
EIM Study ID	CADMA18
USACE Permit Application Number	tbd
Recency Expiration (low-moderate rank = 6 years)	June 2024

4. Project Ranking and Sampling Requirements. This project was ranked "low-moderate" by the DMMP agencies according to the guidelines set out in the DMMP User Manual for areas not likely to be contaminated but with no data to confirm a low rank. In a low-moderate-ranked area the number of samples and analyses are calculated using the following guidelines (DMMP, 2016):
   - Maximum volume of sediment represented by each field sample = 8,000 cubic yards
   - Maximum volume of sediment represented by each analysis in the upper 4-feet of the dredging prism (surface sediment) = 32,000 cubic yards
   - Maximum volume of sediment represented by each analysis in the subsurface portion of the dredging prism = 48,000 cubic yards

   The total project volume in the sampling and analysis plan (SAP) was 21,458 cubic yards (CY), which included a design depth of -13 ft MLLW plus 2 feet of overdredge depth. Using the DMMP sampling and testing guidelines above, two cores were collected and composited into two DMMUs, a surface (DMMU 1) representing 11,877 CY and subsurface DMMU (DMMU 2) representing 9,581 CY. Sampling results are valid until June 2024.

5. Sampling. Sampling took place June 11, 2018 aboard the *R/V Tieton*, operated by Gravity Marine, using a vibracorer. The approved sampling and analysis plan (Anchor QEA, 2018) was followed to the extent possible given the sediment conditions on site. Figure 2 shows the target and actual coring locations and Table 2 has the location coordinates. As anticipated, the sediment was difficult to core and multiple attempts were made at each location with little success in achieving the SAP-required 75% recovery rate. Three coring attempts were made at each location; attempts at location C1 had recoveries of 25%, 68%, and 38%, respectively and attempts at location C2 had recoveries of 62%, 29%, and 29%, respectively. The contractors contacted DMMO from the field to discuss the situation and received approval to use the cores with highest percent recovery from each location even though they were less than the required 75%.

   Core 1 was driven 11.8 feet into the sediment but only 8 feet of sediment was recovered in the core, for a recovery of 68%. Core 2 was driven 10.8 feet into the sediment but only 6.7 feet of sediment was recovered in the core, for a recovery of 62%. Core lengths were corrected for core shortening

by the contractor prior to compositing and subsampling. A uniform correction factor based on the percent recovery was applied over the entire length of each core. The result is that the 8 feet of sediment collected from Core 1 were assumed to represent the entire length of the 11.8 feet the core barrel was driven into the sediment and the intervals representing the top four feet (DMMU 1), the bottom interval (down to -15 ft MLLW) and the z-layer (-15 to -17 ft MLLW) were determined based on the adjusted depths, see Table 3a for depth information for all intervals.

Core shortening - The issue of whether or not to correct for shortening of sediment cores has come up repeatedly in the DMMP in recent years. There are no specific guidelines in the DMMP User Manual on whether or not to account for shortening of sediment cores during collection. Rather, the DMMP agencies rely on the expertise of the sampling team to determine if there is evidence that compaction or other forms of core shortening have occurred and whether core depths should be adjusted for the assumed shortening. An important component of this decision is the type of sediment that is being sampled.

There are three main types of core shortening: physical compaction, sediment thinning, and sediment bypassing. Physical compaction is the simplest, and involves the expulsion of air and or water from the interstices and possible rearrangement of sediment grains to form closer packing. The most common form of shortening is sediment thinning, which happens as the core barrel is pushed downward and results in all the strata being represented in core but with the intervals between strata being shorter than in the environment. Sediment bypassing is more complex, and involves excessive internal resistance within the core barrel, plugging of the core barrel at the cutting edge, and exclusion of underlying sediment so that some strata are bypassed and not recovered in the core barrel (Morton and White, 1997).

For vibracoring operations there is no way to determine the real-time percent recovery of the core during the coring process, so there is no way to determine if core shortening is happening within a certain interval of the core. Therefore it is common to assume a uniform compaction correction that is applied throughout the length of the core, and that is how the core length correction was applied to the cores collected for this project.

However, the DMMP agencies do not agree that a correction for core compaction makes sense for this project for the following reasons:

- The sediment was predominantly sand (90-95%)
- The fact that the other coring attempts had very low recoveries indicate that the issue sampling was either loss of material out the bottom of the core or, more likely, failure of the sediment to enter the core barrel to begin with.
- The high percentage sand in the sediment indicates that physical compaction was not likely to be the cause of shortening

Importantly, if the core depths are reevaluated without a shortening correction factor (Table 3b), then neither Core 1 nor Core 2 were driven deep enough to collect sediment representing the z-sample. The implications of this are discussed below.

6. Chemical Analysis. Analysis of conventionals and all standard DMMP COCs was conducted by Analytical Resources Inc. of Tukwila, WA. The approved sampling and analysis plan (Anchor QEA, 2018a) was followed, and quality control guidelines specified by the DMMP program were generally

met.

Sediment conventional and chemical results are shown in Table 4. The grain size results showed that the dredged material is sand with 90-95% sand, <5% silt and negligible clay. Total organic carbon (TOC) was low, 0.75% in the dredged material and the z-layer sample. Ammonia concentrations were undetected at the surface and increased with depth, but remained low. Sulfides were fairly high, ranging from 291 mg/kg at the surface to 54.7 mg/kg in the z-layer. All sulfides results were J-flagged due to analysis occurring 1 day past the 7-day holding time.

Chemical results were validated by an independent data validator at the EPA Stage 2B level. Some results received J or U-flags based on standard validation guidance. These qualifiers are shown in Tables 4 and 5. In addition, the following key findings were reported in the sediment characterization report (Anchor QEA, 2018b):

- The metals matrix spike and matrix spike duplicate had low percent recoveries of antimony at 12.7% and 11.7%, respectively. Initially, the results were rejected because the laboratory did not include a post-digestion spike. The laboratory reanalyzed the batch quality control samples and included a post-digestion spike, which had a recovery (91.1%) within acceptable limits, so data (which was all non-detect) were UJ-qualified. Low recovery of antimony is a common issue in sediments because in the presence of silicates, antimony can form insoluble oxides during the nitric acid digestion. Using hydrochloric acid could help minimize the issue but can also create chloride interference on the ICP-MS. The post-digestion spike percent recovery was used to validate the batch quality control samples, per the method and validation guidance.
- The semivolatile analysis method blank had low-level detections of naphthalene and diethylphthalate that resulted in slightly elevated detection limits in all samples. Detection limits were still below DMMP SLs.

Chemical concentrations were compared to 2018 DMMP marine screening levels. There were no detected or undetected exceedances of any 2018 DMMP SLs for any of the chemicals. Dioxins/furans were analyzed for the project due to concerns of contaminant movement from the two nearby MTCA cleanup sites, both of which have elevated levels of dioxin. Dioxin/furan results are presented in Tables 4 and 5. Dioxin/furan concentrations were low, between 0.1 and 0.2 pptr TEQ in the two DMMUs, and 0.3 pptr TEQ, in the z-sample. All values are very low (less than 1 pptr TEQ) and significantly less that the DMMP site management objective of 4 pptr TEQ (DMMP, 2010).

Based on the evaluation of the chemical data, bioassay testing was not required for the dredged material. Both DMMUs met suitability guidelines, based on chemistry alone, for open-water disposal at the Port Gardner disposal site.

7. <u>Sediment Exposed by Dredging</u>. The sediment to be exposed by dredging must either meet the State of Washington Sediment Quality Standards (SQS) or the State's Antidegradation standard (Ecology, 2013) as outlined by DMMP guidance (DMMP, 2008).

   - The z-sample results were analyzed up front and are presented in Tables 4 (comparison to DMMP SLs) and Table 5 (comparison to SMS). Given the uncertainly in the depths of the samples collected and analyzed as described in Section 5, multiple lines of evidence were used to evaluate the antidegradation status of this project. First, when z-samples are not analyzed

up front or are not collected, the dredged material is compared to SMS criteria to determine if there is a concern about the quality of sediment to be exposed by dredging. There were no exceedances of any of the SCOs for any chemicals from DMMU 1, DMMU 2 or the z-sample, thus for a typical project, analysis of the actual Z-layer would not be triggered.

- Second, all sample results were compared to DMMP guideline and SMS guidelines. All chemical concentrations were less than the SL and SCO for all parameters.
- Third, as a final check, the concentrations of chemicals were evaluated to see if there were any significant trends of increasing concentrations with depth in a range where the trend would predict an exceedances of a chemical within another 2 feet of depth. The majority of compounds were non-detect or estimated values throughout the depth profile, prohibiting trend analysis for most compounds. Those measured concentrations for compounds which were detected were very low and had no apparent increasing trend with depth.

As demonstrated by the results of the above analysis, the sediment to be exposed by dredging is not considered to be degraded relative to the currently exposed sediment surface. On this basis the DMMP agencies conclude that this project is in compliance with the State of Washington anti-degradation policy.

8. Suitability Determination. This memorandum documents the evaluation of the suitability of sediment proposed for dredging from Cadman Materials Inc. for open-water disposal at the Port Gardner DMMP disposal site. The approved sampling and analysis plan was generally followed. After careful consideration, 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 conclude that all 21,458 CY from Cadman Materials Inc. are suitable for open-water disposal at the Port Gardner non-dispersive site.

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 ***not*** 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. A DNR site use authorization for use of the disposal site must also be acquired.

9. References.

Anchor QEA, 2018a. Cadman Materials Inc., North Everett Facility, Navigational Maintenance Sediment Characterization Sampling and Analysis Plan. Prepared for Lehigh Hanson Inc. by Anchor QEA, June 2018.

Anchor QEA, 2018b. Cadman Materials Inc., North Everett Facility, Navigational Maintenance Sediment Characterization Sediment Characterization Data Report. Prepared for Lehigh Hanson Inc. by Anchor QEA, August 2018.

DMMP, 2016. *Dredged Material Evaluation and Disposal Procedures (Users Manual)*. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program, August 2016.

.

DMMP, 2010. *Dredged Material Management Program New Interim Guidelines for Dioxins*. December 6, 2010.

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.

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

Morton and White, 1997. *Characteristics of and Corrections for Core Shortening in Unconsolidated Sediments*. Journal of Coastal Research, Vol. 13, No. 3, pp. 761-769.

10. Agency Signatures.

The signed copy is on file in the Dredged Material Management Office.

Concur:

_____ _____
Date Kelsey van der Elst - Seattle District Corps of Engineers

_____ _____
Date Erika Hoffman - Environmental Protection Agency

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

_____ _____
Date Celia Barton - Washington Department of Natural Resources

Copies furnished:

DMMP signatories

Joy Dunay, Anchor QEA

Derek Ormerod, Anchor QEA

Christy McDonough, Lehigh Hanson Inc.

USACE Regulatory Project Manager

Table 2. Sampling coordinates

		Coordinates (NAD83)	
		Latitude	Longitude
Station	C1	48.018098°	122.215287°
	C2	48.018338°	122.214737°

Table 3a. Sampling and Compositing with core shortening corrections.

		DMMU 1	DMMU 2	z-sample	Total
	SAP volume (CY):	11,877	9,581		21,458
Station	C1	-6.7 to -10.7	-10.7 to -15.0	-15.0 to -17.0	
	C2	-6.9 to -10.9	-10.9 to -15.0	-15.0 to -17.0	

Table 3b. Sampling and Compositing without core shortening corrections.

		DMMU 1	DMMU 2	z-sample	Total
	SAP volume (CY):	11,877	9,581		21,458
Station	C1	-6.7 to -9.41	-9.41 to -12.33	-12.33 to -13.68	
	C2	-6.9 to -9.38	-9.38to -11.93	-11.93 to -13.17	

Notes:

1) The design depth for the project is -13 feet MLLW, plus 2 feet of overdepth.

2) DMMU volumes are based on December 2017 bathymetry and include side slope volumes.

Table 4. Chemical results compared to DMMP regulatory guidelines.

CHEMICAL	DMMP Guidelines			DMMU 1		DMMU 2		z-sample	
	SL	BT	ML						
CONVENTIONALS				conc	LQ	conc	LQ	conc	LQ
Gravel, %				5.2		2.7		0.6	
Sand, %				93.2		90.9		95.6	
Silt, %						4.7			
Clay, %						1.9			
Fines (Silt + Clay), %						6.6			
Total Solids, %				82.8		77.0		79.6	
Volatile Soilids, %				1.9		2.0		1.7	
Total Organic Carbon, %				0.76		0.74		0.61	
Total Sulfides, mg/kg				291	J	191	J	55	J
Total Ammonia, mg N/kg				0.5	U	6.8		11.6	
METALS (mg/kg dry)									
Antimony	150	---	200	0.2	UJ	0.2	UJ	0.3	UJ
Arsenic	57	507	700	4.9		4.6		5.2	
Cadmium	5.1	11.3	14.0	0.03	J	0.05	J	0.04	J
Chromium	260	260	---	27.9		29.4		31.5	
Copper	390	1,027	1,300	16.4		17.9		16.8	
Lead	450	975	1,200	3.6		4.3		5.0	
Mercury	0.41	1.5	2.3	0.03	U	0.03		0.03	U
Selenium	---	3	---	0.6	U	0.6	U	0.6	U
Silver	6.1	6.1	8.4	0.03	J	0.03	J	0.03	J
Zinc	410	2,783	3,800	41.3		40.8		42.6	
PAHs (ug/kg dry)									
Total LPAH	5,200	---	29,000	27.1	U	31.2	J	45.4	J
Naphthalene	2,100	---	2,400	27.1	U	23	U	52.7	U
Acenaphthylene	560	---	1,300	19.9	U	18.7	U	5.4	J
Acenaphthene	500	---	2,000	19.9	U	5	J	8.6	J
Fluorene	540	---	3,600	19.9	U	7.8	J	7	J
Phenanthrene	1,500	---	21,000	19.9	U	12.7	J	17.4	J
Anthracene	960	---	13,000	19.9	U	5.7	J	7	J
2-Methylnaphthalene	670	---	1,900	5.9	J	7.4	J	14.5	J
Total HPAH	12,000	---	69,000	24.8	J	55.7	J	28.9	J
Fluoranthene	1,700	4,600	30,000	9.6	J	17.9	J	11.4	J
Pyrene	2,600	11,980	16,000	9.3	J	22.3		11.7	J
Benzo(a)anthracene	1,300	---	5,100	19.9	U	7.1	J	19.5	U
Chrysene	1,400	---	21,000	5.9	J	8.4	J	5.8	J
Total benzofluoranthenes	3,200	---	9,900	39.9	U	37.4	U	39	U
Benzo[a]pyrene	1,600	---	3,600	19.9	U	18.7	U	19.5	U
Indeno(1,2,3-c,d)pyrene	600	---	4,400	19.9	U	18.7	U	19.5	U
Dibenzo(a,h)anthracene	230	---	1,900	5	U	4.7	U	4.9	U
Benzo(g,h,i)perylene	670	---	3,200	19.9	U	18.7	U	19.5	U
CHLORINATED BENZENES (ug/kg dry)									
1,2-Dichlorobenzene	35	---	110	5	U	4.7	U	4.9	U
1,4-Dichlorobenzene	110	---	120	5	U	4.7	U	4.9	U
1,2,4-Trichlorobenzene	31	---	64	5	U	4.7	U	4.9	U
Hexachlorobenzene	22	168	230	0.7	U	0.7	U	0.7	U

Table 4. Chemical results compared to DMMP regulatory guidelines.

CHEMICAL	DMMP Guidelines			DMMU 1		DMMU 2		z-sample	
	SL	BT	ML						
PHTHALATE ESTERS (ug/kg dry)									
Dimethyl phthalate	71	---	1,400	5	U	4.7	U	4.9	U
Diethyl phthalate	200	---	1,200	19.9	U	18.7	U	34.7	U
Di-n-butyl phthalate	1,400	---	5,100	14.5	J	10.5	J	19.5	U
Butyl benzyl phthalate	63	---	970	19.9	U	18.7	U	19.5	U
Bis(2-ethylhexyl)phthalate	1,300	---	8,300	67		105		48.7	U
Di-n-octyl phthalate	6,200	---	6,200	19.9	U	18.7	U	19.5	U
PHENOLS (ug/kg dry)									
Phenol	420	---	1,200	4.7	J	7.9		6.6	
2 Methylphenol	63	---	77	6.9		4.7	U	4.9	U
4 Methylphenol	670	---	3,600	31.2		18.9		8.3	
2,4-Dimethylphenol	29	---	210	24.9	U	23.4	U	24.4	U
Pentachlorophenol	400	504	690	19.9	U	18.7	U	19.5	U
MISCELLANEOUS EXTRACTABLES (ug/kg dry)									
Benzoic acid	650	---	760	44.5	J	68	J	17.4	J
Benzyl alcohol	57	---	870	19.9	U	19.1		5.8	J
Dibenzofuran	540	---	1,700	2.6	U	0.9	J	0.9	J
Hexachlorobutadiene	11	---	270	5	U	4.7	U	4.9	U
N-Nitrosodiphenylamine	28	---	130	5	U	4.7	U	4.9	U
PESTICIDES (ug/kg dry)									
Aldrin	9.5	---	---	3.0	U	1.6	U	1.2	U
Total Chlordane	2.8	37	---	1.0	U	1.0	U	1.0	U
Dieldrin	1.9	---	---	1.0	U	1.0	U	1.0	U
Heptachlor	1.5	---	---	0.5	U	0.5	U	0.5	U
p,p'-DDE	9	---	---	1.0	U	1.0	U	1.0	U
p,p'-DDD	16	---	---	1.0	U	1.0	U	1.0	U
p,p'-DDT	12	---	---	1.0	U	1.0	U	1.0	U
Total DDT		50	69	1.0	U	1.0	U	1.0	U
PCBs (ug/kg dry)									
Total PCBs	130	---	3,100	3.8	U	7.4	J	10.2	J
Total PCBs (mg/kg OC)	---	38	---	0.5	U	1	J	1.7	J
Dioxins/furans (pptr TEQ, U = 1/2 RL)									
Dioxins/furans	4	10	---	0.11	J	0.22	J	0.3	J
DMMP DETERMINATION									
DMMU volume				11,877		9,581			
Rank				low-moderate		low-moderate		low-moderate	
Mean sample depth (ft MLLW)				-8.1		-10.8		-12.8	
Maximum sampling depth (ft MLLW				-9.4		-12.3		-13.2	
	SL	BT	ML	DMMU 1		DMMU 2		z-sample	

J = estimated concentration
U = undetected
OC = organic carbon
SL = screening level
BT = bioaccumulation trigger
ML = maximum level

Table 5. Dioxin/furan TEQ calculations. Concentrations are in ng/kg dry weight. Total TEQs are in parts per trillion (pptr).

CHEMICAL	TEF	DMMU 1				DMMU 2				z-sample			
DIOXINS/FURANS		conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)
2,3,7,8-TCDD	1	0.046	U	0	0.023	0.049	U	0	0.0245	0.055	U	0	0.0275
1,2,3,7,8-PeCDD	1	0.049	U	0	0.0245	0.074	U	0	0.037	0.09	U	0	0.045
1,2,3,4,7,8-HxCDD	0.1	0.067	U	0	0.00335	0.079	U	0	0.00395	0.062	U	0	0.0031
1,2,3,6,7,8-HxCDD	0.1	0.088	J	0.0088	0.0088	0.27	J	0.027	0.027	0.283	J	0.0283	0.0283
1,2,3,7,8,9-HxCDD	0.1	0.068	U	0	0.0034	0.183	J	0.0183	0.0183	0.168	J	0.0168	0.0168
1,2,3,4,6,7,8-HpCDD	0.01	1.56	J	0.0156	0.0156	4.81		0.0481	0.0481	7.83		0.0783	0.0783
OCDD	0.0003	13.5		0.00405	0.00405	38.6		0.01158	0.01158	60.6		0.01818	0.01818
2,3,7,8-TCDF	0.1	0.113	J	0.0113	0.0113	0.211	J	0.0211	0.0211	0.306	J	0.0306	0.0306
1,2,3,7,8-PeCDF	0.03	0.04	U	0	0.0006	0.052	U	0	0.00078	0.057	U	0	0.000855
2,3,4,7,8-PeCDF	0.3	0.038	U	0	0.0057	0.05	U	0	0.0075	0.053	U	0	0.00795
1,2,3,4,7,8-HxCDF	0.1	0.031	U	0	0.00155	0.054	U	0	0.0027	0.067	J	0.0067	0.0067
1,2,3,6,7,8-HxCDF	0.1	0.031	U	0	0.00155	0.053	U	0	0.00265	0.07	J	0.007	0.007
1,2,3,7,8,9-HxCDF	0.1	0.033	U	0	0.00165	0.06	U	0	0.003	0.054	U	0	0.0027
2,3,4,6,7,8-HxCDF	0.1	0.033	U	0	0.00165	0.056	U	0	0.0028	0.046	U	0	0.0023
1,2,3,4,6,7,8-HpCDF	0.01	0.27	J	0.0027	0.0027	0.899	J	0.00899	0.00899	2.36		0.0236	0.0236
1,2,3,4,7,8,9-HpCDF	0.01	0.052	U	0	0.00026	0.063	U	0	0.000315	0.126	J	0.00126	0.00126
OCDF	0.0003	0.893	J	0.0002679	0.0002679	1.37	J	0.000411	0.000411	10.3		0.00309	0.00309
TOTAL TEQ				0.04	0.1			0.1	0.2			0.2	0.3

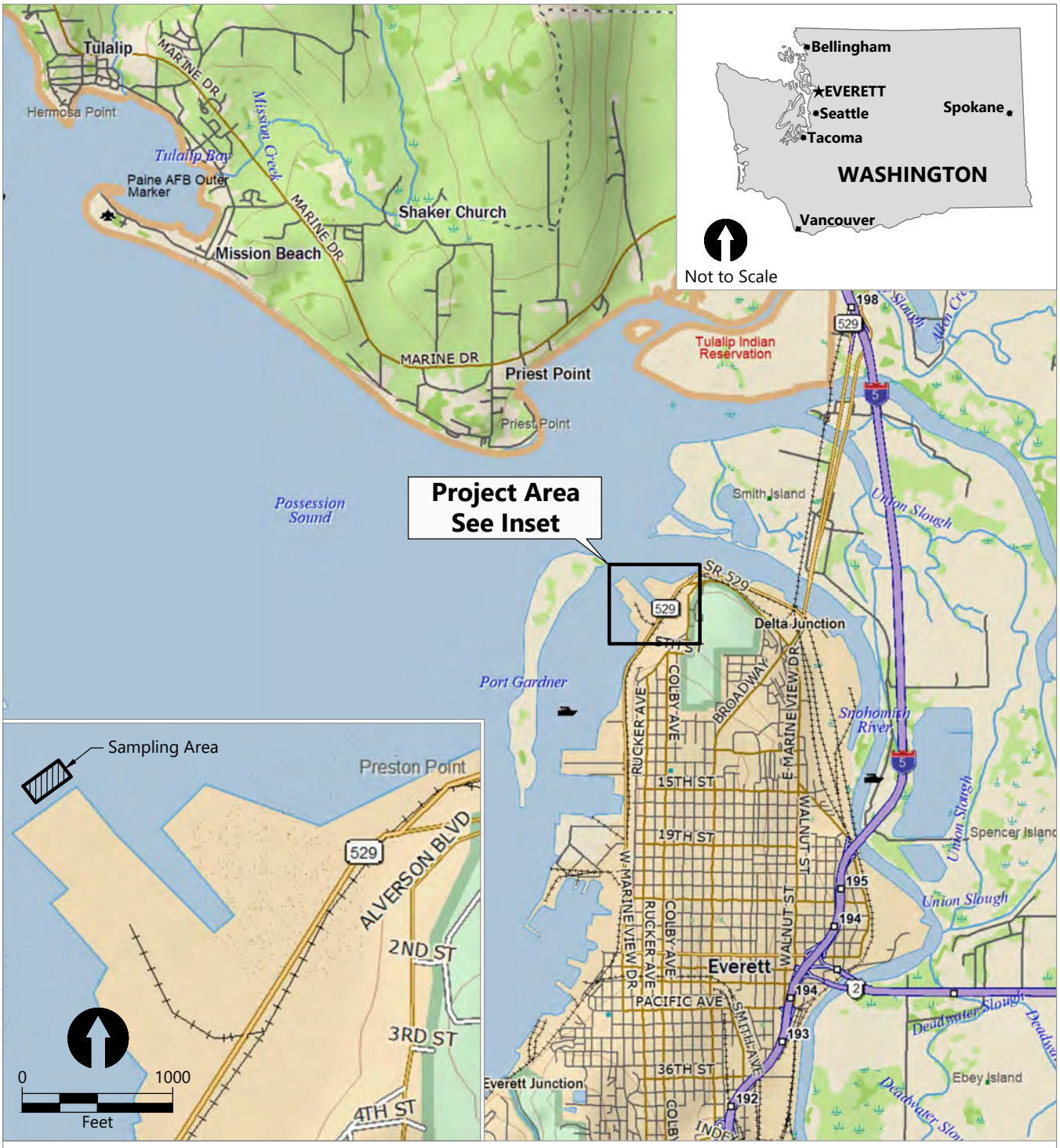
Table 6. Chemical results compared to SMS regulatory guidelines.

CHEMICAL	SMS Guidelines		DMMU 1		DMMU 2		z-sample	
	SQS	CSL	conc	LQ	conc	LQ	conc	LQ
Total Organic Carbon, %			0.76		0.74		0.61	
METALS (mg/kg dry)								
Arsenic	57	93	4.9		4.6		5.2	
Cadmium	5.1	6.7	0.03	J	0.05	J	0.04	J
Chromium	260	270	28		29		32	
Copper	390	390	16		18		17	
Lead	450	530	4		4		5	
Mercury	0.41	0.59	0.03	U	0.03		0.03	U
Silver	6.1	6.1	0.03	J	0.03	J	0.03	J
Zinc	410	960	41		41		43	
PAHs (mg/kg OC)								
Total LPAH	370	780	3.6	U	4.2	J	7.4	J
Naphthalene	99	170	3.6	U	3.1	U	8.6	U
Acenaphthylene	66	66	2.6	U	2.5	U	0.9	J
Acenaphthene	16	57	2.6	U	0.7	J	1.4	J
Fluorene	23	79	2.6	U	1.1	J	1.1	J
Phenanthrene	100	480	2.6	U	1.7	J	2.9	J
Anthracene	220	1200	2.6	U	0.8	J	1.1	J
2-Methylnaphthalene	38	64	0.78	J	1.0	J	2.4	J
Total HPAH	960	5300	3.3	J	7.5	J	4.7	J
Fluoranthene	160	1200	1.3	J	2.4	J	1.9	J
Pyrene	1000	1400	1.2	J	3.0		1.9	J
Benzo(a)anthracene	110	270	2.6	U	1.0	J	3.2	U
Chrysene	110	460	0.8	J	1.1	J	1.0	J
Benzofluoranthenes	230	450	5.3	U	5.1	U	6.4	U
Benzo(a)pyrene	99	210	2.6	U	2.5	U	3.2	U
Indeno(1,2,3-c,d)pyrene	34	88	2.6	U	2.5	U	3.2	U
Dibenzo(a,h)anthracene	12	33	0.66	U	0.64	U	0.80	U
Benzo(g,h,i)perylene	34	88	2.6	U	2.5	U	3.2	U
CHLORINATED BENZENES (mg/kg OC)								
1,2-Dichlorobenzene	2.3	2.3	0.66	U	0.64	U	0.80	U
1,4-Dichlorobenzene	3.1	9	0.66	U	0.64	U	0.80	U
1,2,4-Trichlorobenzene	0.81	1.8	0.66	U	0.64	U	0.80	U
Hexachlorobenzene	0.38	2.3	0.09	U	0.09	U	0.11	U
PHTHALATE ESTERS (mg/kg OC)								
Dimethyl phthalate	53	53	0.66	U	0.64	U	0.80	U
Diethyl phthalate	61	110	2.6	U	2.5	U	5.7	U
Di-n-butyl phthalate	220	1700	1.9	J	1.4	J	3.2	U
Butyl benzyl phthalate	4.9	64	2.6	U	2.5	U	3.2	U
Bis(2-ethylhexyl)phthalate	47	78	8.8		14.2		8.0	U
Di-n-octyl phthalate	58	4500	2.6	U	2.5	U	3.2	U

Table 6. Chemical results compared to SMS regulatory guidelines.

	SMS Guidelines		DMMU 1		DMMU 2		z-sample	
PHENOLS (ug/kg dry)								
Phenol	420	1200	4.7	J	7.9		6.6	
2 Methylphenol	63	63	6.9		4.7	U	4.9	U
4 Methylphenol	670	670	31.2		18.9		8.3	
2,4-Dimethylphenol	29	29	24.9	U	23.4	U	24.4	U
Pentachlorophenol	360	690	19.9	U	18.7	U	19.5	U
MISCELLANEOUS EXTRACTABLES (mg/kg OC)								
Dibenzofuran	15	58	2.6	U	0.9	J	0.9	J
Hexachlorobutadiene	3.9	6.2	0.7	U	0.6	U	0.8	U
N-Nitrosodiphenylamine	11	11	0.7	U	0.6	U	0.8	U
PCBs (mg/kg OC)								
Total PCBs (mg/kg carbon)	12	65	0.50	U	1.0	J	1.7	J
MISCELLANEOUS EXTRACTABLES (ug/kg dry)								
Benzyl alcohol	57	73	2.6	U	2.6		1.0	J
Benzoic acid	650	650	5.9	J	9.2	J	2.9	J

U = undetected
LQ = laboratory qualifier
OC = organic carbon
SMS = Sediment Management Standards
SQS = sediment quality standard
CSL = cleanup screening level

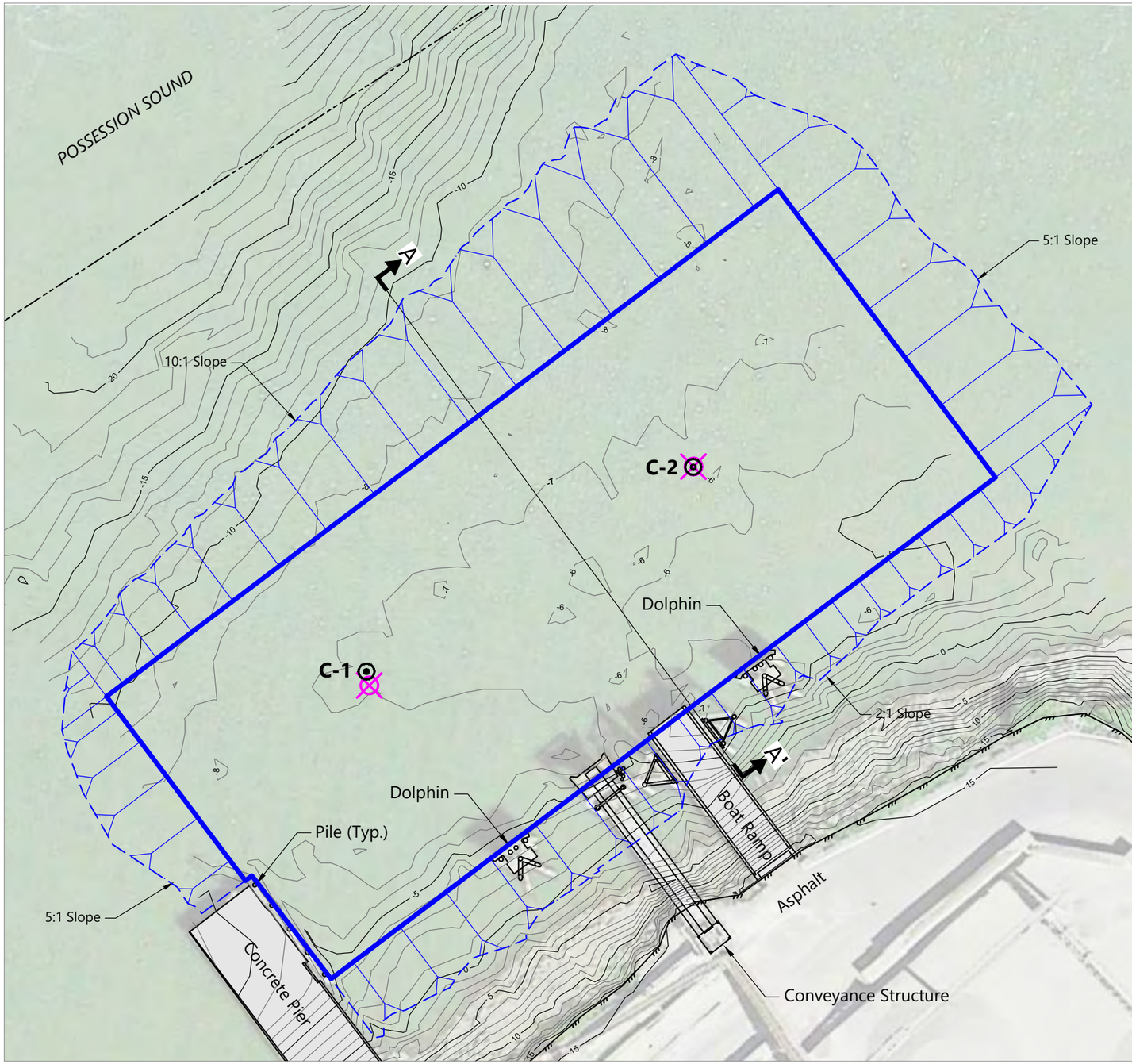


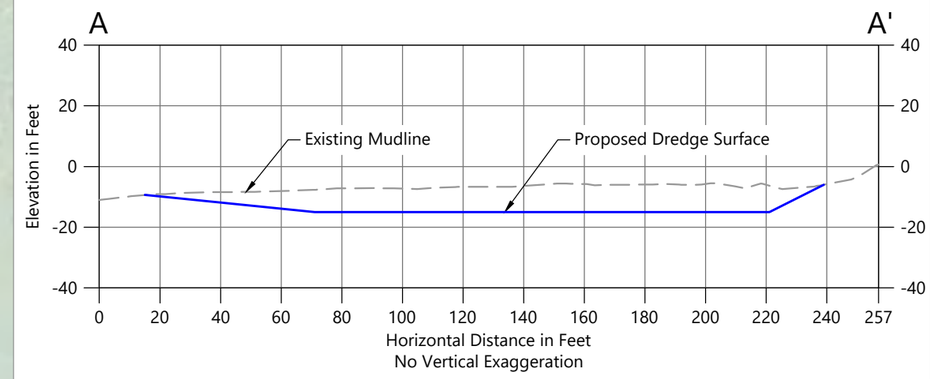
SOURCE: Drawing prepared from DeLorme Topo USA®.

Publish Date: 2018/08/13 10:35 AM | User: jbigsby
Filepath: K:\Projects\1229-Lehigh Hanson\N Everett Maintenance Dredging_Sediment Sample Collection and Testing\1229-RP-001 (Vicinity Map-Everett-Data_Rep).dwg FIG1

ANCHOR QEA

Figure 1
Vicinity Map





Difference in Elevation Between Existing and Design Surface		
DMMU Number	Dredge Thickness in Feet	Volume in Cubic Yards
DMMU1	0.0 to -4.0	11,877
DMMU2	> -4.0	9,581

LEGEND:

- Existing Bathymetric Contours (1- and 5-Foot Intervals)
- Proposed Dredge Prism (-13 + 2 Feet Overdredge)
- Slope Daylight Boundary
- Slope Direction Line
- Navigation Channel
- Proposed Sediment Core Location
- Actual Sediment Core Location
- Cross Section Location

0 50 Feet

SOURCE: Base map and existing bathymetry prepared from a survey provided by Wilson Survey/Engineering, dated 11/10/17. Aerial photograph from Google Earth.
HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet.
VERTICAL DATUM: Mean Lower Low Water.

Publish Date: 2018/08/13 10:55 AM | User: jbigsby
Filepath: K:\Projects\1229-Lehigh Hanson\N Everett Maintenance Dredging_Sediment Sample Collection and Testing\1229-RP-002 (Site Plan-Everett-Data_Rep).dwg FIG2

ANCHOR QEA

Figure 2
Proposed and Actual Sampling Locations

Sediment Characterization Data Report
Cadman Materials Inc. North Everett Facility Navigational Maintenance Sediment Characterization