CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD April 7, 2015

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF PROPOSED DREDGED MATERIAL FROM THE WILLAPA BAY FEDERAL NAVIGATION PROJECTS AT TOKELAND MARINA AND ENTRANCE CHANNEL, BAY CENTER ENTRANCE CHANNEL AND NAHCOTTA MOORING BASIN FOR UNCONFINED OPEN-WATER DISPOSAL AT THE GOOSE POINT OR CAPE SHOALWATER DISPOSAL SITES OR FOR FLOWLANE DISPOSAL AND FOR BENEFICIAL USE.

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 120,610 cubic yards (cy) of dredged material from the Tokeland Marina and Entrance Channel, up to 66,360 cy of dredged material from Bay Center Entrance Channel, and up to 164,440 cy of dredged material from Nahcotta Mooring Basin for disposal at the Goose Point or Cape Shoalwater open-water disposal sites or for flowlane disposal or beneficial use, and for compliance with the State of Washington Antidegradation Policy.

2. Background. Tokeland, Bay Center and Nahcotta are all located within Willapa Bay (Figure 1) on the west coast of Washington State. Previous characterizations of the material from Tokeland, Bay Center and Nahcotta have found all the dredged material to be suitable for open-water disposal. Past suitability determinations are available on the DMMO website.

3. Project Summary. Table 1 includes project summary information. Table 2 includes project tracking information.

Table 1. Project Summary

	Tokeland			Bay Center	Nahcotta
	Entrance channel:	Marina:	Marina area "P1":		
Project ranking	low	low-moderate	low-moderate	low	moderate
Proposed dredging volume	43,190 cy	69,580 cy	7,840 cy	66,360 cy	164,440 cy
Proposed dredging depth (including 1 ft advance maintenance and 1 ft overdredge)	-17 ft MLLW	-19 ft MLLW	-11 ft MLLW	-12 ft MLLW	-12 ft MLLW
Recency date	September 2021	September 2020	September 2020	September 2021	September 2019

Table 2. Project tracking information

1st draft SAP received	August 20, 2014
Comments provided on 1st draft SAP	September 3, 2014
2nd draft SAP received	September 5, 2014
Comments provided on 2nd draft SAP	September 8, 2014
Final SAP received	September 9, 2014
SAP approved	September 9, 2014
Sampling dates	September 9 – 24, 2014
SAP addendum received and approved	December 1, 2014
Draft data report received	February 25th, 2015
Comments provided on draft report	March 9th, 2015
Final data report received	April 1, 2015
EIM Study ID	WILLA14

4. Project Ranking and Sampling Requirements. This project was ranked according to the guidelines set out in the DMMP User Manual for areas in Willapa Bay. Table 1 provides the rankings for each project area. The number of samples and analyses were calculated using the guidelines outlined in the DMMP User Manual (2014) for areas of low, low-moderate, and moderate rank, as appropriate.

   Four DMMUs were delineated at Tokeland, 2 surface DMMUs (0-4 ft, DMMUs 1 and 2) and 2 subsurface DMMUs (>4ft, DMMUs 3 and 4). No subsurface DMMUs were necessary in Bay Center because the depth of shoaled material was generally not more than 5 feet. Therefore, for Bay Center two surface DMMUs were delineated representing the full depth of material. In Nahcotta the shoaled material was only deep enough to warrant a separately dredgable subsurface DMMU in the northwest corner of the marina. Thus, Nahcotta is represented by 10 surface DMMUs and 1 subsurface DMMU (DMMU 11).

5. Sampling. Sampling took place September 9 – 24th, 2014 aboard the *R/V Nancy Ann* operated by Marine Sampling Services. Cores were collected using a hydraulically actuated vibracore. The approved sampling and analysis plan (DOF, 2014) was followed to the extent possible given the sampling circumstances. Figures 2.1 through 2.4 show the target and actual coring locations (DOF, 2015) for Tokeland, Bay Center and Nahcotta, respectively. Tables 3.1 to 3.3 provide the sample compositing information for each area. Tables 4.1 to 4.3 provide the coordinates for each core for each area. All cores collected met the acceptance criteria of 75% percent recovery and 100% penetration to the bottom of the z-layer. Some of the actual sampling locations were moved up to 53 ft away from the original target locations in order to collect an acceptable core. All collected cores were located within the appropriate DMMUs. There were several small errors during collection and compositing of the cores, described below:
   - In Tokeland DMMU 4, due to a computation error in the field, Core 6 was collected and composited to a foot deeper than the design depth for the DMMU.
   - In Nahcotta DMMU 11, due to a computation error in the field, Core 3 was collected and

composited to 1.5 ft deeper than the design depth for the DMMU.

- In Nahcotta DMMU 5, due to a computation error in the field, Core 18 was collected and composited to one foot shy of the design depth for the DMMU.

The DMMP agencies reviewed the sampling and compositing errors and determined that overall the samples collected are representative of the dredged material.

6. Chemical Analysis. Analysis of conventionals and all standard DMMP COCs was conducted by Analytical Resources, Inc. (ARI) of Tukwila, WA. Analysis of pesticides by high resolution GC/MS/MS was performed by ALS Labs of Kelso, WA and analysis of non-standard pesticides was performed by Pacific Agricultural Lab (PAL) of Portland, OR. The results compared to current DMMP guidelines for marine waters are described below by project area.

Tokeland Marina and Entrance Channel. Chemistry and conventional results are presented in Table 5.1. Conventional results showed that most of the dredged material is slightly sandy clayey silts with 6 – 13% sand. DMMU 2 was substantially different, with 42% sand. Total fines (silt + clay) in all DMMUs ranged from 58 – 93%. Total organic carbon (TOC) ranged from 1.74 to 2.51% in the dredged material. Chemical results were either undetected or detected below DMMP SLs for all DMMP COCs except total chlordane, dieldrin and heptachlor. These three pesticides were non-detect at elevated reporting limits above their respective DMMP SLs in all four DMMUs. ARI reported that the results were due to interferences and limitations to the reporting limits using EPA Method 8081. Further pesticide analysis was conducted and is discussed separately below.

Dioxin results for Tokeland are presented in Table 6.1. All dioxin results were below 15 pptr TEQ and 5 ng/kg 2,3,7,8-TCDD, which are the thresholds for dioxin concentrations allowed at dispersive sites in Willapa Bay. Total TEQs (U=1/2 RL) ranged from 1.2 to 2.71 pptr.

Bay Center Entrance Channel. The conventional results showed that each DMMU was very distinct. DMMU 1, which was collected within the inner harbor, consisted of primarily slightly sandy clayey silts with 88% fines. The sediments within DMMU 2, which were collected within the approach and main channel of the Palix River, are slightly silty sands with 84% sand. TOC was 2.4 and 1.4%, respectively. Conventionals and standard DMMP COC results are presented in Table 5.2.

DMMU 1 had non-detected exceedances of SLs for dieldrin and heptachlor due to interferences and limitations to the reporting limits using EPA Method 8081. Further analysis of this DMMU was undertaken and is discussed separately below.

DMMU 2 had an anomalously high level of diethyl phthalate detected at 980 μg/kg, almost five times above the SL (200 μg/kg). There were no other COCs that exceeded SLs; including the other four phthalates. The diethyl phthalate result was confirmed by the laboratory to be present in the original extract. Diethyl phthalate was also detected in the method blank, but at much lower level than in the sample, 21 μg/kg vs. 980 μg/kg. Diethyl phthalate is a common laboratory contaminant, being present in many types of plastic. Possible sources of diethyl phthalate include a small bit of plastic introduced into the sample in the laboratory, or a plastic micro-particle could have been part

of the extracted sediment sample. The laboratory suggested re-extraction and re-analysis of the sediment sample, which the Corps chose to pursue. In total three additional extractions and analyses were conducted on DMMU 2 – one from the composite chemistry archive jar (Rep 1) and two from the original sample jar (Reps 2 and 3). The results of the reanalyses were 19 (U), 18 (J), and 15 (J) μg/kg, respectively (see Table 7).

The DMMP agencies determined that since all three replicate analyses returned similar results that were well below the DMMP SL and were consistent with diethyl phthalate results from the rest of the samples analyzed in Willapa Bay, and since diethyl phthalate is a known and common laboratory contaminant, that the weight of evidence suggested that diethyl phthalate was not a concern in the sediments of Bay Center DMMU 2. Therefore, the DMMP agencies determined that further testing of this material was not warranted.

Dioxin results for Bay Center are presented in Table 6.2. All dioxin results were below 15 pptr TEQ and 5 ng/kg 2,3,7,8-TCDD, which are the thresholds for dioxin concentrations allowed at dispersive sites in Willapa Bay. Total TEQs (U=1/2 RL) for DMMUs 1 and 2 were 1.33 and 0.62 pptr respectively.

Nahcotta Mooring Basin. Chemistry and conventional results are presented in Table 5.3. Conventional results showed that there was a range of physical characteristics, from silty sands to sandy silts to slightly sandy clayey silts. Total fines (silt + clay) in all DMMUs ranged from 25 to 84%. TOC ranged from 0.95 to 2.18% in the dredged material. Chemistry results were either undetected or detected below DMMP SLs for all DMMP COCs except total chlordane and heptachlor. Heptachlor was non-detected at an elevated reporting limit above the SL in DMMU 2 and total chlordane was non-detected at an elevated reporting limit above the SL in DMMU 11. ARI reported that the results were due to interferences and limitations to the reporting limits using EPA Method 8081. Further pesticide analysis was conducted and is discussed separately below.

Dioxin results for Nahcotta are presented in Table 6.3. All dioxin results were below 15 pptr TEQ and 5 ng/kg 2,3,7,8-TCDD, which are the thresholds for dioxin concentrations allowed at dispersive sites in Willapa Bay. Total TEQ (U=1/2 RL) ranged from 1.16 to 3.69 pptr

High Resolution Pesticide Analysis by HRGC/MS/MS. Due to the multiple non-detected exceedances of SLs for total chlordane, dieldrin and heptachlor found at all three Willapa Bay sites, additional analyses were undertaken at the recommendation of the laboratory. ARI suggested analyzing the samples for pesticides using a high resolution method with lower reporting limits and potential ability to identify interferences. Additional analysis on eight DMMUs with non-detect exceedances was performed by ALS Labs using a high resolution GC/MS/MS method. Results of this analysis are presented in Table 8. All results were non-detected well below DMMP SLs, demonstrating that the elevated reporting limits found in the original analysis were the result of an unidentified interference and were not the result of the compounds of interest being present in the samples. The DMMP accepts the results of the high resolution analyses as showing that none of these pesticide compounds are present at levels of concern in the dredged material. No additional analyses are needed for the standard pesticides.

Non-standard pesticide analysis. As was done in previous characterization in Willapa Bay, the

Corps elected to analyze a subset of samples for seven non-standard pesticides that are used or potentially used in Willapa Bay. These included: carbaryl (Sevin), 1-naphthol (a degradation product of carbaryl), imazamox, imazapyr, imidacloprid, glyphosate (Roundup, Rodeo) and aminomethylphosphonic acid (AMPA) - a degradation product of glyphosate. These analyses are done purely for informational purposes, as there are no established sediment screening levels for these compounds.

Analysis of non-standard pesticides was performed on twelve DMMUs that were chosen by the DMMP agencies based on grain-size distribution and TOC content. Results of the non-standard pesticide analysis are shown in Table 9. All results were non-detect with the exception of glyphosate in Tokeland subsurface DMMU 4, which was detected at a concentration of 49 μg/kg. In previous characterizations glyphosate was undetected at 17 μg/kg.

7. Sediment Exposed by Dredging. 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).

   There were no detected SQS exceedances in the dredge prism sediments (Tables 10.1 to 10.3). Therefore, 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 the Willapa Bay Federal Navigation Projects at Tokeland Marina and Entrance Channel, Bay Center Entrance Channel, and Nahcotta Mooring Basin for dispersive disposal at the Goose Point or Cape Shoalwater open-water disposal sites or for flow lane disposal or beneficial use. The approved sampling and analysis plan was generally followed and 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 120,610 cy of material from Tokeland Marina and Entrance Channel, all 66,360 cy of material from Bay Center Entrance Channel, and all 164,440 cy of material from Nachotta Mooring Basin are suitable for open-water disposal at the Goose Point or Cape Shoalwater dispersive sites or for flowlane disposal or beneficial use.

   This suitability determination does ***not*** constitute final agency approval of the project. A dredging plan for this project must be completed as part of the final project approval process. 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.

9. References.

DMMP, 2014. *Dredged Material Evaluation and Disposal Procedures (Users Manual)*. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program. December 2014.

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.

DOF, 2014. Sampling and Analysis Plan, Willapa Bay Federal Navigation Projects Dredged Material Characterization. Prepared for USACE by Dalton Olmsted and Fuglevand, Inc. and Science and Engineering for the Environment LLC. September 9, 2014

DOF, 2015. Final Data Report, Willapa Bay Federal Navigation Projects Dredged Material Characterization. Prepared for USACE by Dalton Olmsted and Fuglevand, Inc. and Science and Engineering for the Environment LLC. March 23, 2015.

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

10. Agency Signatures.

The signed document is on file in the Dredged Material Managment Office.

Concur:

_____	_____
Date	Kelsey van der Elst - Seattle District Corps of Engineers
_____	_____
Date	Justine Barton - Environmental Protection Agency
_____	_____
Date	Laura Inouye, Ph.D. - Washington Department of Ecology
_____	_____
Date	Celia Barton - Washington Department of Natural Resources

Copies furnished:

DMMP signatories

John Hicks, Chief of Navigation Section

Elizabeth Chien, Navigation Project Manager

Tim Thompson, SEE

Table 3.1 Sampling and Compositing at Tokeland in ft MLLW

Tokeland		DMMU 1	DMMU 2	DMMU 3	DMMU 4	Total
	Volume (CY):	31,860	20,740	45,560	22,450	120,610
Station	Core 1	-5.8 to -9.8		-9.8 to -19		
	Core 2	-6.3 to -10.3		-10.3 to -19		
	Core 3	-8.4 to -12.4		-12.4 to -19.1		
	Core 4 (P1)	-4.6 to -8.4		-8.4 to -13		
	Core 5		-7 to -11		-11 to -17	
	Core 6		-5.6 to -9.6		-9.6 to -18	
	Core 7		-4.5 to -8.5		-8.5 to -17	
	Core 8		-11.5 to -17			

Notes:

1) The design depth for Tokeland is -19 ft MLLW in the marina, -13 ft MLLW in Area P1, and -17 ft MLLW in the entrance channel
2) The design depths include 1 ft of advance maintenance and 1 ft of overdredge
3) DMMU volumes have been adjusted for bulking during dredging.

Table 3.2 Sampling and Compositing at Bay Center in ft MLLW.

Bay Center		DMMU 1	DMMU 2	Total
	Volume (CY):	44,510	21,850	66,360
Station	Core 1	-6.2 to -12		
	Core 2	-3.5 to -12		
	Core 3	-4.2 to -12		
	Core 4	-5.2 to -12		
	Core 5		-9.7 to -12	
	Core 6		-6.6 to -12	
	Core 7		-6.3 to -12	
	Core 8		-5.1 to -12	

Notes:

1) The design depth for Bay Center is -12 ft MLLW
2) The design depth includes 1 ft of advance maintenance and 1 ft of overdredge
3) DMMU volumes have been adjusted for bulking during dredging.

Table 3.3 Sampling and Compositing at Nahcotta in ft MLLW.

Nahcotta		DMMU 1	DMMU 2	DMMU 3	DMMU 4	DMMU 5	DMMU 6	DMMU 7	DMMU 8	DMMU 9	DMMU 10	DMMU 11	Total
	Volume (CY):	15,250	15,260	15,260	15,260	12,860	15,180	15,410	15,260	15,260	15,260	14,180	164,440
Station	Core 1	-0.7 to -4.7										-4.7 to -12	
	Core 2	-6.2 to -10.2										-10.2 to -12	
	Core 3	-1.5 to -5.5										-5.5 to -13.5	
	Core 4	-7.2 to -12											
	Core 5		-4 to -8									-8 to -12	
	Core 6		-2.7 to -12										
	Core 7		-8 to -12										
	Core 8		-7.7 to -12										
	Core 9			-3.8 to -12									
	Core 10			-2.7 to -12									
	Core 11			-8.2 to -12									
	Core 12			-8.2 to -12									
	Core 13				-2.5 to -12								
	Core 14				-4.7 to -12								
	Core 15				-8 to -12								
	Core 16				-7.9 to -12								
	Core 17					-7.4 to -12							
	Core 18					-6.7 to -11							
	Core 19					-8.2 to -12							
	Core 20					-8.3 to -12							
	Core 21						-3.8 to -12						
	Core 22						-3.8 to -12						
	Core 23						-7.2 to -12						
	Core 24						-7.5 to -12						
	Core 25							-7.3 to -12					
	Core 26							-8.2 to -12					
	Core 27							-8.3 to -12					
	Core 28							-8.3 to -12					
	Core 29								-7.7 to -12				
	Core 30								-7.6 to -12				
	Core 31								-7.7 to -12				
	Core 32								-8 to -12				
	Core 33									-8.4 to -12			
	Core 34									-7.7 to -12			
	Core 35									-7.9 to -12			
	Core 36									-8.5 to -12			
	Core 37										-7.7 to -12		
	Core 38										-7.6 to -12		
	Core 39										-8.6 to -12		
	Core 40										-8.5 to -12		

Notes:

1) The design depth for Nahcotta is -12 ft MLLW
2) The design depth includes 1 ft of advance maintenance and 1 ft of overdredge
3) DMMU volumes have been adjusted for bulking during dredging.

Table 4.1 Tokeland core coordinates (NAD83)

TKL Core	Latitude (N)	Longitude (W)
1	46° 42.45809	123° 58.15512
2	46° 42.46789	123° 58.11343
3	46° 42.44087	123° 58.08197
4	46° 42.46856	123° 58.05327
5	46° 42.48630	123° 58.10914
6	46° 42.48707	123° 58.05723
7	46° 42.45786	123° 57.99491
8	46° 42.43239	123° 57.84190

Table 4.2 Bay Center core coordinates (NAD83)

BCI Core	Latitude (N)	Longitude (W)
1	46° 37.75893	123° 57.12133
2	46° 37.76498	123° 57.07339
3	46° 37.79580	123° 56.99016
4	46° 37.82935	123° 56.88497
5	46° 37.87352	123° 56.77423
6	46° 37.96814	123° 56.72352
7	46° 38.01890	123° 56.70031
8	46° 38.06489	123° 56.67536

Table 4.3 Nahcotta core coordinates (NAD83)

NMB Core	Latitude (N)	Longitude (W)
1	46° 30.09743 N	124° 01.80641 W
2	46° 30.08613 N	124° 01.78414 W
3	46° 30.10241 N	124° 01.75448 W
4	46° 30.07034 N	124° 01.75332 W
5	46° 30.10223 N	124° 01.73055 W
6	46° 30.10208 N	124° 01.68644 W
7	46° 30.07074 N	124° 01.73207 W
8	46° 30.07388 N	124° 01.67743 W
9	46° 30.10318 N	124° 01.65945 W
10	46° 30.10217 N	124° 01.60395 W
11	46° 30.07049 N	124° 01.66212 W
12	46° 30.06724 N	124° 01.60882 W
13	46° 30.10367 N	124° 01.59313 W
14	46° 30.10105 N	124° 01.54458 W
15	46° 30.07056 N	124° 01.58564 W
16	46° 30.07720 N	124° 01.53262 W
17	46° 30.08456 N	124° 01.52136 W
18	46° 30.08913 N	124° 01.49311 W
19	46° 30.07952 N	124° 01.45120 W
20	46° 30.06192 N	124° 01.49570 W
21	46° 30.03512 N	124° 01.83009 W
22	46° 30.01661 N	124° 01.85737 W
23	46° 29.99164 N	124° 01.83167 W
24	46° 30.01445 N	124° 01.82821 W
25	46° 30.02689 N	124° 01.81070 W
26	46° 30.04113 N	124° 01.75535 W
27	46° 30.06293 N	124° 01.80902 W
28	46° 30.06431 N	124° 01.74941 W
29	46° 30.03039 N	124° 01.73228 W
30	46° 30.02547 N	124° 01.69876 W
31	46° 30.06406 N	124° 01.73500 W
32	46° 30.06214 N	124° 01.68543 W
33	46° 30.03992 N	124° 01.67380 W
34	46° 30.02365 N	124° 01.61586 W
35	46° 30.06090 N	124° 01.66484 W
36	46° 30.05948 N	124° 01.61524 W
37	46° 30.02546 N	124° 01.59295 W
38	46° 30.02313 N	124° 01.54307 W
39	46° 30.06226 N	124° 01.60406 W
40	46° 30.04000 N	124° 01.53974 W

Table 5.1. Tokeland chemical results compared to DMMP regulatory guidelines.

CHEMICAL	DMMP Guidelines			DMMU 1		DMMU 2		DMMU 3		DMMU 4	
	SL	BT	ML								
CONVENTIONALS				conc	LQ	conc	LQ	conc	LQ	conc	LQ
Gravel, %				0.5		0.6		0.9		0.8	
Sand, %				6.3		41.6		12.9		16.3	
Silt, %				57.8		35.8		52.8		50.8	
Clay, %				35.4		22.1		33.4		32.1	
Fines (Silt + Clay), %				93.2		57.9		86.2		82.9	
Total Solids, %				38.34		50.33		48.23		47.72	
Volatile Soilids, %				9.51		5.94		7.81		8.68	
Total Organic Carbon, %				2.51	J	1.74		2.1		1.9	
Total Ammonia, mg N/kg				293		134		386		467	
Total Sulfides, individual core, mg/kg				1780		2630		1840		1400	
Total Sulfides, composite, mg/kg				3530		1230		2500		1560	
METALS (mg/kg dry)											
Antimony	150	---	200	10	UJ	10	UJ	10	UJ	10	UJ
Arsenic	57	507	700	4.1	J	4	J	3.5	J	5.4	J
Cadmium	5.1	11.3	14.0	0.5		0.383	J	0.5		0.5	
Chromium	260	260	---	36		32		38		36	
Copper	390	1,027	1,300	33.6		24.3		32.9		32	
Lead	450	975	1,200	10		8		11		10	
Mercury	0.41	1.5	2.3	0.07		0.05		0.07		0.07	
Selenium	---	3	---	0.97	U	0.68	U	0.77	U	0.89	U
Silver	6.1	6.1	8.4	0.8	U	0.6	U	0.6	U	0.6	U
Zinc	410	2,783	3,800	93		73		97		91	
ORGANOMETALLIC COMPOUNDS (ug/L interstitial water)											
Tributyltin (ion)	0.15	0.15	---	0.005	U	0.005	U	0.005	U	0.005	U
PAHs (ug/kg dry)											
Total LPAH	5,200	---	29,000	89.1		62.2		192.2		68.5	
Naphthalene	2,100	---	2,400	13		25		16		11	
Acenaphthylene	560	---	1,300	3.2	J	5.4		5.2		2.5	J
Acenaphthene	500	---	2,000	9.9		2.6	J	21		8.7	
Fluorene	540	---	3,600	13	J	6.1	J	27	J	11	J
Phenanthrene	1,500	---	21,000	33	J	19	J	93	J	28	J
Anthracene	960	---	13,000	17	J	4.1	J	30	J	7.3	J
2-Methylnaphthalene	670	---	1,900	99		14		16		17	
Total HPAH	12,000	---	69,000	247.1		95.6		586		153.3	
Fluoranthene	1,700	4,600	30,000	90		26		230		51	
Pyrene	2,600	11,980	16,000	61		24		190		40	
Benzo(a)anthracene	1,300	---	5,100	15	J	6.4	J	33	J	9.8	J
Chrysene	1,400	---	21,000	26		8.6		38		13	
Total benzofluoranthenes	3,200	---	9,900	27		13	J	46		19	J
Benzo[a]pyrene	1,600	---	3,600	12		7.1		21		7.9	
Indeno(1,2,3-c,d)pyrene	600	---	4,400	6.7		3.8	J	11		4.9	
Dibenzo(a,h)anthracene	230	---	1,900	4.9	U	4.9	U	4.8	U	4.9	U
Benzo(g,h,i)perylene	670	---	3,200	9.4		6.7		17		7.7	
CHLORINATED BENZENES (ug/kg dry)											
1,4-Dichlorobenzene	110	---	120	20	U	20	U	19	U	19	U
1,2-Dichlorobenzene	35		110	20	U	20	U	19	U	19	U
1,2,4-Trichlorobenzene	31	---	64	20	U	20	U	19	U	19	U
Hexachlorobenzene	22	168	230	19	U	19	U	9	UJ	4.9	U

Table 5.1. Tokeland chemical results compared to DMMP regulatory guidelines.

CHEMICAL	DMMP Guidelines			DMMU 1		DMMU 2		DMMU 3		DMMU 4	
	SL	BT	ML								
PHTHALATE ESTERS (ug/kg dry)											
Dimethyl phthalate	71	---	1,400	20	U	20	U	19	U	19	U
Diethyl phthalate	200	---	1,200	27	U	20	U	25	U	19	U
Di-n-butyl phthalate	1,400	---	5,100	20	U	20	U	19	U	19	U
Butyl benzyl phthalate	63	---	970	20	U	20	U	19	U	19	U
Bis(2-ethylhexyl)phthalate	1,300	---	8,300	140		49	U	48	U	48	U
Di-n-octyl phthalate	6,200	---	6,200	20	U	20	U	19	U	19	U
PHENOLS (ug/kg dry)											
Phenol	420	---	1,200	20	U	44		19	U	19	U
2 Methylphenol	63	---	77	20	U	20	U	19	U	19	U
4 Methylphenol	670	---	3,600	67		79		64		19	U
2,4-Dimethylphenol	29	---	210	14	J	25	U	24	U	24	U
Pentachlorophenol	400	504	690	98	U	99	U	96	U	97	U
MISCELLANEOUS EXTRACTABLES (ug/kg dry)											
Benzyl alcohol	57		870	20	U	20	U	19	U	19	U
Benzoic acid	650	---	760	620		230		320		240	
Dibenzofuran	540	---	1,700	20	U	20	U	19	U	19	U
Hexachlorobutadiene	11	---	270	4.8	U	4.9	U	4.8	U	4.9	U
N-Nitrosodiphenylamine	28	---	130	20	U	20	U	19	U	19	U
PESTICIDES (ug/kg dry)											
p,p'-DDD	16	---	---	4.8	U	4.9	U	4.8	U	4.9	U
p,p'-DDE	9	---	---	4.8	U	4.9	U	4.8	U	4.9	U
p,p'-DDT	12	---	---	4.8	U	4.9	U	4.8	U	7.6	UJ
Total DDT		50	69	4.8	U	4.9	U	4.8	U	7.6	UJ
Aldrin	9.5	---	---	8.3	U	6.6	U	2.4	U	6.8	U
Total Chlordane	2.8	37	---	18	U	49	U	11	U	27	U
Dieldrin	1.9	---	---	4.8	U	4.9	U	4.8	U	4.9	U
Heptachlor	1.5	---	---	14	U	2.5	U	4.8	U	9.6	U
PCBs (ug/kg dry)											
Total PCBs	130	---	3,100	24	U	20	U	23	U	20	U
Total PCBs (mg/kg OC)	---	38	---	0.96	U	1.15	U	1.10	U	1.05	U
SUMMARY											
DMMP determination				PASS		PASS		PASS		PASS	
DMMU volume				31,860		20,740		45,560		22,450	
Rank				low-moderate		low		low-moderate		low	
Mean sample depth				2		2.2		3.7		3.8	
Maximum sampling depth				4		5.5		9.2		8.5	
	SL	BT	ML								

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

Table 5.2. Bay Center chemical results compared to DMMP regulatory guidelines.

CHEMICAL	DMMP Guidelines			DMMU 1		DMMU 2	
	SL	BT	ML				
CONVENTIONALS				conc	LQ	conc	LQ
Gravel, %				0.7		0.4	
Sand, %				11.5		83.9	
Silt, %				57.3		9.4	
Clay, %				30.5		6.5	
Fines (Silt + Clay), %				87.8		15.9	
Total Solids, %				47.04		67.47	
Volatile Soilids, %				8.79		3.94	
Total Organic Carbon, %				2.42		1.43	
Total Ammonia, mg N/kg				231		38.4	
Total Sulfides, individual core, mg/kg				2970		357	
Total Sulfides, composite, mg/kg				2880		525	J
METALS (mg/kg dry)							
Antimony	150	---	200	10	UJ	8	UJ
Arsenic	57	507	700	1.5	J	2.78	J
Cadmium	5.1	11.3	14.0	0.5		0.3	U
Chromium	260	260	---	38		22.1	
Copper	390	1,027	1,300	32.2		11.5	
Lead	450	975	1,200	9		5	
Mercury	0.41	1.5	2.3	0.07		0.026	J
Selenium	---	3	---	0.68	U	0.472	U
Silver	6.1	6.1	8.4	0.6	U	0.5	U
Zinc	410	2,783	3,800	91		54	
ORGANOMETALLIC COMPOUNDS (ug/L interstitial water)							
Tributyltin (ion)	0.15	0.15	---	0.005	U	0.005	U
PAHs (ug/kg dry)							
Total LPAH	5,200	---	29,000	70.9		37.1	
Naphthalene	2,100	---	2,400	14		15	
Acenaphthylene	560	---	1,300	6		2.4	J
Acenaphthene	500	---	2,000	2.5	J	4.8	U
Fluorene	540	---	3,600	8.4	J	3.5	J
Phenanthrene	1,500	---	21,000	24	J	13	J
Anthracene	960	---	13,000	16	J	3.2	J
2-Methylnaphthalene	670	---	1,900	33	J	6.9	
Total HPAH	12,000	---	69,000	362.9		131	
Fluoranthene	1,700	4,600	30,000	93		29	
Pyrene	2,600	11,980	16,000	69		26	
Benzo(a)anthracene	1,300	---	5,100	27	J	11	J
Chrysene	1,400	---	21,000	43		13	
Total benzofluoranthenes	3,200	---	9,900	65		29	
Benzo[a]pyrene	1,600	---	3,600	25		12	
Indeno(1,2,3-c,d)pyrene	600	---	4,400	16		5.2	
Dibenzo(a,h)anthracene	230	---	1,900	3.9	J	4.8	U
Benzo(g,h,i)perylene	670	---	3,200	21		5.8	
CHLORINATED BENZENES (ug/kg dry)							
1,4-Dichlorobenzene	110	---	120	20	U	19	U
1,2-Dichlorobenzene	35		110	20	U	19	U
1,2,4-Trichlorobenzene	31	---	64	20	U	19	U
Hexachlorobenzene	22	168	230	19	U	1.8	U

Table 5.2. Bay Center chemical results compared to DMMP regulatory guidelines.

CHEMICAL	DMMP Guidelines			DMMU 1		DMMU 2	
	SL	BT	ML				
PHTHALATE ESTERS (ug/kg dry)							
Dimethyl phthalate	71	---	1,400	20	U	25	
Diethyl phthalate	200	---	1,200	20	U	980	
Di-n-butyl phthalate	1,400	---	5,100	20	U	19	U
Butyl benzyl phthalate	63	---	970	20	U	19	U
Bis(2-ethylhexyl)phthalate	1,300	---	8,300	49	U	48	U
Di-n-octyl phthalate	6,200	---	6,200	20	U	19	U
PHENOLS (ug/kg dry)							
Phenol	420	---	1,200	70		18	J
2 Methylphenol	63	---	77	20	U	19	U
4 Methylphenol	670	---	3,600	57		19	U
2,4-Dimethylphenol	29	---	210	24	U	24	U
Pentachlorophenol	400	504	690	97	U	96	U
MISCELLANEOUS EXTRACTABLES (ug/kg dry)							
Benzyl alcohol	57		870	20	U	19	U
Benzoic acid	650	---	760	240		190	U
Dibenzofuran	540	---	1,700	20	U	19	U
Hexachlorobutadiene	11	---	270	5	U	0.96	U
N-Nitrosodiphenylamine	28	---	130	20	U	19	R
PESTICIDES (ug/kg dry)							
p,p'-DDD	16	---	---	5	U	0.96	U
p,p'-DDE	9	---	---	5	U	0.96	U
p,p'-DDT	12	---	---	5	U	0.96	U
Total DDT		50	69	5	U	0.96	U
Aldrin	9.5	---	---	2.5	U	0.53	U
Total Chlordane	2.8	37	---	10	U	0.96	U
Dieldrin	1.9	---	---	5	U	0.96	U
Heptachlor	1.5	---	---	5.3	U	0.48	U
PCBs (ug/kg dry)							
Total PCBs	130	---	3,100	*9.8*	*U*	*9.1*	*U*
Total PCBs (mg/kg OC)	---	38	---	0.40		0.64	
SUMMARY							
DMMP determination				PASS		PASS	
DMMU volume				44,510		21,850	
Rank				low		low	
Mean sample depth				3.6		2.5	
Maximum sampling depth				8.5		6.9	
	SL	BT	ML				

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

Table 5.3. Nahcotta chemical results compared to DMMP regulatory guidelines.

CHEMICAL	DMMP Guidelines			DMMU 1		DMMU 2		DMMU 3		DMMU 4		DMMU 5		DMMU 6		DMMU 7		DMMU 8		DMMU 9		DMMU 10		DMMU 11	
	SL	BT	ML																						
CONVENTIONALS				conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ
Gravel, %				2.8		0.1U		0.6		0.9		1.4		0.2		2		0.1		0.8		0.4		0.1	
Sand, %				53.8		50		59.2		51		16.7		74.5		42.1		27.5		15.6		42.3		52.7	
Silt, %				27.8		29.1		23.5		29		49.7		15.3		34.2		42.7		49.1		34.4		28.6	
Clay, %				15.6		20.9		16.7		19.1		32.3		9.9		21.6		29.7		34.5		22.9		18.6	
Fines (Silt + Clay), %				43.4		50		40.2		48.1		82		25.2		55.8		72.4		83.6		57.3		47.2	
Total Solids, %				57.49		53.9		59.21		57.69		45.28		63.06		51.85		47.45		44.22		54.18		57.65	
Volatile Soilids, %				4.18		4.8		4.21		4.74		7.41		2.68		5.35		6.06		7.47		5.14		4.18	
Total Organic Carbon, %				1.64	J	1.58		1.62		2.18		1.62		0.954		1.89		1.84		2.09		1.58		1.61	
Total Ammonia, mg N/kg				36.7		49.5		53.7		69.7		48.4		11.8		30		29.4		37		19		95.8	
Total Sulfides, individual core, mg/kg				1440		1.49	U	647		1950		418		1730		1010		978		1780		609		1990	
Total Sulfides, composite, mg/kg				1450	J	279		815		830		750		21.1		1550		1760		1080		974		1920	
METALS (mg/kg dry)																									
Antimony	150	---	200	9	UJ	9	UJ	8	UJ	8	UJ	10	UJ	8	UJ	9	UJ	10	UJ	10	UJ	9	UJ	8	UJ
Arsenic	57	507	700	9	U	9	U	8	U	8	U	10	U	3.92	J	9	U	10	U	10	U	9	U	8	U
Cadmium	5.1	11.3	14.0	0.248	J	0.293	J	0.3	J	0.3		0.5		0.3	U	0.352	J	0.4		0.5		0.4		0.4	
Chromium	260	260	---	22.8		26.7		21.5		25.4		35		18.3		26.8		33		36		28.2		26.7	
Copper	390	1,027	1,300	18.9		20.4		15.6		19.8		28.8		15.4		24.5		33.9		33.8		24.9		21.8	
Lead	450	975	1,200	7		7		6		7		10		5		8		11		12		8		9	
Mercury	0.41	1.5	2.3	0.04		0.06		0.06		0.07		0.09		0.0232	J	0.05		0.09		0.12		0.08		0.09	
Selenium	---	3	---	0.286	J	0.326	J	0.299	J	0.318	J	0.51	J	0.171	J	0.28	J	0.46	J	0.52	J	0.371	J	0.256	J
Silver	6.1	6.1	8.4	0.5	U	0.5	U	0.5	U	0.5	U	0.6	U	0.5	U	0.5	U	0.6	U	0.6	U	0.5	U	0.5	U
Zinc	410	2,783	3,800	66		70		56		65		91		53		78		91		103		76		73	
ORGANOMETALLIC COMPOUNDS (ug/L interstitial water)																									
Tributyltin (ion)	0.15	0.15	---	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U
PAHs (ug/kg dry)																									
Total LPAH	5,200	---	29,000	43.7		48.7		42		80.4		253.6		47.1		49		74		84.2		53.8		86.9	
Naphthalene	2,100	---	2,400	8.6		12		11		19		17		5.8		5.5		16		18		13		18	
Acenaphthylene	560	---	1,300	2.9	J	3.9	J	3.5	J	5.6		26		4.8		5.5		7.1		8.4		5.8		5.6	
Acenaphthene	500	---	2,000	2.6	J	3	J	4.8	U	3.5	J	8.6		4.4	J	4.9	U	3.6	J	3.2	J	2.8	J	3.7	J
Fluorene	540	---	3,600	3.6	J	4.5	J	4.4	J	6.3	J	16	J	5.1	J	4	J	5.3	J	5.6	J	3.8	J	7.6	J
Phenanthrene	1,500	---	21,000	18	J	19	J	17	J	30	J	130	J	15	J	22	J	30	J	35	J	21	J	38	J

Table 5.3. Nahcotta chemical results compared to DMMP regulatory guidelines.

CHEMICAL	DMMP Guidelines			DMMU 1		DMMU 2		DMMU 3		DMMU 4		DMMU 5		DMMU 6		DMMU 7		DMMU 8		DMMU 9		DMMU 10		DMMU 11	
	SL	BT	ML																						
Anthracene	960	---	13,000	8	J	6.3	J	6.1	J	16	J	56	J	12	J	12	J	12	J	14	J	7.4	J	14	J
2-Methylnaphthalene	670	---	1,900	19		44		13		25		13		4.3	J	7.9		18		14		20		21	
Total HPAH	12,000	---	69,000	226.7		211		198.4		234.6		4186		393.4		467.2		400		509.6		227		327.5	
Fluoranthene	1,700	4,600	30,000	45	J	42	J	47	J	58	J	1200	J	63	J	89	J	62	J	73	J	35	J	77	J
Pyrene	2,600	11,980	16,000	65	J	63	J	53	J	62	J	860	J	120	J	140	J	110	J	140	J	61	J	87	J
Benzo(a)anthracene	1,300	---	5,100	19	J	15	J	14	J	17	J	240	J	26	J	34	J	26	J	37	J	16	J	24	J
Chrysene	1,400	---	21,000	30		18		23		21		960		37		44		38		50		23		31	
Total benzofluoranthenes	3,200	---	9,900	37		35		31		36		660		82		88		86		100		46		48	
Benzo[a]pyrene	1,600	---	3,600	13		15		12		16		100		30		33		33		46		19		23	
Indeno(1,2,3-c,d)pyrene	600	---	4,400	7.7		9		7.4		9.6		72		14		15		17		24		11		14	
Dibenzo(a,h)anthracene	230	---	1,900	4.8	UJ	5	UJ	4.8	UJ	4.8	UJ	18	J	3.4	J	4.2	J	4	J	5.6	J	4.9	UJ	2.5	J
Benzo(g,h,i)perylene	670	---	3,200	10		14		11		15		76		18		20		24		34		16		21	
CHLORINATED BENZENES (ug/kg dry)																									
1,4-Dichlorobenzene	110	---	120	19	U	20	U	19	U	19	U	20	U	19	U	19	U	19	U	20	U	20	U	19	U
1,2-Dichlorobenzene	35		110	19	U	20	U	19	U	19	U	20	U	19	U	19	U	19	U	20	U	20	U	19	U
1,2,4-Trichlorobenzene	31	---	64	19	U	20	U	19	U	19	U	20	U	19	U	19	U	19	U	20	U	20	U	19	U
Hexachlorobenzene	22	168	230	2.9	U	0.98	U	0.98	U	0.99	U	1.7	U	0.98	U	0.98	U	0.97	U	0.96	U	0.97	U	0.99	U
PHTHALATE ESTERS (ug/kg dry)																									
Dimethyl phthalate	71	---	1,400	19	U	20	U	19	U	19	U	20	U	19	U	19	U	19	U	20	U	20	U	19	U
Diethyl phthalate	200	---	1,200	19	U	19	J	19	U	19	U	48		19	U	19	U	19	U	20	U	20	U	34	
Di-n-butyl phthalate	1,400	---	5,100	19	U	20	U	19	U	19	U	20	U	19	U	19	U	19	U	20	U	20	U	19	U
Butyl benzyl phthalate	63	---	970	19	UJ	20	UJ	19	UJ	19	UJ	20	UJ	19	UJ	19	UJ	19	UJ	20	UJ	20	UJ	19	UJ
Bis(2-ethylhexyl)phthalate	1,300	---	8,300	48	U	49	U	48	U	48	U	49	U	50		49	U	48	U	49	U	49	U	48	U
Di-n-octyl phthalate	6,200	---	6,200	19	U	20	U	19	U	19	U	20	U	19	U	19	U	19	U	20	U	20	U	19	U
PHENOLS (ug/kg dry)																									
Phenol	420	---	1,200	32		9.9	J	12	J	9.6	J	20	U	19	U	21		19	U	20	U	12	J	12	J
2 Methylphenol	63	---	77	19	U	20	U	19	U	19	U	20	U	19	U	19	U	19	U	20	U	20	U	19	U
4 Methylphenol	670	---	3,600	20	J	20	U	19	U	19	U	20	U	19	U	19	U	19	U	20	U	20	U	14	J
2,4-Dimethylphenol	29	---	210	24	U	25	U	24	U	24	U	25	U	24	U	24	U	24	U	24	U	24	U	24	U
Pentachlorophenol	400	504	690	95	U	99	U	97	U	96	U	98	U	94	U	97	U	95	U	97	U	97	U	96	U

Table 5.3. Nahcotta chemical results compared to DMMP regulatory guidelines.

CHEMICAL	DMMP Guidelines			DMMU 1		DMMU 2		DMMU 3		DMMU 4		DMMU 5		DMMU 6		DMMU 7		DMMU 8		DMMU 9		DMMU 10		DMMU 11	
	SL	BT	ML																						
MISCELLANEOUS EXTRACTABLES (ug/kg dry)																									
Benzyl alcohol	57		870	19	U	20	U	19	U	19	U	20	U	19	U	19	U	19	U	20	U	20	U	19	U
Benzoic acid	650	---	760	120	J	200	U	190	U	190	U	200	U	190	U	97	J	190	U	200	U	200	U	190	U
Dibenzofuran	540	---	1,700	19	U	20	U	19	U	4.8	J	20	U	19	U	19	U	19	U	20	U	20	U	19	U
Hexachlorobutadiene	11	---	270	0.98	U	0.98	U	0.98	U	0.99	U	0.98	U	0.98	U	1.8	U	0.97	U	0.96	U	0.97	U	0.99	U
N-Nitrosodiphenylamine	28	---	130	19	U	20	U	19	U	19	U	20	U	19	U	19	U	19	U	20	U	20	U	19	U
PESTICIDES (ug/kg dry)																									
p,p'-DDD	16	---	---	0.98	U	0.98	U	0.98	U	0.99	U	0.98	U	0.98	U	0.98	U	0.97	U	0.96	U	0.97	U	1.3	
p,p'-DDE	9	---	---	0.98	U	0.98	U	0.98	UJ	0.99	U	0.98	U	0.98	U	0.98	U	0.97	U	0.96	U	0.97	U	0.99	U
p,p'-DDT	12	---	---	0.98	U	0.98	U	0.98	UJ	0.99	U	0.98	U	0.98	U	0.98	U	0.97	U	0.96	U	0.97	U	0.99	U
Total DDT		50	69	0.98	U	0.98	U	0.98	U	0.99	U	0.98	U	0.98	U	0.98	U	0.97	U	0.96	U	0.97	U	1.3	
Aldrin	9.5	---	---	1.1	U	0.49	U	1.1	U	1.4	U	0.49	U	0.49	U	0.49	U	0.48	U	0.48	U	0.48	U	1.1	U
Total Chlordane	2.8	37	---	0.98	U	0.98	U	0.98	U	1.5	U	0.98	U	0.98	U	0.98	U	0.97	U	0.96	U	0.97	U	2.9	U
Dieldrin	1.9	---	---	0.98	U	0.98	U	0.98	U	0.99	U	0.98	U	0.98	U	0.98	U	0.97	U	0.96	U	0.97	U	0.99	U
Heptachlor	1.5	---	---	0.49	U	1.8	U	0.49	U	1.4	U	0.49	U	0.49	U	1.5	U	0.48	U	0.48	U	0.48	U	0.49	U
PCBs (ug/kg dry)																									
Total PCBs	130	---	3,100	9.6	U	24	U	9.2	U	24	U	25	U	23	U	58	U	48	U	23	U	23	U	24	U
Total PCBs (mg/kg OC)	---	38	---	0.59	U	1.52	U	0.57	U	1.10	U	1.54	U	2.41	U	3.07	U	2.61	U	1.10	U	1.46	U	1.49	U
SUMMARY																									
DMMP determination				PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
DMMU volume				15,250		15,260		15,260		15,260		12,860		15,180		15,410		15,260		15,260		15,260		14,180	
Rank				moderate		moderate		moderate		moderate		moderate		moderate		moderate		moderate		moderate		moderate		moderate	
Mean sample depth				2.1		2.7		3.1		3.1		2.1		3.2		2		2.1		1.9		1.95		2.6	
Maximum sampling depth				4.8		9.3		9.3		9.5		4.6		8.2		4.7		4.4		4.3		4.4		8	
	SL	BT	ML																						

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

Table 6.1. Tokeland Dioxin Results

CHEMICAL	TEF	DMMU 1				DMMU 2				DMMU 3				DMMU 4			
DIOXINS/FURANS		conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)
2,3,7,8-TCDD	1	0.544	UJ	0	0.272	0.442	UJ	0	0.221	0.478	UJ	0	0.239	0.505	UJ	0	0.2525
1,2,3,7,8-PeCDD	1	0.745	J	0.745	0.745	0.446	J	0.446	0.446	0.787	J	0.787	0.787	0.661	J	0.661	0.661
1,2,3,4,7,8-HxCDD	0.1	0.657	J	0.066	0.066	0.378	J	0.038	0.038	0.66	J	0.066	0.066	0.483	J	0.048	0.0483
1,2,3,6,7,8-HxCDD	0.1	1.74		0.174	0.174	0.908	J	0.091	0.091	2.72		0.272	0.272	1.4		0.14	0.14
1,2,3,7,8,9-HxCDD	0.1	1.6		0.16	0.16	1.05	J	0.105	0.105	1.89		0.189	0.189	1.46		0.146	0.146
1,2,3,4,6,7,8-HpCDD	0.01	33.8		0.338	0.338	15.7		0.157	0.157	56		0.56	0.56	24		0.24	0.24
OCDD	0.0003	258		0.077	0.077	102		0.031	0.031	575		0.173	0.173	160		0.048	0.048
2,3,7,8-TCDF	0.1	0.531	J	0.053	0.053	0.408	UJ	0	0.02	0.773	J	0.077	0.077	0.724	UJ	0	0.0362
1,2,3,7,8-PeCDF	0.03	0.277	UJ	0	0.004	0.15	UJ	0	0.002	0.407	J	0.012	0.012	0.231	J	0.007	0.00693
2,3,4,7,8-PeCDF	0.3	0.269	UJ	0	0.04	0.172	UJ	0	0.026	0.428	UJ	0	0.064	0.238	J	0.071	0.0714
1,2,3,4,7,8-HxCDF	0.1	0.557	J	0.056	0.056	0.268	UJ	0	0.013	1.12	J	0.112	0.112	0.409	J	0.041	0.0409
1,2,3,6,7,8-HxCDF	0.1	0.327	UJ	0	0.016	0.142	J	0.014	0.014	0.464	UJ	0	0.023	0.256	J	0.026	0.0256
1,2,3,7,8,9-HxCDF	0.1	0.177	UJ	0	0.009	0.0939	U	0	0.005	0.388	UJ	0	0.019	0.089	J	0.0089	0.0089
2,3,4,6,7,8-HxCDF	0.1	0.369	UJ	0	0.018	0.186	UJ	0	0.009	0.545	UJ	0	0.027	0.329	J	0.033	0.0329
1,2,3,4,6,7,8-HpCDF	0.01	4.56		0.046	0.046	2.31		0.023	0.023	8.02		0.08	0.08	3.81		0.038	0.0381
1,2,3,4,7,8,9-HpCDF	0.01	0.094	U	0	0.0005	0.1	U	0	0.0005	0.505	UJ	0	0.003	0.201	UJ	0	0.001005
OCDF	0.0003	9.86		0.003	0.003	4.38		0.001	0.0013	16.3		0.005	0.005	7.86		0.002	0.002358
TOTAL TEQ (pptr)				1.72	2.08			0.91	1.20			2.33	2.71			1.51	1.80

Validation Qualifiers (VQ):

J - The reported concentration is an estimated value

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Table 6.2. Bay Center Dioxin Results

CHEMICAL	TEF	DMMU 1				DMMU 2			
DIOXINS/FURANS		conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)
2,3,7,8-TCDD	1	0.324	UJ	0	0.162	0.229	UJ	0	0.1145
1,2,3,7,8-PeCDD	1	0.398	UJ	0	0.199	0.231	UJ	0	0.1155
1,2,3,4,7,8-HxCDD	0.1	0.498	UJ	0	0.025	0.135	U	0	0.00675
1,2,3,6,7,8-HxCDD	0.1	1.55		0.155	0.155	0.552	J	0.055	0.055
1,2,3,7,8,9-HxCDD	0.1	1.3		0.13	0.133	0.505	J	0.051	0.051
1,2,3,4,6,7,8-HpCDD	0.01	33.2		0.332	0.332	14.5	J	0.145	0.145
OCDD	0.0003	286		0.086	0.086	112		0.034	0.034
2,3,7,8-TCDF	0.1	0.659	J	0.066	0.066	0.217	J	0.022	0.022
1,2,3,7,8-PeCDF	0.03	0.249	J	0.007	0.007	0.119	UJ	0	0.001785
2,3,4,7,8-PeCDF	0.3	0.146	J	0.044	0.044	0.129	UJ	0	0.01935
1,2,3,4,7,8-HxCDF	0.1	0.444	UJ	0	0.022	0.2	UJ	0	0.01
1,2,3,6,7,8-HxCDF	0.1	0.221	UJ	0	0.011	0.107	J	0.011	0.011
1,2,3,7,8,9-HxCDF	0.1	0.127	UJ	0	0.006	0.093	U	0	0.00465
2,3,4,6,7,8-HxCDF	0.1	0.344	J	0.034	0.034	0.0732	U	0	0.00366
1,2,3,4,6,7,8-HpCDF	0.01	4.31		0.043	0.043	1.83	J	0.018	0.018
1,2,3,4,7,8,9-HpCDF	0.01	0.193	UJ	0	0.001	0.186	UJ	0	0.00093
OCDF	0.0003	12.4		0.004	0.004	5.32		0.002	0.002
TOTAL TEQ (pptr)				0.90	1.33			0.34	0.62

Validation Qualifiers (VQ):

J - The reported concentration is an estimated value

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Table 6.3. Nahcotta Dioxin Results

CHEMICAL	TEF	DMMU 1				DMMU 2				DMMU 3				DMMU 4			
DIOXINS/FURANS		conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)
2,3,7,8-TCDD	1	0.302	U	0	0.151	0.354	U	0	0.177	0.242	U	0	0.121	0.356	U	0	0.178
1,2,3,7,8-PeCDD	1	0.4	U	0	0.2	0.442	J	0.442	0.442	0.323	U	0	0.162	0.721	J	0.721	0.721
1,2,3,4,7,8-HxCDD	0.1	0.497	J	0.05	0.05	0.575	J	0.058	0.058	0.369	U	0	0.018	0.751	J	0.075	0.075
1,2,3,6,7,8-HxCDD	0.1	2.23		0.223	0.223	1.94		0.194	0.194	1.38		0.138	0.138	2.1		0.21	0.21
1,2,3,7,8,9-HxCDD	0.1	1.2		0.121	0.121	1.44		0.144	0.144	1.14		0.114	0.114	1.6		0.16	0.16
1,2,3,4,6,7,8-HpCDD	0.01	39.8		0.398	0.398	38.8		0.388	0.388	27.4		0.274	0.274	27.3		0.273	0.273
OCDD	0.0003	334	J	0.1	0.1	337	J	0.101	0.101	234	UJ	0	0.035	222	UJ	0	0.033
2,3,7,8-TCDF	0.1	0.694	U	0	0.035	0.979	J	0.098	0.098	0.789	U	0	0.039	0.87	U	0	0.044
1,2,3,7,8-PeCDF	0.03	0.272	U	0	0.004	0.31	J	0.009	0.009	0.287	U	0	0.004	0.606	J	0.018	0.018
2,3,4,7,8-PeCDF	0.3	0.274	J	0.082	0.082	0.368	J	0.11	0.11	0.242	U	0	0.036	0.651	J	0.195	0.195
1,2,3,4,7,8-HxCDF	0.1	0.583	J	0.058	0.058	0.633	J	0.063	0.063	0.611	J	0.061	0.061	0.906	J	0.091	0.091
1,2,3,6,7,8-HxCDF	0.1	0.382	J	0.038	0.038	0.36	J	0.036	0.036	0.353	J	0.035	0.035	0.731	J	0.073	0.073
1,2,3,7,8,9-HxCDF	0.1	0.153	U	0	0.008	0.143	J	0.014	0.014	0.182	J	0.018	0.018	0.449	U	0	0.022
2,3,4,6,7,8-HxCDF	0.1	0.455	J	0.046	0.046	0.579	J	0.058	0.058	0.494	J	0.049	0.049	0.872	U	0	0.044
1,2,3,4,6,7,8-HpCDF	0.01	6.05		0.061	0.061	6.5		0.065	0.065	5.4		0.054	0.054	5.85		0.059	0.059
1,2,3,4,7,8,9-HpCDF	0.01	0.394	J	0.004	0.004	0.432	J	0.004	0.004	0.387	U	0	0.002	0.711	J	0	0.007
OCDF	0.0003	13.7		0.004	0.004	15.5		0.005	0.005	11.8		0.004	0.004	13.6		0.004	0.004
TOTAL TEQ (pptr)				1.19	1.58			1.79	1.97			0.75	1.16			1.88	2.21

CHEMICAL	TEF	DMMU 5				DMMU 6				DMMU 7				DMMU 8			
DIOXINS/FURANS		conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)
2,3,7,8-TCDD	1	0.367	U	0	0.184	0.219	U	0	0.11	0.269	U	0	0.135	0.379	U	0	0.19
1,2,3,7,8-PeCDD	1	0.806	U	0	0.403	0.416	J	0.416	0.416	0.561	U	0	0.281	0.756	J	0.756	0.756
1,2,3,4,7,8-HxCDD	0.1	0.729	U	0	0.036	0.712	U	0	0.036	0.75	J	0.075	0.075	0.766	J	0.077	0.077
1,2,3,6,7,8-HxCDD	0.1	2.89		0.289	0.289	3.68		0.368	0.368	3.38		0.338	0.338	3.36		0.336	0.336
1,2,3,7,8,9-HxCDD	0.1	2.4		0.24	0.236	1.49		0.149	0.149	1.91		0.191	0.191	2.19		0.219	0.219
1,2,3,4,6,7,8-HpCDD	0.01	45.9		0.459	0.459	99.2		0.992	0.992	81.7		0.817	0.817	73.5		0.735	0.735
OCDD	0.0003	353	J	0.106	0.106	927	J	0.278	0.278	829	J	0.249	0.249	683	J	0.205	0.205
2,3,7,8-TCDF	0.1	1.79		0.179	0.179	0.375	U	0	0.019	0.724	J	0.072	0.072	1.14	J	0.114	0.114
1,2,3,7,8-PeCDF	0.03	0.519	J	0.016	0.016	0.302	U	0	0.005	0.368	J	0.011	0.011	0.491	U	0	0.007
2,3,4,7,8-PeCDF	0.3	0.453	U	0	0.068	0.316	J	0.095	0.095	0.316	J	0.095	0.095	0.433	J	0.13	0.13
1,2,3,4,7,8-HxCDF	0.1	0.998		0.1	0.1	0.781	J	0.078	0.078	0.798	J	0.08	0.08	1.13		0.113	0.113
1,2,3,6,7,8-HxCDF	0.1	0.607	U	0	0.03	0.627	J	0.063	0.063	0.5	J	0.05	0.05	0.671	J	0.067	0.067
1,2,3,7,8,9-HxCDF	0.1	0.253	J	0.025	0.025	0.353	J	0.035	0.035	0.289	U	0	0.014	0.367	J	0.0367	0.037
2,3,4,6,7,8-HxCDF	0.1	0.733	J	0.073	0.073	0.832	J	0.083	0.083	0.697	J	0.07	0.07	0.882	U	0	0.044
1,2,3,4,6,7,8-HpCDF	0.01	8.59		0.086	0.086	8.03		0.08	0.08	8.8		0.088	0.088	11.6		0.116	0.116
1,2,3,4,7,8,9-HpCDF	0.01	0.523	J	0.005	0.005	0.469	U	0	0.002	0.591	J	0.006	0.006	0.766	J	0	0.008
OCDF	0.0003	17.9		0.005	0.005	23.5		0.007	0.007	25.8		0.008	0.008	27.5		0.008	0.008
TOTAL TEQ (pptr)				1.58	2.30			2.64	2.82			2.15	2.58			2.91	3.16

Table 6.3. Nahcotta Dioxin Results

CHEMICAL	TEF	DMMU 9				DMMU 10				DMMU 11			
DIOXINS/FURANS		conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)	conc (ng/kg)	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)
2,3,7,8-TCDD	1	0.434	U	0	0.217	0.287	U	0	0.144	0.343	U	0	0.172
1,2,3,7,8-PeCDD	1	0.842	J	0.842	0.842	0.589	U	0	0.295	0.55	J	0.55	0.55
1,2,3,4,7,8-HxCDD	0.1	0.972	U	0	0.049	0.635	J	0.064	0.064	0.668	J	0.067	0.067
1,2,3,6,7,8-HxCDD	0.1	4.07		0.407	0.407	2.46		0.246	0.246	2.18		0.218	0.218
1,2,3,7,8,9-HxCDD	0.1	2.73		0.273	0.273	1.69		0.169	0.169	1.73		0.173	0.173
1,2,3,4,6,7,8-HpCDD	0.01	75.3		0.753	0.753	50.9		0.509	0.509	42		0.42	0.42
OCDD	0.0003	663	J	0.199	0.199	603	J	0.181	0.181	507	J	0.152	0.152
2,3,7,8-TCDF	0.1	1.78	J	0.178	0.178	0.941	J	0.094	0.094	1.29	J	0.129	0.129
1,2,3,7,8-PeCDF	0.03	0.712	J	0.021	0.021	0.366	J	0.011	0.011	0.465	J	0.014	0.014
2,3,4,7,8-PeCDF	0.3	0.576	J	0.173	0.173	0.344	J	0.103	0.103	0.433	J	0.13	0.13
1,2,3,4,7,8-HxCDF	0.1	1.56		0.156	0.156	0.981	J	0.098	0.098	1.05		0.105	0.105
1,2,3,6,7,8-HxCDF	0.1	0.896	J	0.09	0.09	0.551	J	0.055	0.055	0.656	U	0	0.033
1,2,3,7,8,9-HxCDF	0.1	0.416	J	0.042	0.042	0.295	J	0.03	0.03	0.273	U	0	0.014
2,3,4,6,7,8-HxCDF	0.1	1.23	J	0.123	0.123	0.726	U	0	0.036	0.814	J	0.081	0.081
1,2,3,4,6,7,8-HpCDF	0.01	14.7		0.147	0.147	10		0.1	0.1	11.1		0.111	0.111
1,2,3,4,7,8,9-HpCDF	0.01	0.964	J	0.01	0.01	0.647	U	0	0.003	0.718	U	0	0.004
OCDF	0.0003	35.2		0.011	0.011	25.9		0.008	0.008	31.7		0.01	0.01
TOTAL TEQ (pptr)				3.43	3.69			1.67	2.15			2.16	2.38

Validation Qualifiers (VQ):

J - The reported concentration is an estimated value

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Table 7. Bay Center diethyl phthalate results

Chemical	DMMU 2 Original		DMMU 2 Rep 1		DMMU 2 Rep 2		DMMU 2 Rep 3	
	conc	VQ	conc	VQ	conc	VQ	conc	VQ
Diethylphthalate (µg/kg)	980		19	U	18	J	15	J

Validation Qualifier (VQ)

J - The reported concentration is an estimated value

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

Table 8. High Resolution GC/MS/MS Pesticide Results

Organochlorine Pesticides	Sample ID			TKL01		TKL02		TKL03		TKL04		BCI01		NMB02		NMB04		NMB11	
	DMMP Marine Guidelines			Results		Results		Results		Results		Results		Results		Results		Results	
(µg/kg)	SL	BT	ML	Value	VQ	Value	VQ	Value	VQ	Value	VQ	Value	VQ	Value	VQ	Value	VQ	Value	VQ
Total Chlordane	2.8	37	---	*0.26*	*U*	*0.2*	*U*	*0.21*	*U*	*0.21*	*U*	*0.21*	*U*	*0.2*	*U*	*0.2*	*U*	*0.2*	*U*
trans-Chlordane	---	---	---	0.13	U	0.099	U	0.11	U	0.11	U	0.11	U	0.091	U	0.086	U	0.1	
cis-Chlordane	---	---	---	0.13	U	0.099	U	0.11	U	0.11	U	0.11	U	0.091	U	0.086	U	0.087	U
Oxychlordane	---	---	---	0.26	U	0.2	U	0.21	U	0.21	U	0.21	U	0.2	U	0.2	U	0.2	U
cis-Nonachlor	---	---	---	0.13	U	0.099	U	0.11	U	0.11	U	0.11	U	0.097	U	0.097	U	0.097	U
trans-Nonachlor	---	---	---	0.13	U	0.099	U	0.11	U	0.11	U	0.11	U	0.091	U	0.086	U	0.087	U
Dieldrin	19	---	1700	0.26	U	0.2	U	0.21	U	0.21	U	0.21	U	0.2	U	0.2	U	0.2	U
Heptachlor	1.5	---	270	0.13	U	0.099	U	0.11	U	0.11	U	0.11	U	0.091	U	0.086	U	0.087	U

Validation Qualifiers (VQ):

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

Table 9. Non-standard pesticide results

	TKL01		TKL02		TKL03		TKL04		BCI01	
	Value	VQ	Value	VQ	Value	VQ	Value	VQ	Value	VQ
Nonstandard Pesticides (mg/kg)										
1-Naphthol	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
AMPA	0.034	U	0.034	U	0.034	U	0.034	U	0.034	U
Carbaryl	0.0067	U	0.0067	U	0.0067	U	0.0067	U	0.0067	U
Glyphosate	0.017	U	0.017	U	0.017	U	0.049		0.017	U
Imidacloprid	0.0067	U	0.0067	U	0.0067	U	0.0067	U	0.0067	U
Nonstandard Pesticides (ug/kg)										
Imazamox	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Imazapyr	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U

	NMB02		NMB04		NMB07		NMB08		NMB09		NMB11	
	Value	VQ	Value	VQ	Value	VQ	Value	VQ	Value	VQ	Value	VQ
Nonstandard Pesticides (mg/kg)												
1-Naphthol	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
AMPA	0.034	U	0.034	U	0.034	U	0.034	U	0.034	U	0.034	U
Carbaryl	0.0067	U	0.0067	U	0.0067	U	0.0067	U	0.0067	U	0.0067	U
Glyphosate	0.017	U	0.017	U	0.017	U	0.017	U	0.017	U	0.017	U
Imidacloprid	0.0067	U	0.0067	U	0.0067	U	0.0067	U	0.0067	U	0.0067	U
Nonstandard Pesticides (ug/kg)												
Imazamox	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Imazapyr	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U

Validation Qualifiers (VQ):

U - The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.

Table 10.1. Tokeland chemical results compared to SMS regulatory guidelines.

CHEMICAL	SMS Guidelines		DMMU 1		DMMU 2		DMMU 3		DMMU 4	
	SQS	CSL	conc	LQ	conc	LQ	conc	LQ	conc	LQ
Total Organic Carbon, %			2.51	J	1.74		2.1		1.9	
METALS (mg/kg dry)										
Arsenic	57	93	4.1	J	4	J	3.5	J	5.4	J
Cadmium	5.1	6.7	0.5		0.383	J	0.5		0.5	
Chromium	260	270	36		32		38		36	
Copper	390	390	33.6		24.3		32.9		32	
Lead	450	530	10		8		11		10	
Mercury	0.41	0.59	0.07		0.05		0.07		0.07	
Silver	6.1	6.1	0.8	U	0.6	U	0.6	U	0.6	U
Zinc	410	960	93		73		97		91	
PAHs (mg/kg OC)										
Total LPAH	370	780	3.55		3.57		9.15		3.61	
Naphthalene	99	170	0.52		1.44		0.76		0.58	
Acenaphthylene	66	66	0.13	J	0.31		0.25		0.13	J
Acenaphthene	16	57	0.39		0.15	J	1.00		0.46	
Fluorene	23	79	0.52	J	0.35	J	1.29	J	0.58	J
Phenanthrene	100	480	1.31	J	1.09	J	4.43	J	1.47	J
Anthracene	220	1200	0.68	J	0.24	J	1.43	J	0.38	J
2-Methylnaphthalene	38	64	3.94		0.80		0.76		0.89	
Total HPAH	960	5300	9.84		5.49		27.90		8.07	
Fluoranthene	160	1200	3.59		1.49		10.95		2.68	
Pyrene	1000	1400	2.43		1.38		9.05		2.11	
Benzo(a)anthracene	110	270	0.60	J	0.37	J	1.57	J	0.52	J
Chrysene	110	460	1.04		0.49		1.81		0.68	
Benzofluoranthenes	230	450	1.08		0.75	J	2.19		1.00	J
Benzo(a)pyrene	99	210	0.48		0.41		1.00		0.42	
Indeno(1,2,3-c,d)pyrene	34	88	0.27		0.22	J	0.52		0.26	
Dibenzo(a,h)anthracene	12	33	0.20	U	0.28	U	0.23	U	0.26	U
Benzo(g,h,i)perylene	34	88	0.37		0.39		0.81		0.41	
CHLORINATED BENZENES (mg/kg OC)										
1,4-Dichlorobenzene	3	9	0.80	U	1.15	U	0.90	U	1.00	U
1,2-Dichlorobenzene	2.3	2.3	0.80	U	1.15	U	0.90	U	1.00	U
1,2,4-Trichlorobenzene	0.81	1.8	0.80	U	1.15	U	0.90	U	1.00	U
Hexachlorobenzene	0.38	2.3	0.76	U	1.09	U	0.43	UJ	0.26	U
PHTHALATE ESTERS (mg/kg OC)										
Dimethyl phthalate	53	53	0.80	U	1.15	U	0.90	U	1.00	U
Diethyl phthalate	61	110	1.08	U	1.15	U	1.19	U	1.00	U
Di-n-butyl phthalate	220	1700	0.80	U	1.15	U	0.90	U	1.00	U
Butyl benzyl phthalate	4.9	64	0.80	U	1.15	U	0.90	U	1.00	U
Bis(2-ethylhexyl)phthalate	47	78	5.58		2.82	U	2.29	U	2.53	U
Di-n-octyl phthalate	58	4500	0.80	U	1.15	U	0.90	U	1.00	U
PHENOLS (ug/kg dry)										
Phenol	420	1200	20	U	44		19	U	19	U
2 Methylphenol	63	63	20	U	20	U	19	U	19	U
4 Methylphenol	670	670	67		79		64		19	U
2,4-Dimethylphenol	29	29	14	J	25	U	24	U	24	U
Pentachlorophenol	360	690	98	U	99	U	96	U	97	U
MISCELLANEOUS EXTRACTABLES (mg/kg OC)										
Dibenzofuran	15	58	0.80	U	1.15	U	0.90	U	1.00	U
Hexachlorobutadiene	3.9	6.2	0.19	U	0.28	U	0.23	U	0.26	U
N-Nitrosodiphenylamine	11	11	0.80	U	1.15	U	0.90	U	1.00	U
PCBs (mg/kg OC)										
Total PCBs (mg/kg carbon)	12	65	0.96	U	1.15	U	1.10	U	1.05	U
MISCELLANEOUS EXTRACTABLES (ug/kg dry)										
Benzyl alcohol	57	73	20	U	20	U	19	U	19	U
Benzoic acid	650	650	620		230		320		240	

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

Table 10.2. Bay Center chemical results compared to SMS regulatory guidelines.

CHEMICAL	SMS Guidelines		DMMU 1		DMMU 2	
	SQS	CSL	conc	LQ	conc	LQ
Total Organic Carbon, %			2.42		1.43	
METALS (mg/kg dry)						
Arsenic	57	93	1.5	J	2.78	J
Cadmium	5.1	6.7	0.5		0.3	U
Chromium	260	270	38		22.1	
Copper	390	390	32.2		11.5	
Lead	450	530	9		5	
Mercury	0.41	0.59	0.07		0.026	J
Silver	6.1	6.1	0.6	U	0.5	U
Zinc	410	960	91		54	
PAHs (mg/kg OC)						
Total LPAH	370	780	2.93		2.59	
Naphthalene	99	170	0.58		1.05	
Acenaphthylene	66	66	0.25		0.17	J
Acenaphthene	16	57	0.10	J	0.34	U
Fluorene	23	79	0.35	J	0.24	J
Phenanthrene	100	480	0.99	J	0.91	J
Anthracene	220	1200	0.66	J	0.22	J
2-Methylnaphthalene	38	64	1.36	J	0.48	
Total HPAH	960	5300	15.00		9.16	
Fluoranthene	160	1200	3.84		2.03	
Pyrene	1000	1400	2.85		1.82	
Benzo(a)anthracene	110	270	1.12	J	0.77	J
Chrysene	110	460	1.78		0.91	
Benzofluoranthenes	230	450	2.69		2.03	
Benzo(a)pyrene	99	210	1.03		0.84	
Indeno(1,2,3-c,d)pyrene	34	88	0.66		0.36	
Dibenzo(a,h)anthracene	12	33	0.16	J	0.34	U
Benzo(g,h,i)perylene	34	88	0.87		0.41	
CHLORINATED BENZENES (mg/kg OC)						
1,4-Dichlorobenzene	3	9	0.83	U	1.33	U
1,2-Dichlorobenzene	2.3	2.3	0.83	U	1.33	U
1,2,4-Trichlorobenzene	0.81	1.8	0.83	U	1.33	U
Hexachlorobenzene	0.38	2.3	0.79	U	0.13	U
PHTHALATE ESTERS (mg/kg OC)						
Dimethyl phthalate	53	53	0.83	U	1.75	
Diethyl phthalate	61	110	0.83	U	1.33	*
Di-n-butyl phthalate	220	1700	0.83	U	1.33	U
Butyl benzyl phthalate	4.9	64	0.83	U	1.33	U
Bis(2-ethylhexyl)phthalate	47	78	2.02	U	3.36	U
Di-n-octyl phthalate	58	4500	0.83	U	1.33	U
PHENOLS (ug/kg dry)						
Phenol	420	1200	70		18	J
2 Methylphenol	63	63	20	U	19	U
4 Methylphenol	670	670	57		19	U
2,4-Dimethylphenol	29	29	24	U	24	U
Pentachlorophenol	360	690	97	U	96	U
MISCELLANEOUS EXTRACTABLES (mg/kg OC)						
Dibenzofuran	15	58	0.83	U	1.33	U
Hexachlorobutadiene	3.9	6.2	0.21	U	0.07	U
N-Nitrosodiphenylamine	11	11	0.83	U	1.33	R
PCBs (mg/kg OC)						
Total PCBs (mg/kg carbon)	12	65	0.40	U	0.64	U
MISCELLANEOUS EXTRACTABLES (ug/kg dry)						
Benzyl alcohol	57	73	20	U	19	U
Benzoic acid	650	650	240		190	U

U = undetected
QL = laboratory qualifier
OC = organic carbon
SMS = Sediment Management Standards
SQS = sediment quality standard
CSL = cleanup screening level
* value based on 19 µg/kg, the highest of re-analysis values
undetected SQS exceedance

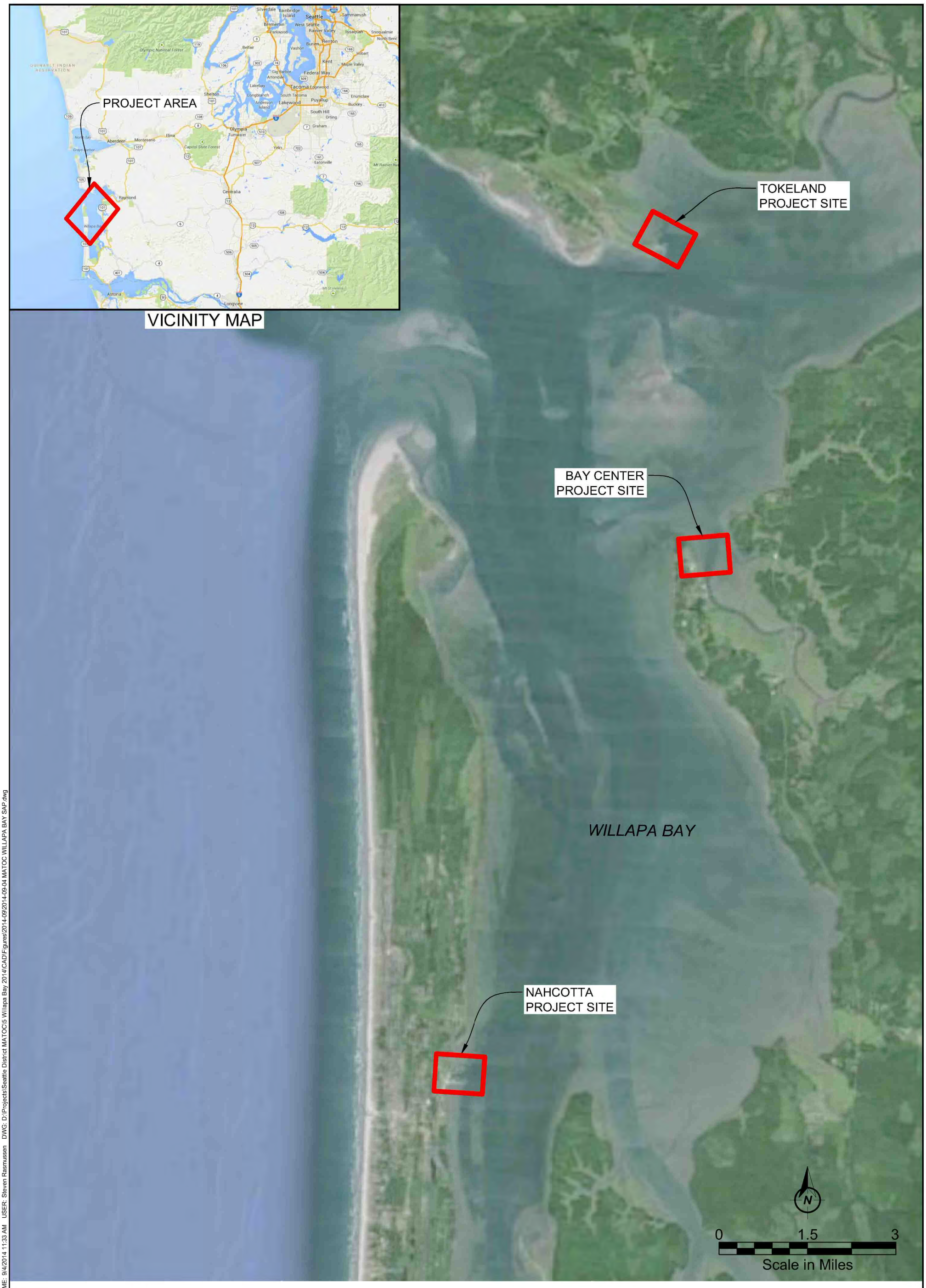
Table 10.3. Nahcotta chemical results compared to SMS regulatory guidelines.

CHEMICAL	SMS Guidelines		DMMU 1		DMMU 2		DMMU 3		DMMU 4		DMMU 5		DMMU 6		DMMU 7		DMMU 8		DMMU 9		DMMU 10		DMMU 11	
	SQS	CSL	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ
Total Organic Carbon, %			1.64	J	1.58		1.62		2.18		1.62		0.954		1.89		1.84		2.09		1.58		1.61	
METALS (mg/kg dry)																								
Arsenic	57	93	9	U	9	U	8	U	8	U	10	U	3.92	J	9	U	10	U	10	U	9	U	8	U
Cadmium	5.1	6.7	0.248	J	0.293	J	0.3	J	0.3		0.5		0.3	U	0.352	J	0.4		0.5		0.4		0.4	
Chromium	260	270	22.8		26.7		21.5		25.4		35		18.3		26.8		33		36		28.2		26.7	
Copper	390	390	18.9		20.4		15.6		19.8		28.8		15.4		24.5		33.9		33.8		24.9		21.8	
Lead	450	530	7		7		6		7		10		5		8		11		12		8		9	
Mercury	0.41	0.59	0.04		0.06		0.06		0.07		0.09		0.0232	J	0.05		0.09		0.12		0.08		0.09	
Silver	6.1	6.1	0.5	U	0.5	U	0.5	U	0.5	U	0.6	U	0.5	U	0.5	U	0.6	U	0.6	U	0.5	U	0.5	U
Zinc	410	960	66		70		56		65		91		53		78		91		103		76		73	
PAHs (mg/kg OC)																								
Total LPAH	370	780	2.66		3.08		2.59		3.69		15.65		4.94		2.59		4.02		4.03		3.41		5.40	
Naphthalene	99	170	0.52		0.76		0.68		0.87		1.05		0.61		0.29		0.87		0.86		0.82		1.12	
Acenaphthylene	66	66	0.18	J	0.25	J	0.22	J	0.26		1.60		0.50		0.29		0.39		0.40		0.37		0.35	
Acenaphthene	16	57	0.16	J	0.19	J	0.30	U	0.16	J	0.53		0.46	J	0.26	U	0.20	J	0.15	J	0.18	J	0.23	J
Fluorene	23	79	0.22	J	0.28	J	0.27	J	0.29	J	0.99	J	0.53	J	0.21	J	0.29	J	0.27	J	0.24	J	0.47	J
Phenanthrene	100	480	1.10	J	1.20	J	1.05	J	1.38	J	8.02	J	1.57	J	1.16	J	1.63	J	1.67	J	1.33	J	2.36	J
Anthracene	220	1200	0.49	J	0.40	J	0.38	J	0.73	J	3.46	J	1.26	J	0.63	J	0.65	J	0.67	J	0.47	J	0.87	J
2-Methylnaphthalene	38	64	1.16		2.78		0.80		1.15		0.80		0.45	J	0.42		0.98		0.67		1.27		1.30	
Total HPAH	960	5300	13.82		13.35		12.25		10.76		258.40		41.24		24.72		21.74		24.38		14.37		20.34	
Fluoranthene	160	1200	2.74	J	2.66	J	2.90	J	2.66	J	74.07	J	6.60	J	4.71	J	3.37	J	3.49	J	2.22	J	4.78	J
Pyrene	1000	1400	3.96	J	3.99	J	3.27	J	2.84	J	53.09	J	12.58	J	7.41	J	5.98	J	6.70	J	3.86	J	5.40	J
Benzo(a)anthracene	110	270	1.16	J	0.95	J	0.86	J	0.78	J	14.81	J	2.73	J	1.80	J	1.41	J	1.77	J	1.01	J	1.49	J
Chrysene	110	460	1.83		1.14		1.42		0.96		59.26		3.88		2.33		2.07		2.39		1.46		1.93	
Benzofluoranthenes	230	450	2.26		2.22		1.91		1.65		40.74		8.60		4.66		4.67		4.78		2.91		2.98	
Benzo(a)pyrene	99	210	0.79		0.95		0.74		0.73		6.17		3.14		1.75		1.79		2.20		1.20		1.43	
Indeno(1,2,3-c,d)pyrene	34	88	0.47		0.57		0.46		0.44		4.44		1.47		0.79		0.92		1.15		0.70		0.87	
Dibenzo(a,h)anthracene	12	33	0.29	UJ	0.32	UJ	0.30	UJ	0.22	UJ	1.11	J	0.36	J	0.22	J	0.22	J	0.27	J	0.31	UJ	0.16	J
Benzo(g,h,i)perylene	34	88	0.61		0.89		0.68		0.69		4.69		1.89		1.06		1.30		1.63		1.01		1.30	
CHLORINATED BENZENES (mg/kg OC)																								
1,4-Dichlorobenzene	3	9	1.16	U	1.27	U	1.17	U	0.87	U	1.23	U	1.99	U	1.01	U	1.03	U	0.96	U	1.27	U	1.18	U
1,2-Dichlorobenzene	2.3	2.3	1.16	U	1.27	U	1.17	U	0.87	U	1.23	U	1.99	U	1.01	U	1.03	U	0.96	U	1.27	U	1.18	U
1,2,4-Trichlorobenzene	0.81	1.8	1.16	U	1.27	U	1.17	U	0.87	U	1.23	U	1.99	U	1.01	U	1.03	U	0.96	U	1.27	U	1.18	U
Hexachlorobenzene	0.38	2.3	0.18	U	0.06	U	0.06	U	0.05	U	0.10	U	0.10	U	0.05	U	0.05	U	0.05	U	0.06	U	0.06	U
PHTHALATE ESTERS (mg/kg OC)																								
Dimethyl phthalate	53	53	1.16	U	1.27	U	1.17	U	0.87	U	1.23	U	1.99	U	1.01	U	1.03	U	0.96	U	1.27	U	1.18	U
Diethyl phthalate	61	110	1.16	U	1.20	J	1.17	U	0.87	U	2.96		1.99	U	1.01	U	1.03	U	0.96	U	1.27	U	2.11	U
Di-n-butyl phthalate	220	1700	1.16	U	1.27	U	1.17	U	0.87	U	1.23	U	1.99	U	1.01	U	1.03	U	0.96	U	1.27	U	1.18	U
Butyl benzyl phthalate	4.9	64	1.16	UJ	1.27	UJ	1.17	UJ	0.87	UJ	1.23	UJ	1.99	UJ	1.01	UJ	1.03	UJ	0.96	UJ	1.27	UJ	1.18	UJ
Bis(2-ethylhexyl)phthalate	47	78	2.93	U	3.10	U	2.96	U	2.20	U	3.02	U	5.24		2.59	U	2.61	U	2.34	U	3.10	U	2.98	U
Di-n-octyl phthalate	58	4500	1.16	U	1.27	U	1.17	U	0.87	U	1.23	U	1.99	U	1.01	U	1.03	U	0.96	U	1.27	U	1.18	U

Table 10.3. Nahcotta chemical results compared to SMS regulatory guidelines.

CHEMICAL	SMS Guidelines		DMMU 1		DMMU 2		DMMU 3		DMMU 4		DMMU 5		DMMU 6		DMMU 7		DMMU 8		DMMU 9		DMMU 10		DMMU 11	
	SQS	CSL	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ	conc	LQ
PHENOLS (ug/kg dry)																								
Phenol	420	1200	32		9.9	J	12	J	9.6	J	20	U	19	U	21		19	U	20	U	12	J	12	J
2 Methylphenol	63	63	19	U	20	U	19	U	19	U	20	U	19	U	19	U	19	U	20	U	20	U	19	U
4 Methylphenol	670	670	20	J	20	U	19	U	19	U	20	U	19	U	19	U	19	U	20	U	20	U	14	J
2,4-Dimethylphenol	29	29	24	U	25	U	24	U	24	U	25	U	24	U	24	U	24	U	24	U	24	U	24	U
Pentachlorophenol	360	690	95	U	99	U	97	U	96	U	98	U	94	U	97	U	95	U	97	U	97	U	96	U
MISCELLANEOUS EXTRACTABLES (mg/kg OC)																								
Dibenzofuran	15	58	1.16	U	1.27	U	1.17	U	0.22	J	1.23	U	1.99	U	1.01	U	1.03	U	0.96	U	1.27	U	1.18	U
Hexachlorobutadiene	3.9	6.2	0.06	U	0.06	U	0.06	U	0.05	U	0.06	U	0.10	U	0.10	U	0.05	U	0.05	U	0.06	U	0.06	U
N-Nitrosodiphenylamine	11	11	1.16	U	1.27	U	1.17	U	0.87	U	1.23	U	1.99	U	1.01	U	1.03	U	0.96	U	1.27	U	1.18	U
PCBs (mg/kg OC)																								
Total PCBs (mg/kg carbon)	12	65	0.59	U	1.52	U	0.57	U	1.10	U	1.54	U	2.41	U	3.07	U	2.61	U	1.10	U	1.46	U	1.49	U
MISCELLANEOUS EXTRACTABLES (ug/kg dry)																								
Benzyl alcohol	57	73	19	U	20	U	19	U	19	U	20	U	19	U	19	U	19	U	20	U	20	U	19	U
Benzoic acid	650	650	120	J	200	U	190	U	190	U	200	U	190	U	97	J	190	U	200	U	200	U	190	U

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



LEGEND

PROJECT AREA

NOTES:

1. BACKGROUND IMAGE SOURCE: GOOGLE EARTH 7/6/2012.

U.S. ARMY CORPS OF ENGINEERS

SEATTLE DISTRICT MATOC
SEATTLE, WASHINGTON

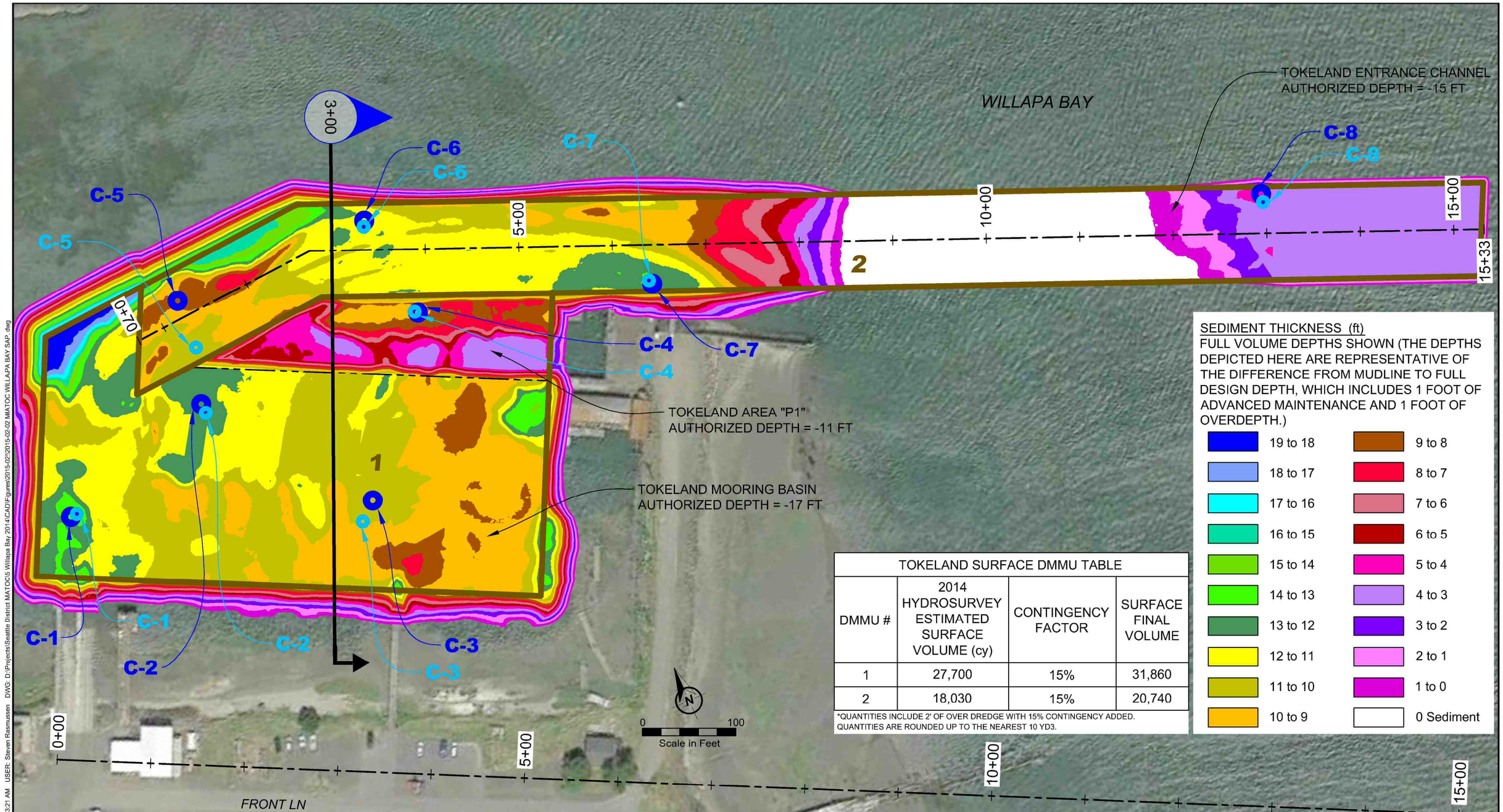
VICINITY MAP FOR THE WILLAPA BAY FEDERAL NAVIGATION CHANNELS

DALTON OLMSTED FUGLEVAND

FIGURE 1-1

SEPTEMBER 4, 2014

PLOT TIME: 9/4/2014 12:05 PM MOD TIME: 9/4/2014 11:33 AM USER: Steven Rasmussen DWG: D:\Projects\Seattle District MATOC\5 Willapa Bay 2014\CAD\Figures\2014-09\2014-09-04 MATOC WILLAPA BAY SAP.dwg



TOKELAND SURFACE DMMU TABLE

DMMU #	2014 HYDROSURVEY ESTIMATED SURFACE VOLUME (cy)	CONTINGENCY FACTOR	SURFACE FINAL VOLUME
1	27,700	15%	31,860
2	18,030	15%	20,740

*QUANTITIES INCLUDE 2' OF OVER DREDGE WITH 15% CONTINGENCY ADDED.
QUANTITIES ARE ROUNDED UP TO THE NEAREST 10 YD3.

NOTES:

1. BATHYMETRIC CONTOURS GENERATED FROM HYDRO SURVEY DATA COLLECTED MAY 28, 2014 BY USACE.
2. HORIZONTAL COORDINATE SYSTEM WASHINGTON STATE PLANE SOUTH, VERTICAL TIDAL DATUM NOS MLLW EPOCH 1983-2001, U.S. FOOT.
3. BASE MAP DRAWING INFORMATION PROVIDED BY USACE.
4. BACKGROUND IMAGE SOURCE: GOOGLE EARTH 7/6/2012.

LEGEND

X DMMU

C-x PROPOSED SAMPLE LOCATION

C-x ACTUAL SAMPLE LOCATION

NAVIGATION CHANNEL

NAVIGATION CHANNEL CENTERLINE

U.S. ARMY CORPS OF ENGINEERS
SEATTLE DISTRICT MATOC

TOKELAND FEDERAL NAVIGATION CHANNEL
TOKELAND, WASHINGTON

SURFACE DMMUs AND PROPOSED SEDIMENT SAMPLING LOCATIONS

DOF DALTON OLMSTED FUGLEVAND

FIGURE 2-1

FEBRUARY 2, 2015

PLOT TIME: 2/2/2015 3:35 AM MOD TIME: 2/2/2015 3:21 AM USER: Steven Rasmussen DWG: D:\Projects\Seattle District MATOC\5 Willapa Bay 2014\CAD\Figures\2015-02\2015-02-02 MIA TOC WILLAPA BAY S&P .dwg

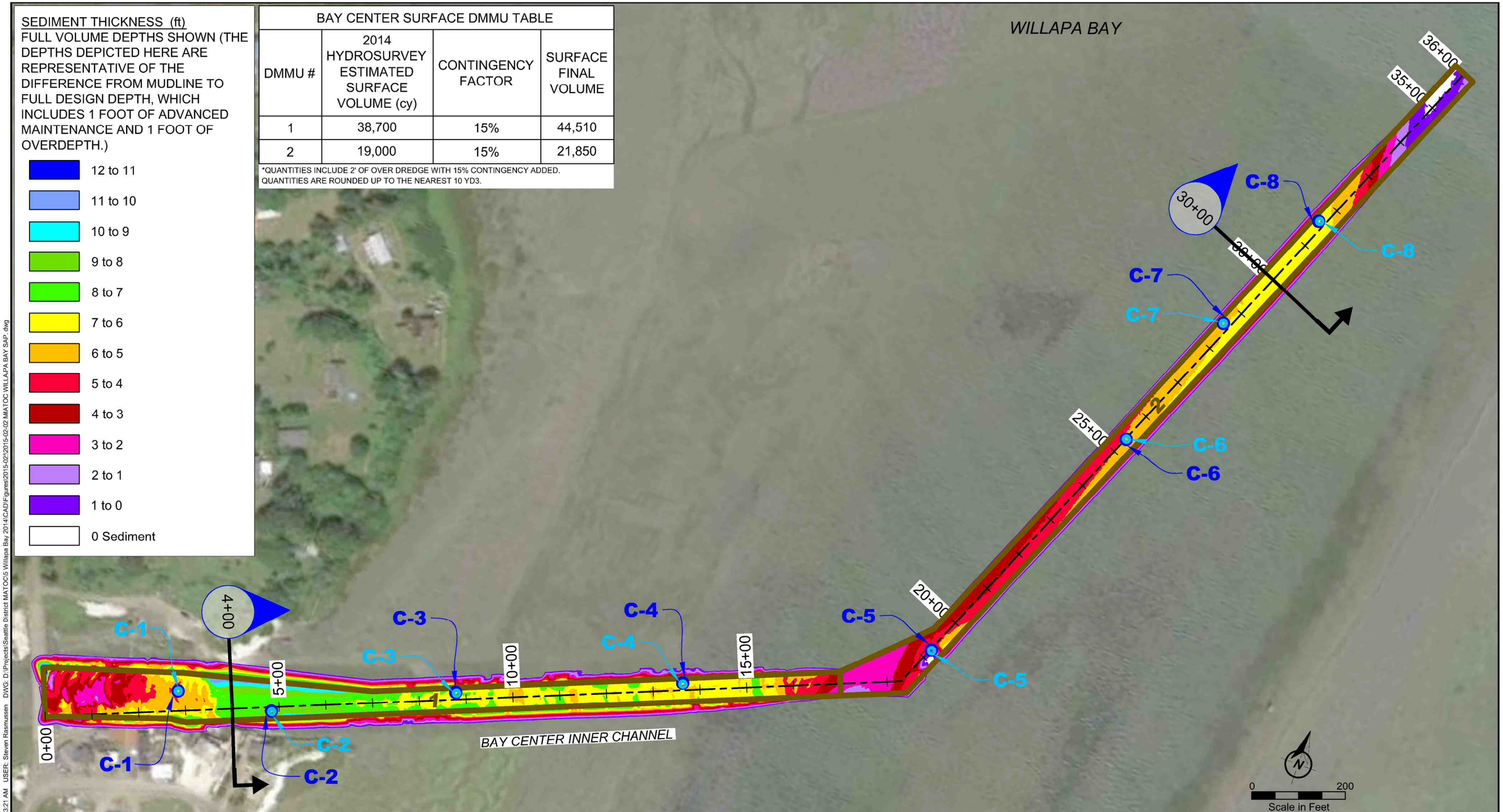
SEDIMENT THICKNESS (ft)
FULL VOLUME DEPTHS SHOWN (THE DEPTHS DEPICTED HERE ARE REPRESENTATIVE OF THE DIFFERENCE FROM MUDLINE TO FULL DESIGN DEPTH, WHICH INCLUDES 1 FOOT OF ADVANCED MAINTENANCE AND 1 FOOT OF OVERDEPTH.)

- 12 to 11
- 11 to 10
- 10 to 9
- 9 to 8
- 8 to 7
- 7 to 6
- 6 to 5
- 5 to 4
- 4 to 3
- 3 to 2
- 2 to 1
- 1 to 0
- 0 Sediment

BAY CENTER SURFACE DMMU TABLE

DMMU #	2014 HYDROSURVEY ESTIMATED SURFACE VOLUME (cy)	CONTINGENCY FACTOR	SURFACE FINAL VOLUME
1	38,700	15%	44,510
2	19,000	15%	21,850

*QUANTITIES INCLUDE 2' OF OVER DREDGE WITH 15% CONTINGENCY ADDED.
QUANTITIES ARE ROUNDED UP TO THE NEAREST 10 YD3.



NOTES:

1. BATHYMETRIC CONTOURS GENERATED FROM HYDRO SURVEY DATA COLLECTED MAY 28, 2014 BY USACE.
2. HORIZONTAL COORDINATE SYSTEM WASHINGTON STATE PLANE SOUTH, VERTICAL DATUM NAVD88, TIDAL DATUM NOS MLLW EPOCH 1983-2001, U.S. FOOT.
3. BASE MAP DRAWING INFORMATION PROVIDED BY USACE.
4. BACKGROUND IMAGE SOURCE: GOOGLE EARTH 7/6/2012.

LEGEND

- X — DMMU
- C-x — PROPOSED SAMPLE LOCATION
- C-x — ACTUAL SAMPLE LOCATION
- NAVIGATION CHANNEL
- NAVIGATION CHANNEL CENTERLINE

U.S. ARMY CORPS OF ENGINEERS
SEATTLE DISTRICT MATOC

BAY CENTER INNER FEDERAL NAVIGATION CHANNEL
BAY CENTER, WASHINGTON

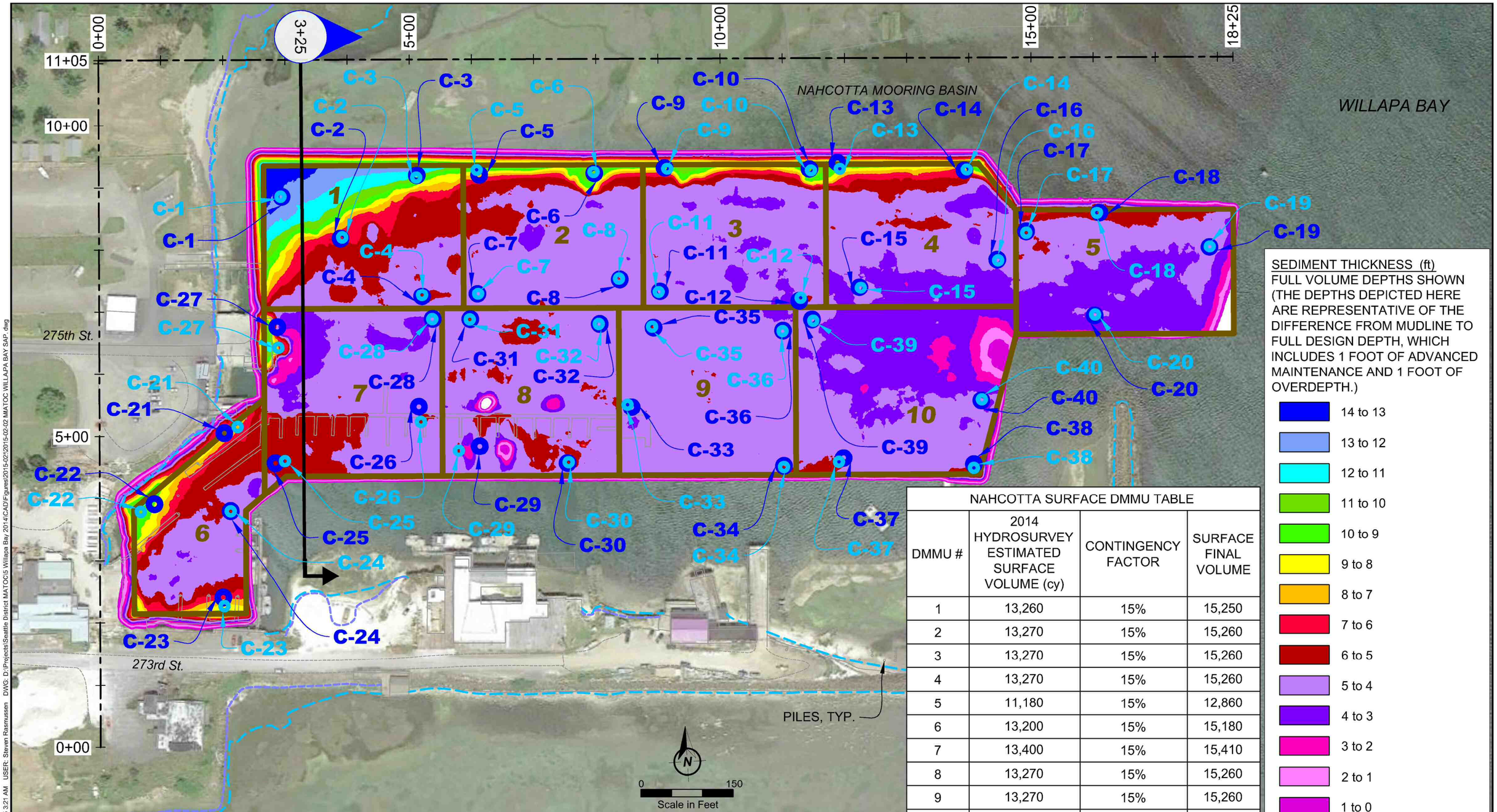
PROPOSED DMMUs AND PROPOSED SEDIMENT SAMPLING LOCATIONS

DALTON OLMSTED FUGLEVAND

FIGURE 2-2

FEBRUARY 2, 2015

PLOT TIME: 2/2/2015 9:37 AM MOD TIME: 2/2/2015 9:21 AM USER: Steven Rasmussen DWG: D:\Projects\Seattle District MATOC\S Willapa Bay 2014\CAD\Figures\2015-02\2015-02-02 MIA\TOC WILLAPA BAY SAP .dwg



NAHCOTTA SURFACE DMMU TABLE

DMMU #	2014 HYDROSURVEY ESTIMATED SURFACE VOLUME (cy)	CONTINGENCY FACTOR	SURFACE FINAL VOLUME
1	13,260	15%	15,250
2	13,270	15%	15,260
3	13,270	15%	15,260
4	13,270	15%	15,260
5	11,180	15%	12,860
6	13,200	15%	15,180
7	13,400	15%	15,410
8	13,270	15%	15,260
9	13,270	15%	15,260
10	13,270	15%	15,260

*QUANTITIES INCLUDE 2' OF OVER DREDGE WITH 15% CONTINGENCY ADDED. QUANTITIES ARE ROUNDED UP TO THE NEAREST 10 YD3.

NOTES:

1. BATHYMETRIC CONTOURS GENERATED FROM HYDRO SURVEY DATA COLLECTED APRIL 24, 2014 BY USACE.
2. HORIZONTAL COORDINATE SYSTEM WASHINGTON STATE PLANE SOUTH, VERTICAL TIDAL DATUM NOS MLLW EPOCH 1983-2001, U.S. FOOT.
3. BASE MAP DRAWING INFORMATION PROVIDED BY USACE.
4. BACKGROUND IMAGE SOURCE: GOOGLE EARTH 7/6/2012.

LEGEND

- X — DMMU
- C-x — PROPOSED SAMPLE LOCATION
- NAVIGATION CHANNEL
- NAVIGATION CHANNEL CENTERLINE
- EXISTING SHORELINE
- EXISTING LANDEDGE (MHHW)
- C-x — ACTUAL SAMPLE LOCATION

U.S. ARMY CORPS OF ENGINEERS
SEATTLE DISTRICT MATOC

NAHCOTTA FEDERAL NAVIGATION CHANNEL
OCEAN PARK, WASHINGTON

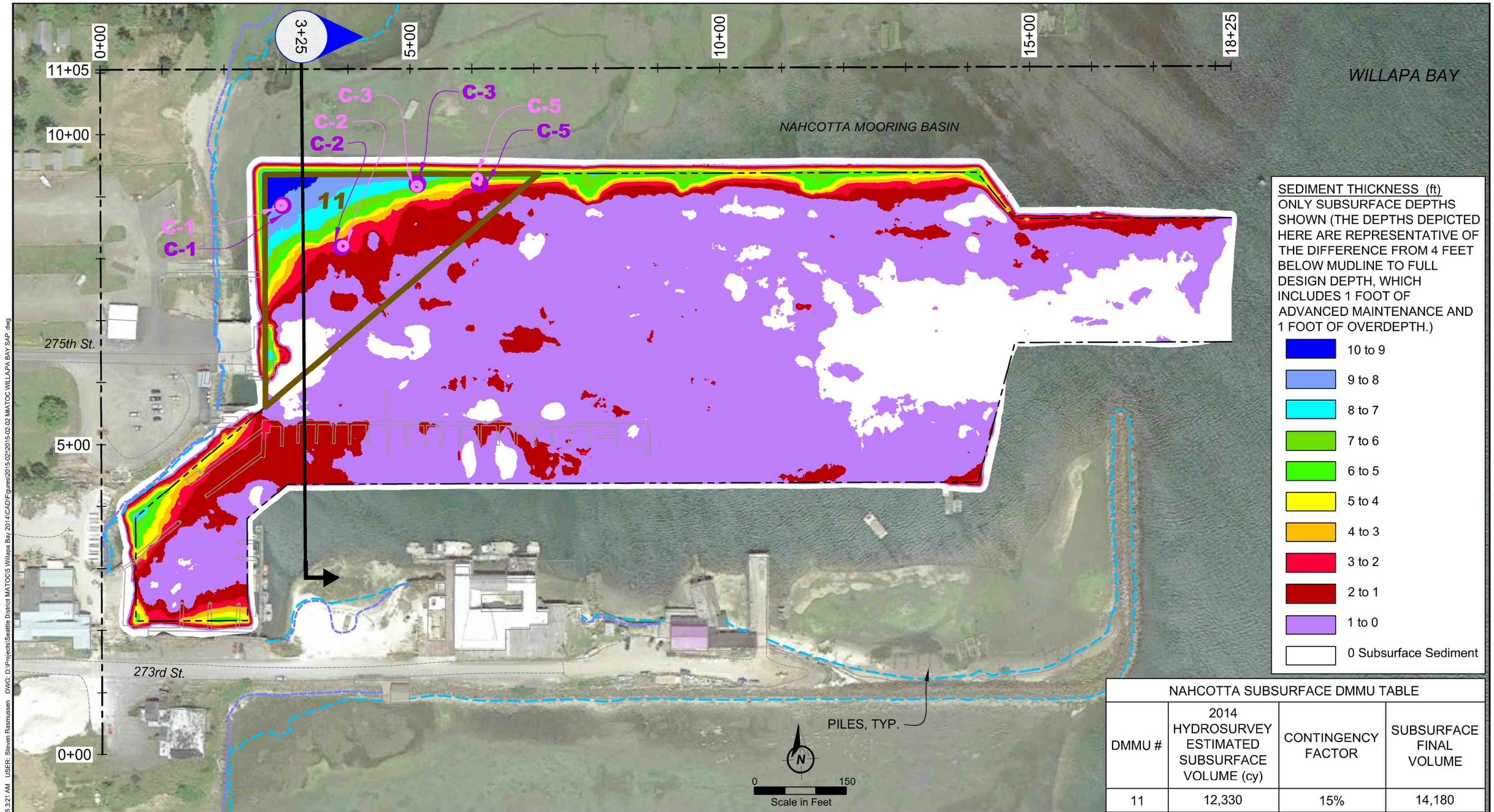
SURFACE DMMUs AND PROPOSED SEDIMENT SAMPLING LOCATIONS

DALTON OLMSTED FUGLEVAND

FIGURE 2-3

FEBRUARY 2, 2015

PLOT TIME: 2/2/2015 3:39 AM MOD TIME: 2/2/2015 3:21 AM USER: Steven Rasmussen DWG: D:\Projects\Seattle District MATOC\S Willapa Bay 2014\CAD\Figures\2015-02\2015-02-02 MATOC WILLAPA BAY SAP .dwg



NAHCOTTA SUBSURFACE DMMU TABLE

DMMU #	2014 HYDROSURVEY ESTIMATED SUBSURFACE VOLUME (cy)	CONTINGENCY FACTOR	SUBSURFACE FINAL VOLUME
11	12,330	15%	14,180

*QUANTITIES INCLUDE 2' OF OVER DREDGE WITH 15% CONTINGENCY ADDED. QUANTITIES ARE ROUNDED UP TO THE NEAREST 10 YD3.

NOTES:

1. BATHYMETRIC CONTOURS GENERATED FROM HYDRO SURVEY DATA COLLECTED APRIL 24, 2014 BY USACE.
2. HORIZONTAL COORDINATE SYSTEM WASHINGTON STATE PLANE SOUTH, VERTICAL TIDAL DATUM NOS MLLW EPOCH 1983-2001, U.S. FOOT.
3. BASE MAP DRAWING INFORMATION PROVIDED BY USACE.
4. BACKGROUND IMAGE SOURCE: GOOGLE EARTH 7/6/2012.

LEGEND

- X — DMMU
- C-x — PROPOSED SAMPLE LOCATION
- NAVIGATION CHANNEL
- NAVIGATION CHANNEL CENTERLINE
- EXISTING SHORELINE
- EXISTING LANDEDGE (MHHW)
- C-x — ACTUAL SAMPLE LOCATION

U.S. ARMY CORPS OF ENGINEERS
SEATTLE DISTRICT MATOC

NAHCOTTA FEDERAL NAVIGATION CHANNEL
OCEAN PARK, WASHINGTON

SUBSURFACE DMMU AND PROPOSED SEDIMENT SAMPLING LOCATIONS

DALTON OLMSTED FUGLEVAND

FIGURE 2-4

FEBRUARY 2, 2015

PLOT TIME: 2/2/2015 3:40 AM MOD TIME: 2/2/2015 3:21 AM USER: Steven Rasmussen DWG: D:\Projects\Seattle District MATOC\5 Willapa Bay 2014\CAD\Figures\2015-02\2015-02-02 MATOC WILLAPA BAY SAP .dwg