CENWS-OD-TS **12 April 2001**
Dredged Material Management Office

MEMORANDUM FOR RECORD

SUBJECT: DETERMINATION OF THE SUITABILITY OF DREDGED MATERIAL TESTED UNDER DMMP EVALUATION PROCEDURES FOR THE PORT OF ANACORTES CAP SANTE MARINA DREDGING PROJECT (2001-2-00399) WITH PROPOSED DISPOSAL AT THE ROSARIO STRAIT OPEN WATER DISPOSAL SITE.

1. The Port of Anacortes proposes to dredge in the Cap Sante Marina, located on the eastern shoreline of the City of Anacortes. The estimated volume of material proposed for dredging is 345,000 cubic yards. The following summary reflects the DMMP agencies (Corps of Engineers, Department of Ecology, Department of Natural Resources and the Environmental Protection Agency) consensus decision on the acceptability of the sampling plan and all relevant test data to make a determination of suitability for the disposal of the material at a PSDDA open-water disposal site.

2. The ranking for this area is "moderate" based on the guidance found in the PSDDA User's Manual (1998).

3. A sampling and analysis plan was completed for this project and approved by the DMMP agencies on 14 December 1998. Initial project sampling was performed on 17-23 February 1999. Bioaccumulation sampling was completed on 19 January 2000.

SAP approval date	14 December 1998
Sampling dates	17-23 February 1999 19 January 2000
Data Report submittal date	June 2000
Recency determination dates	February 2004 to February 2006

4. Samples were taken from forty-seven surface locations and composited for twelve analyses (Figure 1) . Analysis was completed for all chemicals of concern. In addition, pore-water analysis for tributyltin was completed on all surface composites.

5. Only one DMMU (C-8) had exceedances of 1998 DMMP screening levels for the standard list of chemicals of concern. All samples had exceedances of the porewater TBT screening level. (Table 2 lists SL exceedances.)

6. Due to the screening level exceedances, bioassay testing was required for DMMU C-8. The amphipod 10-day acute toxicity test, the bivalve sediment larval combined mortality and abnormality (effective mortality) test, and the *Neanthes* 20-day growth test were conducted. Tests were conducted according to the guidelines specified by PSEP (1995), as modified by the PSDDA program.

7. Reference sediment for use in the bioassays came from Carr Inlet. *Ampelisca Abdita* was used for the amphipod bioassay. Organisms for the amphipod test were obtained from Eastern Aquatic Biosupply. Control sediment for the amphipod test was collected from Naragansett Bay. *Strongylocentrotus pupuratus* was used in the larval test. Organisms were obtained from Carlsbad Aquafarm, Carlsbad CA. Control sediment for the Neanthes test was collected from West Beach. The seawater used for the seawater control was provided by the National Marine Fisheries Service at Mukilteo WA.

8. There were no bioassay failures. All QA/QC requirements were met, with one exception. The *amphipod* and *Neanthes* tests were initiated two days beyond the standard holding time of 56 days, due to late arrival of test organisms. This delay made the tests more ecologically conservative, and the agencies agreed that the data could be used for decision-making.

9. DMMUs C1, C2, C6, C7, C8, C9, C10, C11 and C12 had screening level exceedances of tributyltin. Additional sediment was collected for bioaccumulation testing based on an addendum to the original sampling plan. Two test composites were created, one representing those samples with TBT detections above 0.30 μG/L and those with detections below 0.30 μG/L but above the SL. All TBT exceedances are listed in Table 3.

10. Bioaccumulation testing was performed with bivalve *Macoma nasuta* and the polychaete *Nephtys caecoides*. The two species were tested together in the same 18-liter glass aquarium. At the time of project initiation, the standard DMMP bioaccumulation protocol called for 28-day test duration. The project proponents agreed to extend the test to 45 days, based on the recommendation of the DMMP agencies. The extended test provides a better approximation of steady-state tissue concentrations for TBT.

11. Six replicate aquaria (five test replicates and one replicate for steady state monitoring) were run for the two test sediments, the two reference sediments and the negative control. Tissue concentrations from the 45-day exposure were compared to the reference sediments. Initial sediment chemistry was used to adjust the observed tissue concentrations.

12. The DMMP agencies agreed to use the target tissue level developed for the East Waterway project, 3 ppm dry weight of TBT in tissue, as the value appropriate for the Cap Sante project. Given the limited residue-effects data for the Anacortes

area, it was determined that the number calculated for Elliott Bay would be the closest approximation available for making a determination of suitability. The method of calculation and the data supporting this value is documented in the suitability determination for the East Waterway project suitability determination (1999), paragraph 18, and in the "Review of Tissue Residue Effects Data for Tributyltin, Mercury and Polychlorinated Biphenyls", prepared by EVS solutions for the Port of Seattle.

13. TBT concentrations in tissues from *Macoma* and *Nephtys* exposed to test sediments were significantly less than the target tissue level of 3 ppm dry weight TBT in tissue. TBT tissue concentrations were also compared to reference and no significant differences were observed for both DMMU. These results are listed in Table 4.

14. In summary, the DMMP-approved sampling and analysis plan was followed, and quality assurance, quality control guidelines specified by the DMMP were followed. The data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP program. Based on the results of the chemical and biological testing, the consensus determination of the DMMP agencies is that approximately 345,000 cubic yards Port of Anacortes Cap Sante Marina dredging project are suitable for open-water disposal at either a dispersive or nondispersive site. Approximately 16,000 cubic yards of material from Dakota Creek is not suitable for open-water disposal.

15. This memorandum documents the suitability of proposed dredged sediments for disposal at a PSDDA open water disposal site or for beneficial use. It 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, including both vertical and horizontal buffers for the unsuitable material. A final decision will be made after full consideration of agency and public input, and after an alternatives analysis is done under section 404 (b) 1 of the Clean Water Act.

Port of Anacortes
Cap Sante Marina

Concur:

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Date

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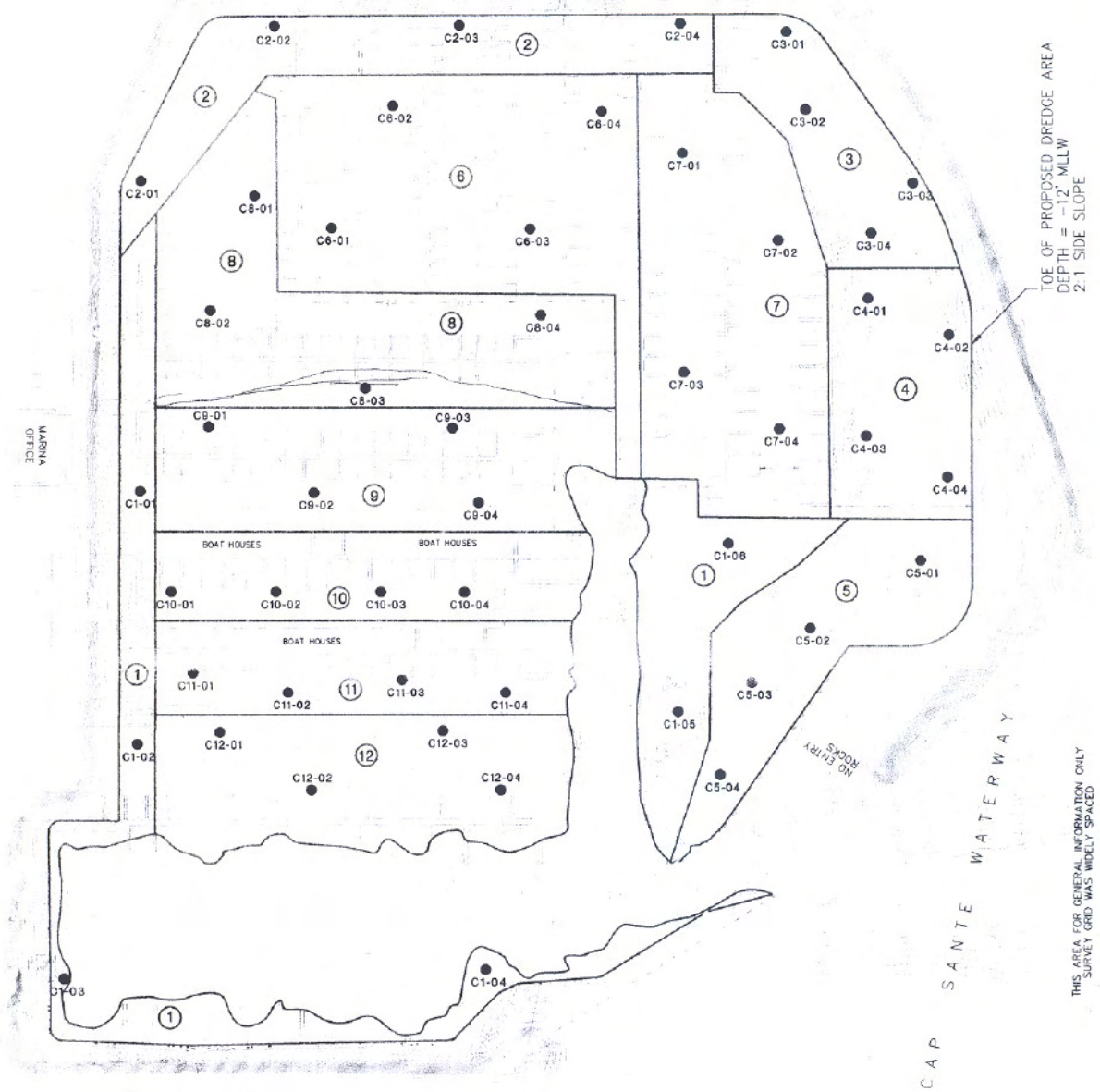
Proposed Sampling Location Plan
Cap Sante



SURFACE DMMU DESIGNATION

C2-01 PROPOSED SAMPLE LOCATION AND NUMBER

FOUND C.O.E. BRASS CAP MONUMENTS.

FOUND PREVIOUS SURVEY CONTROL POINTS

SET 2" AL CAP ON #5 REBAR

SET PN&D NAIL WITH SHINER

WOOD PILE

WOOD PILE WAVE BARRIER

CULVERT LOCATION

0 200 400
Scale in Feet

Note: Base map prepared from drawing provided by Pertorvich, Nottingham & Drage, Inc. entitled "Plan View", dated September 7, 1998.

HARTCROWSER
J-4974 10/98
Figure 3-3

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Table 1. Sediment Conventional Parameters

Parameter	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Total Solids (%)	53	53.4	68.6	60.7	59.2	43	45.3	40	59	47.3
Total Organic Carbon (%)	3.6	3.5	1.4	1.8	4.5	1.9	3	3.2	3.9	3.7
Bulk Ammonia (mg/kg)	66	22	5.3	12	24	20	40	58	80	67
Total Sulfides (mg/kg)	270	200	310	100	200	380	220	870	930	130
Grain-size										
gravel	0	3	12	1	15	0	0	0	0	0
sand	26	27	47	21	47	44	13	15	5	7
silt	54	50	35	57	35	41	65	71	73	68
clay	20	20	6	21	6	15	22	14	22	25

Table 1. Sediment Conventional Parameters (Continued)

Parameter	C11	C12
Total Solids (%)	43	49
Total Organic Carbon (%)	4.1	3.9
Bulk Ammonia (mg/kg)	76	35
Total Sulfides (mg/kg)	640	70
Grain-size		
gravel	0	0
sand	4	16
silt	70	59
clay	26	25

Table 2. Screening Level Exceedances

Analyte (in µg/kg)	DMMP Screening Level (in µg/kg)	DMMU C8
Naphthalene	1500	1800
Fluoranthene	1700	5200
Crysene	1400	1500
Pyrene	2600	3000
Total HPAHs	12000	14550

Table 3. TBT Screening Level Exceedances

	C1	C2	C6	C7	C8	C9	C10	C11	C12	Comp1	Comp2
TBT in µg/L	0.47	0.20	0.18	0.34	0.29	0.24	0.32	0.27	0.20	0.30	0.29

Table 3b. Cap Sante DMMP Full Characterization Results (DAIS Value Table - Dry Weight Basis).

Project: ANAC31CF169 Cape Sante Marina Project

	units	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
SEDIMENT CONVENTIONALS													
Total Solids	%	53	53.4	68.6	60.7	59.2	-	45.3	40	59	47.3	-	-
Volatile Solids	%	9.39	6.94	3.36	4.35	8.29	4.34	9.22	7.51	9.3	16.4	9.08	8.48
Total Organic Carbon	%	3.6	3.5	1.4	1.8	4.5	1.9 j	3	3.2	3.9	3.7	4.1 j	3.9 j
Ammonia	MG/KG	66	22	5.3	12	24	20	40	58	80	67	76	35
Total Sulfides	MG/KG	270	200	310	100	200	380	220	870	930	130	640	70
METALS													
Antimony (1)	MG/KG	5.8 u	5.5 u	3.9 u	4.6 u	4.7 u	4.8 u	5.8 u	5.5 u	6.5 u	6.2 u	6.2 u	5.6 u
Arsenic	MG/KG	6.4	5.2	5.1	4.8	5.5	4.2	5.9	5.5	6.4	5.3	6.8	6.3
Cadmium	MG/KG	0.58 u	0.55 u	0.39 u	0.46 u	0.47 u	0.48 u	0.58 u	0.55 u	0.65	0.62 u	0.78	0.6
Chromium	MG/KG	-	-	-	-	-	-	-	-	-	-	-	-
Copper	MG/KG	55	43	21	20	22	33	48	51	59	64	67	280
Lead (1)	MG/KG	26	12	7.6	7.2	8.6	7.7	10	19	26	25	33	23
Mercury	MG/KG	0.21 u	0.2 u	0.16 u	0.17 u	0.18 u	0.18 u	0.21 u	0.2 u	0.24 u	0.27	0.23	0.22 u
Nickel	MG/KG	26	28	15	19	18	21	24	30	32	27	33	27
Selenium	MG/KG	-	-	-	-	-	-	-	-	-	-	-	-
LPAH													
Silver	MG/KG	1.2 u	1.1 u	0.78 u	0.92 u	0.95 u	0.97 u	1.2 u	1.1 u	1.3 u	1.2 u	2.5 u	1.1 u
Zinc	MG/KG	95 j	77 j	49 j	46	44 j	58	120 j	90 j	110 j	92 j	120	100
2-Methylnaphthalene (1)	UG/KG	36	11 j	7 j	32 u	14 j	22 u	17 j	3 j	4 j	5 j	21 j	4 j
Acenaphthene (1)	UG/KG	50	8 j	17 u	19 u	24	11 j	20	30 j	24	19 u	22	17
Acenaphthylene (1)	UG/KG	23	33	12 j	21 u	5 j	17	59	31 j	20	4 j	30	21
Anthracene (1)	UG/KG	110	72	34 j	10 j	34 j	23 j	150	110	33	27 j	88	51
Fluorene (1)	UG/KG	45	27	21	16 j	28	22	56	100	30	19 j	36	29
Naphthalene (1)	UG/KG	110	94	58	60	85	16 j	63	14 j	27	28 j	53	40
HPAH													
Phenanthrene (1)	UG/KG	220	230	160	61	160	71	340	1800	130	130	200	210
Total LPAH (1)	UG/KG	558	464	285	147	336	160	688	2085	264	208	429	368
Benzo(a)anthracene (1)	UG/KG	200	260	93	25 j	82	63	330	470	91	83	220	140
Benzo(a)pyrene (1)	UG/KG	130	290	99	26	67	64	290	250	87	74	180	160
Benzo(g,h,i)perylene (1)	UG/KG	67	180	59	16 j	36	35	210	130	58	42	140	93
Benzofluoranthenes (1)	UG/KG	330	610	150	52 j	170	190	470	1900	160	170	460	480
Chrysene (1)	UG/KG	290	460	110	43	180	120	410	1500	140	190	330	260
Dibenzo(a,h)anthracene (1)	UG/KG	35	27	12 j	21 u	19 u	14 j	71	62 j	27	21 u	57	45
Fluoranthene	UG/KG	1100	470	390	89	340	190	780	5200	250	270	580	500
Indeno(1,2,3-c,d)pyrene (1)	UG/KG	65	160	51	22 u	32	34	180	140	54	37	120	91
CHLORINATED HYDROCARBONS													
Pyrene	UG/KG	440	590	220	100	350	220	700	3000	250	260	560	390
Total HPAH (1)	UG/KG	2987	3657	1334	403	1427	1120	3911	14550	1277	1296	3107	2639
1,2,4-Trichlorobenzene (1)	UG/KG	23 u	31 u	28 u	31 u	28 u	21 u	29 u	22 u	22 u	31 u	23 u	23 u
1,2-Dichlorobenzene (1)	UG/KG	4 u	4 u	3 u	3 u	5 u	4 u	4 u	3 u	5 u	4 u	5 u	3 u
1,3-Dichlorobenzene (3)	UG/KG	4 u	4 u	3 u	3 u	5 u	4 u	4 u	3 u	5 u	4 u	5 u	3 u
PHTHALATES													

	units	C1		C2		C3		C4		C5		C6		C7		C8		C9		C10		C11		C12	
1,4-Dichlorobenzene (1)	UG/KG	4	u	4	u	3	u	3	u	5	u	4	u	4	u	3	u	5	u	4	u	5	u	3	u
Hexachlorobenzene	UG/KG	4	u	3	u	3	u	3	u	3	u	3	u	4	u	3	u	4	u	4	u	4	u	4	u
Bis(2-ethylhexyl)phthalate (1)	UG/KG	150		180		23	u	46	u	55	u	89		140		110		120		130		160		200	
Butyl benzyl phthalate (1)	UG/KG	20	j	110	u	49	u	53	u	48	u	36	u	50	u	37	u	38	u	53	u	39	u	40	u
Di-n-butyl phthalate (1)	UG/KG	21	u	36	u	33	u	36	u	32	u	25	u	34	u	25	u	20	u	36	u	26	u	21	j
Di-n-octyl phthalate (1)	UG/KG	38	u	130		47	u	52	u	47	u	36	u	49	u	36	u	37	u	52	u	76	u	39	u
PHENOLS																									
Diethyl phthalate (1)	UG/KG	28	u	38	u	35	u	38	u	34	u	26	u	35	u	26	u	27	u	38	u	28	u	28	u
Dimethyl phthalate (1)	UG/KG	25		14	j	31	u	34	u	30	u	9	j	8	j	14	j	17	j	34	u	15	j	17	j
2 Methylphenol (1)	UG/KG	3.5	j	33	u	30	u	33	u	29	u	45	u	30	u	1.4	j	2.4	j	33	u	2.7	j	2.4	j
2,4-Dimethylphenol (1)	UG/KG	3.4	j	1.3	j	0.65	j	15	u	0.96	j	21	u	1.4	j	1.3	j	1.4	j	1.3	j	2.9	j	1.9	j
4 Methylphenol (1)	UG/KG	190		74		51		67		63		26	j	56		55		130		140		140		190	
MISCELLANEOUS EXTRACTABLES																									
Pentachlorophenol	UG/KG	6.5	j	2.7	j	48	u	53	u	1	j	2.1	j	2.2	j	11	j	8	j	4.5	j	26	j	24	j
Phenol (1)	UG/KG	39	j	15	j	18	j	18	j	10	u	8	u	16	j	30	j	36	j	31		30	j	20	j
Benzoic acid (1)	UG/KG	49	j	50	j	14	j	14	j	19	j	18	j	26	j	43	j	43	j	53	j	46	j	32	j
Benzyl alcohol (1)	UG/KG	3.2	j	0.77	j	33	u	36	u	0.74	j	49	u	0.83	j	1.9	j	1.9	j	5	j	2.1	j	1.6	j
Dibenzofuran (1)	UG/KG	47		9	j	20	u	22	u	24		9	j	28		55	j	19		22	u	16	u	16	
Hexachlorobutadiene (1)	UG/KG	4	u	3	u	3	u	3	u	3	u	3	u	4	u	3	u	4	u	4	u	4	u	4	u
VOLATILE ORGANICS																									
Hexachloroethane (1)	UG/KG	29	u	40	u	37	u	40	u	36	u	28	u	38	u	28	u	29	u	40	u	29	u	30	u
N-Nitrosodiphenylamine (1)	UG/KG	17	u	23	u	21	u	23	u	21	u	16	u	22	u	16	u	16	u	23	u	17	u	17	u
Ethylbenzene (1)	UG/KG	4	u	4	u	3	u	3	u	5	u	4	u	4	u	3	u	5	u	4	u	5	u	3	u
Tetrachloroethene (1)	UG/KG	4	u	4	u	3	u	3	u	5	u	4	u	4	u	3	u	5	u	4	u	5	u	3	u
PESTICIDES AND PCBs																									
Total Xylene (1)	UG/KG	4	u	4	u	3	u	3	u	5	u	4	u	4	u	3	u	5	u	4	u	5	u	3	u
Trichloroethene (1)	UG/KG	4	u	4	u	3	u	3	u	5	u	4	u	4	u	3	u	5	u	4	u	5	u	3	u
Aldrin (3)	UG/KG	4	u	3	u	3	u	3	u	3	u	3	u	4	u	3	u	4	u	4	u	4	u	4	u
Chlordane (2)	UG/KG	4	u	3	u	3	u	3	u	3	u	3	u	4	u	3	u	4	u	4	u	4	u	4	u
Dieldrin (3)	UG/KG	7	u	7	u	5	u	6	u	6	u	6	u	7	u	7	u	8	u	8	u	8	u	7	u
Heptachlor (3)	UG/KG	-		-		-		-		-		-		-		-		-		-		-		-	
Lindane (3)	UG/KG	4	u	3	u	3	u	3	u	3	u	3	u	4	u	3	u	4	u	4	u	4	u	4	u
ORGANOMETALLICS: TBT	UG/L	0.47		0.20		0.015		0.02		0.03		0.18		0.34		0.29		0.24		0.32		0.27		0.20	
Total DDT	UG/KG	-		-		-		-		-		-		-		-		-		-		-		-	
Total PCBs	UG/KG	71	u	67	u	51	u	56	u	60	u	61	u	72	u	68	u	79	u	78	u	78	u	72	u
Volume (cy) Sur: 185,000/Sub:160,000	Surface	16,000		16,000		16,000		16,000		16,000		16,000		16,000		16,000		16,000		16,000		16,000		16,000 = 192,000 cy	

Table 4. Bioaccumulation Results

Table 10- Summary of Bioaccumulation Testing Analytical Results

	Concentration in mg/kg (wet weight)					
	Tetra-n-butyltin	Tri-n-butyltin		Di-n-butyltin	n-Butyltin	Lipids
DMMP Tissue Guideline	None	0.6		None	None	in %
Comp-1						
Initial testing (TBT porewater)		max value 0.47 ug/l				
Retest of composite (TBT porewater)		0.29 ug/l	Adjusted tissue			
ratio I/R		1.62	chemistry values			
MAC-2	0.001 U	0.011	0.0178	0.0028	0.0003 J	1.05
MAC-3	0.001 U	0.01	0.0162	0.0025	0.001 U	1.07
MAC-8	0.001 U	0.011	0.0178	0.0027	0.001 U	0.97
MAC-12	0.001 U	0.015	0.0243	0.0036	0.001 U	1.23
MAC-17	0.001 U	0.013	0.0211	0.0025	0.001 U	1.16
Average	0.001 U	0.012	0.0194	0.00282	0.00086 J	1.096
Variance	0	0.0000040	0.0000105	0.000000207	0.000000098	0.0102
t statistic (test vs guidelines)	NA	-657.4039854	-400.4940475 SD	NA	NA	NA
NEP-2	0.001 U	0.0013	0.0021	0.0011	0.001 U	1.11
NEP-3	0.001 U	0.0012	0.0019	0.001 J	0.0002 J	1.20
NEP-8	0.001 U	0.0011	0.0018	0.0008 J	0.001 U	1.20
NEP-12	0.001 U	0.001	0.0016	0.0013	0.0003 J	1.25
NEP-17	0.001 U	0.0013	0.0021	0.0005 J	0.0002 J	1.16
Average	0.001 U	0.00118	0.0019	0.00094	0.00054 J	1.18
Variance	0	0.00000002	0.00000004	0.0000001	0.0000001	0.0022
t statistic (test vs guidelines)	NA	-10269.67828	-6328.859723 SD	NA	NA	NA
Comp-2						
Initial testing (TBT porewater)		max value 0.29 ug/l				
Retest of composite (TBT porewater)		0.30 ug/l				
ratio I/R		0.966666667				
MAC-1	0.001 U	0.015		0.0035	0.0013	1.39
MAC-7	0.001 U	0.018		0.0043	0.0005 J	1.08
MAC-10	0.001 U	0.018		0.0029	0.001 U	1.07
MAC-11	0.001 U	0.017		0.0032	0.001 U	1.32
MAC-20	0.001 U	0.021		0.0048	0.0005 J	1.16
Average	0.001 U	0.0178		0.00374	0.00086	1.20
Variance	0	0.0000047		0.0000006	0.0000001	0.0167
t statistic (test vs guidelines)	NA	-600.4934496		NA	NA	NA
NEP-1	0.001 U	0.0017		0.0013	0.001 U	1.66
NEP-7	0.001 U	0.0018		0.0016	0.0003 J	1.15
NEP-10	0.001 U	0.0021		0.0007 J	0.0005 J	1.24
NEP-11	0.001 U	0.002		0.0012	0.0003 J	1.21
NEP-20	0.001 U	0.0017		0.0013	0.001 U	1.20
Average	0.001 U	0.00186		0.00122	0.00062 J	1.29
Variance	0	0.00000003		0.0000001	0.0000001	0.0347
t statistic (test vs guidelines)	NA	-7362.594441		NA	NA	NA
Reference						
MAC-5	0.001 U	0.0012		0.0024	0.001 U	1.01
MAC-6	0.001 U	0.0016		0.0018	0.001 U	1.25
MAC-9	0.001 U	0.0014		0.0016	0.001 U	1.04
MAC-15	0.001 U	0.0019		0.0034	0.001 U	1.06
MAC-19	0.001 U	0.0016		0.0014	0.001 U	1.06
Average	0.001 U	0.00154		0.00212	0.001 U	1.08
Variance	0	0.0000001		0.0000007	0.0000000	0.009
NEP-5	0.001 U	0.001 U		0.0008 J	0.001 U	1.35
NEP-6	0.001 U	0.001 U		0.0006 J	0.001 U	1.24
NEP-9	0.001 U	0.001 U		0.0004 J	0.001 U	1.15
NEP-15	0.001 U	0.001 U		0.0014	0.0002 J	1.07
NEP-19	0.001 U	0.001 U		0.001 U	0.001 U	1.20
Average	0.001 U	0.001 U		0.00084	0.00084	1.20
Variance	0	0		0.000000148	0.000000128	0.0109
Background						
MAC-21	0.001 U	0.0067		0.0028	0.0009 J	1.26
MAC-22	0.001 U	0.0023		0.0021	0.001 U	1.27
MAC-23	0.001 U	0.0032		0.0027	0.001 U	1.29
Average	0.001 U	0.004066667		0.002533333	0.000966667 U	1.27
Variance	0	0.0000054		0.0000001	0.000000003	0.0002
NEP-24	0.001 U	0.001 U		0.001 U	0.001 U	1.19
NEP-25	0.001 U	0.001 U		0.001 U	0.001 U	1.48
NEP-26	0.001 U	0.001 U		0.001 U	0.001 U	1.41
Average	0.001 U	0.001 U		0.001 U	0.001 U	1.36
Variance	0	0		0	0	0.0229

Notes:

SD- Result is significantly different than the tributyltin tissue guideline (0.6 mg/kg wet weight/ 3 mg/kg dry weight)

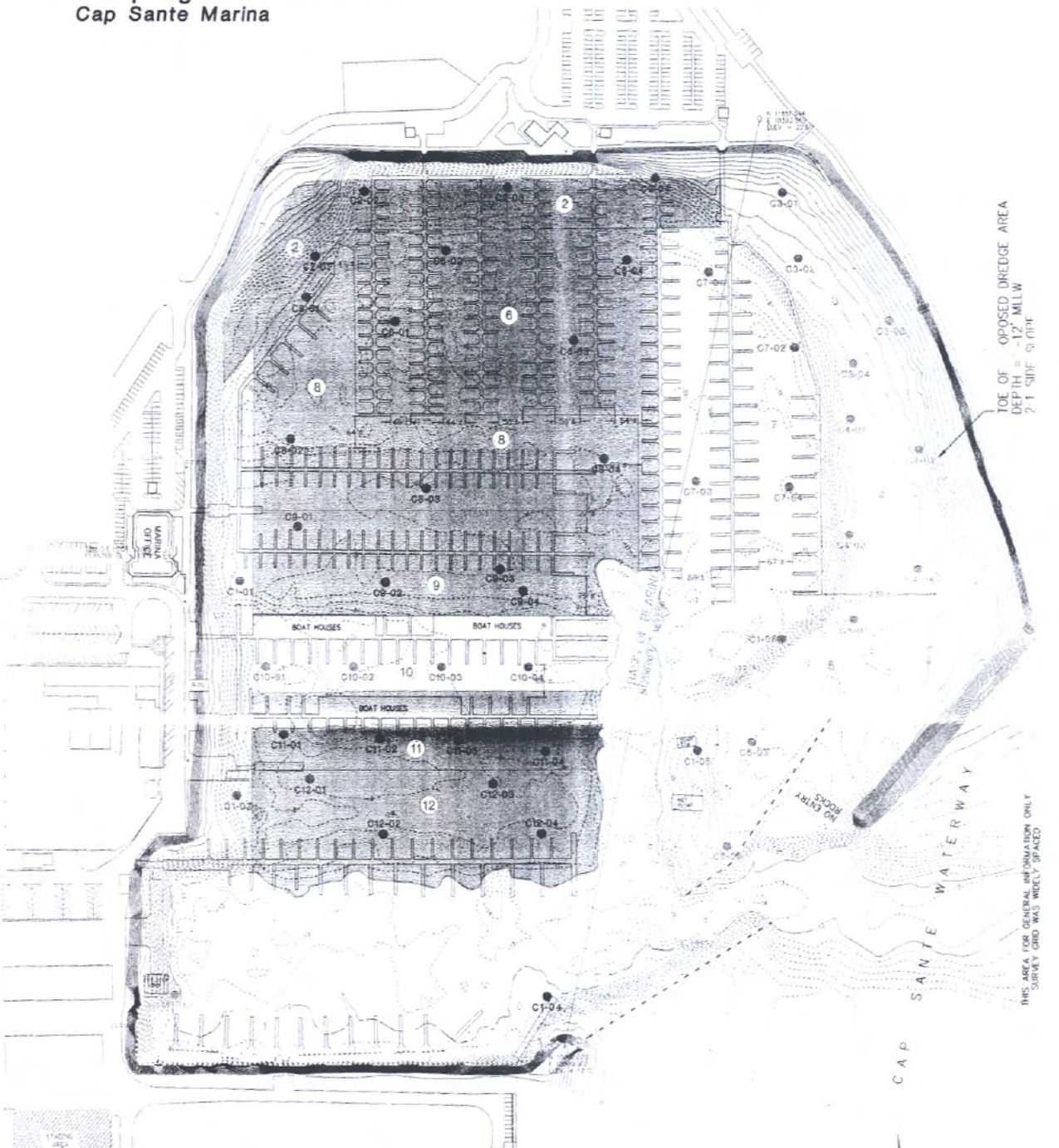
U = Not detected at indicated detection limit.

J = Estimated value.

NA = Not applicable.

4974/CapTables.xls - Table 10

TBT Bioaccumulation Testing
Sampling Location Plan
Cap Sante Marina



DMMUs INCLUDED IN BIOACCUMULATION TEST SAMPLE COMP 1

DMMUs INCLUDED IN BIOACCUMULATION TEST SAMPLE COMP 2

SURFACE DMMU DESIGNATION

CONFIRMED SAMPLE LOCATION AND NUMBER

C1-04 PROPOSED LOCATION NOT SAMPLED

FOUND C.O.E. BRASS CAP MONUMENTS.

FOUND PREVIOUS SURVEY CONTROL POINTS

SET 2" AL CAP ON #5 REBAR

SET PN&D NAIL WITH SHINER

WOOD PILE

WOOD PILE WAVE BARRIFR

N

0 200 400

Scale in Feet

Note: Base map prepared from drawing provided by Pertorvich, Nottingham & Drage, Inc. entitled "Plan View", dated September 7, 1998.

HARTCROWS

J-4974

Figure 3