CENWS-OD-TS-DM

MEMORANDUM FOR RECORD 27 December 2007

SUBJECT: DETERMINATION ON THE SUITABILITY OF DREDGED MATERIAL CHARACTERIZED AT THE CITY OF DES MOINES MARINA (NWS-2007-1762-NO) UNDER SECTION 404 OF THE CLEAN WATER ACT FOR THE PURPOSE OF DETERMINING THE SUITABILITY OF THE DREDGED MATERIAL FOR OPEN-WATER DISPOSAL AT A DMMP NON-DISPERSIVE DISPOSAL SITE.

1. This Memorandum documents the Dredged Material Management Program (DMMP) characterization of 10,580 cubic yards to restore navigational access within berthing areas at the City of Des Moines Marina. It reflects the consensus determination of the Dredged Material Management Program (DMMP) which consists of the principal agencies having jurisdiction for dredge/disposal projects in Washington State (i.e., the Corps of Engineers, Department of Ecology, Department of Natural Resources, and the Environmental Protection Agency).

2. This determination evaluates the suitability of an estimated 10,580 cy of maintenance dredged material tested within the City of Des Moines Marina area for unconfined open-water disposal at either the Elliott Bay or Commencement Bay non-dispersive disposal site. The dredging proposed is to restore the minimum maintenance required to provide navigational access to the marina berthing areas and entrance channel.

3. Relevant dates for regulatory tracking purposes are included in **Table 1**.

Table 1. Regulatory Tracking Dates

Application Number:	NWS-2007-1762-NO
SAP Submital date:	June 15, 2007
SAP Approval date(s):	July 10, 2007
Sampling date:	September 11, 2007
Characterization Report submittal date:	December 18, 2007
DAIS Tracking No.	DESMM-1-B-F-277
Recency Determination Date: Moderate = 5 years	September 2012

4. The project is located in a Moderate Concern area, and was previously maintenance dredged in 1983 (pre-PSDDA/DMMP) and again in 1994. Maintenance dredging was accomplished within the entrance channel in 1994 to -13 ft. Mean Lower Low Water (MLLW), and at the south end of the Marina to -10 ft MLLW for a total cumulative volume of 5,616 cy at both locations. For this maintenance dredging cycle, four areas require maintenance dredging within the marina, which includes the entrance channel (Area A), the area in the vicinity of the 36-inch outfall (Area B), the area in the vicinity of the 36-inch outfall near Dock D (Area C), and the area adjacent to the

breakwater at the south end of the marina (Area D) (**Figure 1 = Vicinity Map; Figures 2-3 = Plan View DMMU boundary and core sampling locations within the 4 dredging locations**). The proposed dredge depths are -13, -13, -10, and -10 feet MLLW, respectively, each with 1 foot of allowable overdredge, with a total volume of material estimated for removal at approximately 10,580 cy. The volume initially proposed within DMMU-1 (Area A) was reduced from 15,000 cy to 7,000 cy after re-evaluation of Marina's navigation needs following DMMP SAP approval. This change was coordinated with DMMP through the Dredged Material Management Office (DMMO).

5. A sampling and analysis plan was submitted to the DMMP agencies for review on June 15, 2007, and the DMMP agencies approved the SAP on July 10, 2007.

6. A total of six vibracore samples were collected on September 11, 2007 within the 4 locations and 3 DMMUs identified for characterization (**Figures 2 and 3**). Sampling within area C (DMMU-2) encountered refusal at approximately 2.5 feet below mudline, and two additional cores were necessary to obtain adequate sample volume. The sediment collected within Area A (DMMU-C1) was too dry to extract pore-water necessary for TBT analysis, therefore TBT analysis of DMMU-C1 was not accomplished.

7. The characterization report was submitted to the DMMP agencies for review on December 18, 2007. The quality assurance/quality control guidelines specified by the PSDDA Users Manual were generally complied with, and the data gathered were deemed sufficient and acceptable for decision-making by the DMMP agencies based on best professional judgment.

8. **Table 2** provides a complete summary of sediment testing results for the 3 characterized DMMUs. Analysis results for the 3 DMMUs tested, indicated that DMMU-C1 and DMMU-C3 had no detected or undetected screening level (SL) exceedances of DMMP chemical guidelines. DMMU-C2 had detected Fluoranthene, Butylbenzylphthalate, and Bis(2-ethylhexyl)phthalate SL exceedances, and an undetected detection limit SL exceedance for DDT. Moreover, comparison to SMS guidelines, illustrated that DMMU-C1 and C3 had no SQS or CSL exceedances, whereas DMMU-C2 had a detected SQS exceedance for Butylbenzylphthalate and a CSL exceedance for Bis(2-ethylhexyl)phthalate. Based on the chemical analysis results DMMU-C2 required toxicity testing to complete the DMMP evaluation for suitability for non-dispersive site disposal.

9. **Table 3** provides the bioassay testing QA/QC requirements and non-dispersive site interpretive guidelines. **Table 4** summarizes the testing results for DMMU-2 for the amphipod (*Eohaustorius estuaries*), Echinoderm larval (*Dendraster excentricus*), and juvenile *Neanthes* 20-day growth bioassay. Testing was conducted by NewFields for the 3 test species for DMMU-2 using reference sediment collected from Carr Inlet (CR-22) on October 15, 2007. Control sediments for the amphipod used Yaquina Bay, Oregon sediment, and sediments from this location were also used for the *Neanthes* test control sediment. All three tests met the QA/QC performance requirements for both Control sediment/seawater and reference sediment. The results of the testing for DMMIU-C2 sediment indicated that both the amphipod and sediment larval bioassays exhibited no toxicity (e.g., relative to either 2-hit or 1-hit response guidelines). However, the *Neanthes* test did register a 2-hit response (e.g. C-2 test sediment was 67% of reference sediment Mean Individual Growth (MIG): 2-hit response: Test MIG > 70% Reference MIG), but there was no other corroborating response from the other 2 bioassays, so DMMU-C2 passes the non-dispersive site interpretive

guidelines.

10. The agencies concluded that all three DMMUs tested representing a total of 10,580 cy are suitable for unconfined open-water disposal at either the Elliott Bay or the Commencement Bay site. However, the DMMP agencies prefer that the Elliott Bay site be used rather than the Commencement Bay site, due to heavy recent site use by the Port of Tacoma.

11. Based on these testing results, the DMMP agencies recommend sequencing of dredging and disposal as follows. DMMU-C2 should be dredged first/disposed before either DMMU-C1 or DMMU-C3.

12. This memorandum affirms the suitability of the sediment proposed for dredging at the City of Des Moines Marina for disposal at either the Elliott Bay or the Commencement Bay non-dispersive open-water disposal site. However, 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.

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Concur:

1/3/08
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Table 3. DMMP BIOASSAY PERFORMANCE STANDARDS AND EVALUATION GUIDELINES

Bioassay	Negative Control Performance Standard	Reference Sediment Performance Standard	Dispersive Disposal Site Interpretation Guidelines		Nondispersive Disposal Site Interpretation Guidelines	
			1-hit rule	2-hit rule	1-hit rule	2-hit rule
Amphipod	$M_C < 10\%$	$M_R - M_C < 20\%$	$M_T - M_C > 20\%$ and M_T vs M_R SD (p=.05) and		$M_T - M_C > 20\%$ and M_T vs M_R SD (p=.05) and	
			$M_T - M_R > 10\%$	NOCN	$M_T - M_R > 30\%$	NOCN
Larval	$N_C \div I > 0.70$	$N_R > N_C > 0.65$	$N_T \div N_C < 0.80$ and N_T/N_C vs N_R/N_C SD (p=.10) and		$N_T \div N_C < 0.80$ and N_T/N_C vs N_R/N_C SD (p=.10) and	
			$N_R/N_C - N_T/N_C > 0.15$	NOCN	$N_R/N_C - N_T/N_C > 0.30$	NOCN
Neanthes growth	$M_C < 10\%$ and $MIG_C > 0.38$	$M_R < 20\%$ and $MIG_R \div MIG_C > 0.80$	$MIG_T \div MIG_C < 0.80$ and MIG_T vs MIG_R SD (p=.05) and		$MIG_T \div MIG_C < 0.80$ and MIG_T vs MIG_R SD (p=.05) and	
			$MIG_T/MIG_R < 0.70$	NOCN	$MIG_T/MIG_R < 0.50$	$MIG_T/MIG_R < 0.70$

M = mortality, N = normal survivors, I = initial count, MIG = mean individual growth rate (mg/individual/day)
SD = statistically different, NOCN = no other conditions necessary, N/A = not applicable
Subscripts: R = reference sediment, C = negative control, T = test sediment

Table 4. Summary of Bioassay Testing Results for DMMU-C2

Treatment	Amphipod (*Eohaustorius estuaries*)		Juvenile Polychaete Growth (*Neanthes* sp.)		Echinoderm Sediment Larval (*Dendraster excentricus*)	
	Mean Survival (%)	**Mean Mortality (%)**	**Survival (%)**	**MIG (mg/ind/day)**	**Mean NCMA**	**Mean Normal Larvae**
Control	91	9 ± 2.2	100	0.725 ± 0.0	8.2 ± 7.5 ($N_{C/I}$ = 0.92)	185
Reference (Car Inlet 22)	92	8 ± 4.5	100	0.746 ± 0.2	18.2 ± 10.6	151
DMMU-C2	90	10 ± 3.5 (**NH**)	100	0.489 ± 0.2 (MIG_T/MIG_R = 66%; < 70% of Ref = **2H)**	9.7 ± 10.1 (**NH**)	172

Legend: MIG = Mean Individual Growth; **NCMA** = Mean Normalized Mortality and Abnormality; **NH** = No Hit Response; **2H** = 2H response under non-dispersive interpretive guidelines (requires another corroborating response)

Table 2. DesMoines Marina DMMP/SMS Characterization Summary

								DMMU ID:	DMMU-C1 (C1-A1, C1-A2)		DMMU-C2 (C2-B1, C2-C1, C2-C2)		
	DMMP				SMS			mg/kg-dry wgt	mg/kg-OC	VQ	mg/kg-dry wgt	mg/kg-OC	VQ
CHEMICAL NAME	Units	SL	BT	ML	Units	SQS	CSL	DMMP	SMS		DMMP	SMS	
Antimony		150		200				6.0		UJ	7.0		UJ
Arsenic	mg/kg	57	507.1	700	mg/kg	57	93	6.0		U	**7.0**		
Cadmium	mg/kg	5.1	11.3	14	mg/kg	5.1	6.7	0.20		U	**0.60**		
Chromium	mg/kg	(2)	267	(2)	mg/kg	260	270	**21.2**			**29.8**		
Copper	mg/kg	390	1,027	1,300	mg/kg	390	390	**12.4**			**48.8**		
Lead	mg/kg	450	975	1,200	mg/kg	450	530	**8.0**			**108**		
Mercury	mg/kg	0.41	1.5	2.3	mg/kg	0.41	0.59	0.05		U	**0.11**		
Nickel	mg/kg	140	370	370	mg/kg	--	--	**19.0**			**21.0**		
Selenium	mg/kg	(2)	3	(2)	mg/kg	--	--	0.2		U	0.3		U
Silver	mg/kg	6.1	6.1	8.4	mg/kg	6.1	6.1	0.3		U	0.4		U
Zinc	mg/kg	410	2,783	3,800	mg/kg	410	960	**45.0**			**109.0**		
TBT ion (porewater)	ug/L	0.15	0.15		ug/L	0.05	0.35	**NT**			**0.06**		J
Naphthalene	ug/kg	2,100		2,400	mg/kg-OC	99	170	20.0	2.04	U	20.0	1.10	U
Acenaphthylene	ug/kg	560		2,000	mg/kg-OC	66	66	20.0	2.04	U	**24.0**	**1.33**	
Acenaphthene	ug/kg	500		2,000	mg/kg-OC	16	57	20.0	2.04	U	**41.0**	**2.27**	
Fluorene	ug/kg	540		3,600	mg/kg-OC	23	79	20.0	2.04	U	**48**	**2.65**	
Phenanthrene	ug/kg	1,500		2,100	mg/kg-OC	100	480	**27.0**	**2.76**		**630**	**34.8**	
Anthracene	ug/kg	560		13,000	mg/kg-OC	220	1,200	20.00	2.04	U	**160**	**8.84**	
2-Methylnapthalene	ug/kg	670		1,900	mg/kg-OC	38	64	20.0	2.04	U	20.0	1.10	U
Total LPAH	ug/kg	5,200		29,000	mg/kg-OC	370	780	**27.0**	**2.76**		**903**	**49.9**	
Fluoranthene	ug/kg	1,700	4,600	30,000	mg/kg-OC	160	1,200	**98.0**	**10.0**		**2,000**	**110.5**	
Pyrene	ug/kg	2,600	11,980	16,000	mg/kg-OC	1,000	1,400	**97.0**	**9.91**		**2,000**	**110.5**	
Benzo(a)anthracene	ug/kg	1,300		5,100	mg/kg-OC	110	270	**41.0**	**4.19**		**660**	**36.5**	
Chrysene	ug/kg	1,400		21,000	mg/kg-OC	110	460	**50.0**	**5.11**		**1,200**	**66.3**	
Total Benzo(b+k)fluoranthenes	ug/kg	3,200		9,900	mg/kg/OC	230	450	**91.0**	**9.30**		**2,300**	**127.1**	
Benzo(a)pyrene	ug/kg	1,600		3,600	mg/kg-OC	99	210	**34.00**	**3.47**		**1,000**	**55.2**	
Indeno(1,2,3-cd)pyrene	ug/kg	600		4,400	mg/kg-OC	34	88		**-**		20.00	1.1	U
Dibenzo(a,h)anthracene	ug/kg	230		1,900	mg/kg-OC	12	33	20.0	2.04	U	150.0	**8.3**	U
Benzo(g,h,I)perylene	ug/kg	670		3,200	mg/kg-OC	31	78	**23.0**	**2.35**		**300.0**	**16.6**	
Total HPAH	ug/kg	12,000		69,000	mg/kg-OC	960	5,300	**434.0**	**44.3**		**10,220**	**564.6**	
1,3-Dichlorobenzene	ug/kg	170			mg/kg-OC	2.3	2.3	0.9	0.09	U	1.0	0.1	U
1,4-Dichlorobenzene	ug/kg	110		120	mg/kg-OC	3.1	9	0.9	0.09	U	1.0	0.1	U
1,2-Dichlorobenzene	ug/kg	35		110	mg/kg-OC	2.3	2.3	0.9	0.09	U	1.0	0.1	U
1,2,4-Trichlorobenzene	ug/kg	31		64	mg/kg-OC	0.81	1.8	4.7	0.48	U	5.0	0.3	U
Hexachlorobenzne (HCB)	ug/kg	22	168	230	mg/kg-OC	0.38	2.3	0.98	0.10	U	4.0	0.2	U
Dimethylphthalate	ug/kg	71		1,400	mg/kg-OC	53	53	6.2	0.63	U	**27.0**	1.5	
Diethylphthalate	ug/kg	200		1,200	mg/kg-OC	61	110	**6.2**	**0.63**		6.1	0.3	U
Di-n-butylphthalate	ug/kg	1,400		5,100	mg/kg-OC	220	1,700	20.0	2.04	U	**28.0**	**1.5**	
Butylbenzylphthalate	ug/kg	63		970	mg/kg-OC	4.9	64	**6.2**	**0.63**		**180**	**9.9**	
Bis(2-ethylhexyl)phthalate	ug/kg	1,300		8,300	mg/kg-OC	47	78	20.0	2.04	U	**2,600**	143.6	
Di-n-octylphthalate	ug/kg	6,200		6,200	mg/kg-OC	58	4,500	20.0	2.04	U	**20.0**	**1.1**	
Phenol	ug/kg	420		1,200	ug/kg	420	1,200	20.0	2.04	U	20.0	1.1	U
2-Methylphenol	ug/kg	63		77	ug/kg	63	63	6.2	0.63	U	6.1	0.3	U
4-Methylphenol	ug/kg	670		3,600	ug/kg	670	670	20.0	2.04	U	**160**	**8.8**	
2,4-Dimethylphenol	ug/kg	29		210	ug/kg	29	29	6.2	0.63	U	6.1	0.3	U
Pentachlorophenol	ug/kg	400		690	ug/kg	360	690	31.0	3.17	U	31.0	1.7	U
Benzyl alcohol	ug/kg	57		87	ug/kg	57	73	31.0	3.17	UJ	31.0	1.7	UJ
Benzoic acid	ug/kg	650		760	ug/kg	650	650	200.0	20.43	U	200	11.0	U
Dibenzofuran	ug/kg	540		1,700	mg/kg-OC	15	58	20.0	2.04	U	20.0	1.1	U
Hexachloroethane	ug/kg	600		1,600	mg/kg-OC			20.0		U	20.0		U
Hexachlorobutadiene	ug/kg	29		270	mg/kg-OC	3.9	6.2	0.98	0.10	U	4.0	0.22	U
N-Nitrosodiphenylamine	ug/kg	280		130	mg/kg-OC	11	11	20	2.04	U	20	1.10	U
Trichloroethene	ug/kg	160		1,600	ug/kg	--	--	0.9		U	1.0		U
Tetrachloroethene	ug/kg	57		210	ug/kg	--	--	0.9		U	1.0		U
Ethylbenzene	ug/kg	10		50	ug/kg	--	--	0.9		U	1.0		U
Total Zylene (sum of o-,m-,p-)	ug/kg	40		160	ug/kg	--	--	0.9		U	1.0		U
Total DDT (sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT)	ug/kg	6.9	50	69		--	--	2.0		U	7.9		U
Aldrin	ug/kg	10				--	--	0.98		U	4.0		U
Chlordane	ug/kg	10	37			--	--	2.0		U	7.90		U
Dieldrin	ug/kg	10				--	--	2.0		U	7.9		U
Heptachlor	ug/kg	10				--	--	0.98		U	4.00		U
Gamma-BHC (Lindane)	ug/kg	10				--	--	0.98		U	4.00		U
Total PCBs	ug/kg	130	38***	3,100.0	mg/kg-OC	12	65	9.8	1.00	U	97.0	**5.36**	

Table 2. DesMoines Marina DMMP/SMS Characterization Summary

								DMMU ID:	DMMU-C1 (C1-A1, C1-A2)			DMMU-C2 (C2-B1, C2-C1, C2-C2)		
	DMMP				SMS				mg/kg-dry wgt	mg/kg-OC	VQ	mg/kg-dry wgt	mg/kg-OC	VQ
CHEMICAL NAME	Units	SL	BT	ML	Units	SQS	CSL		DMMP	SMS		DMMP	SMS	
Total Solids	%								82.7			65.7		
Total Volatile Solids	%								1.7			5.0		
Total Organic Carbon	%								1.0			1.8		
Total Ammonia (Nitrogen)	mg/kg								1.5			15.0		
Total Sulfides	mg/kg								167			483		
Gravel	%								12.0			16.1		
Sand	%								82.8			63.9		
Silt	%								3.6			13.8		
Clay	%								1.6			6.1		
Fines (percent silt + clay)	%								5.2			19.9		
Amphipod (*Eohaustorius estuarius*):	NH, 2H, 1H											NH		
Juvenile *Neanthes* 20-day Growth:	NH, 2H, 1H											2H		
Echinoderm Sediment Larval (*Dendraster excentricus*):	NH, 2H, 1H											NH		
Bioassay Determination: (P/F)									NR			PASS		
BTs exceeded:									No			No		
Bioaccumulation conducted:									No			No		
ML Rule exceeded:									No			No		
PSDDA Determination:									PASS			PASS		
DMMU Volume:	cy								7,000			3,040		
Rank									M			M		
Mean Core sampling depth (includes Z-sample)	ft								8.1			3.6		
Maximum sampling depth (mudline) includes Z-sample	ft								9.0			5.7		
DMMU ID:									DMMU-C1			DMMU-C2		

Legend:

SL = Screening Level exceedance
BT = Bioaccumulation Trigger exceedance
P = Pass (Suitable for UCOWD)
F = Failure (Unsuitable for UCOWD)
SQS = Sediment Quality Standards exceedance (SMS)
CSL = Cleanup Screening Level exceedance (SMS)

VQ = Validation Qualifier
UCOWD = Unconfined open-water disposal
U = undetected at the reported concentration
J = Estimated Concentration (< reporting limit)
NT = Not Tested, laboratory unable to run a porewater test as sediment too dry
NR = Not Required

Table 2. DesMoines Marina DMMP/SMS Characterization Summary

							DMMU ID:	DMMU-C3 (C3-D1)			Reference (CR-22)		
	DMMP				SMS			mg/kg-dry wgt	mg/kg-OC	VQ	mg/kg-dry wgt	mg/kg-OC	VQ
CHEMICAL NAME	Units	SL	BT	ML	Units	SQS	CSL	DMMP	SMS		DMMP	SMS	
Antimony		150		200				6.0		UJ			
Arsenic	mg/kg	57	507.1	700	mg/kg	57	93	6.0		U			
Cadmium	mg/kg	5.1	11.3	14	mg/kg	5.1	6.7	0.3		U			
Chromium	mg/kg	(2)	267	(2)	mg/kg	260	270	**17.6**					
Copper	mg/kg	390	1,027	1,300	mg/kg	390	390	**18.0**					
Lead	mg/kg	450	975	1,200	mg/kg	450	530	**4.0**					
Mercury	mg/kg	0.41	1.5	2.3	mg/kg	0.41	0.59	0.05		U			
Nickel	mg/kg	140	370	370	mg/kg	--	--	**14.0**					
Selenium	mg/kg	(2)	3	(2)	mg/kg	--	--	0.3		U			
Silver	mg/kg	6.1	6.1	8.4	mg/kg	6.1	6.1	0.4		U			
Zinc	mg/kg	410	2,783	3,800	mg/kg	410	960	**39.0**					
TBT ion (porewater)	ug/L	0.15	0.15		ug/L	0.05	0.35	0.02		UJ			
Naphthalene	ug/kg	2,100		2,400	mg/kg-OC	99	170	20.0	2.31	U			
Acenaphthylene	ug/kg	560		2,000	mg/kg-OC	66	66	20.0	2.31	U			
Acenaphthene	ug/kg	500		2,000	mg/kg-OC	16	57	20.0	2.31	U			
Fluorene	ug/kg	540		3,600	mg/kg-OC	23	79	20.0	2.31	U			
Phenanthrene	ug/kg	1,500		2,100	mg/kg-OC	100	480	**22.0**	**2.54**				
Anthracene	ug/kg	560		13,000	mg/kg-OC	220	1,200	20.0	2.31	U			
2-Methylnapthalene	ug/kg	670		1,900	mg/kg-OC	38	64	20.0	2.31	U			
Total LPAH	ug/kg	5,200		29,000	mg/kg-OC	370	780	**22**	**2.54**				
Fluoranthene	ug/kg	1,700	4,600	30,000	mg/kg-OC	160	1,200	**72.0**	**8.32**				
Pyrene	ug/kg	2,600	11,980	16,000	mg/kg-OC	1,000	1,400	**85.0**	**9.83**				
Benzo(a)anthracene	ug/kg	1,300		5,100	mg/kg-OC	110	270	**29.0**	**3.35**				
Chrysene	ug/kg	1,400		21,000	mg/kg-OC	110	460	**75.0**	**8.67**				
Total Benzo(b+k)fluoranthenes	ug/kg	3,200		9,900	mg/kg/OC	230	450	**116.0**	**13.41**				
Benzo(a)pyrene	ug/kg	1,600		3,600	mg/kg-OC	99	210	**40.00**	**4.62**				
Indeno(1,2,3-cd)pyrene	ug/kg	600		4,400	mg/kg-OC	34	88	**310**	**35.8**				
Dibenzo(a,h)anthracene	ug/kg	230		1,900	mg/kg-OC	12	33	20.0	2.31	U			
Benzo(g,h,I)perylene	ug/kg	670		3,200	mg/kg-OC	31	78	**22.0**	**2.54**				
Total HPAH	ug/kg	12,000		69,000	mg/kg-OC	960	5,300	**461.0**	**53.29**				
1,3-Dichlorobenzene	ug/kg	170			mg/kg-OC	2.3	2.3	1.1	0.13	U			
1,4-Dichlorobenzene	ug/kg	110		120	mg/kg-OC	3.1	9	1.1	0.13	U			
1,2-Dichlorobenzene	ug/kg	35		110	mg/kg-OC	2.3	2.3	1.1	0.13	U			
1,2,4-Trichlorobenzene	ug/kg	31		64	mg/kg-OC	0.81	1.8	5.6	0.65	U			
Hexachlorobenzne (HCB)	ug/kg	22	168	230	mg/kg-OC	0.38	2.3	0.99	0.11	U			
Dimethylphthalate	ug/kg	71		1,400	mg/kg-OC	53	53		-	U			
Diethylphthalate	ug/kg	200		1,200	mg/kg-OC	61	110	6.2	0.72	U			
Di-n-butylphthalate	ug/kg	1,400		5,100	mg/kg-OC	220	1,700	20.0	2.31	U			
Butylbenzylphthalate	ug/kg	63		970	mg/kg-OC	4.9	64	**12.0**	**1.39**				
Bis(2-ethylhexyl)phthalate	ug/kg	1,300		8,300	mg/kg-OC	47	78	**31.0**	**3.58**				
Di-n-octylphthalate	ug/kg	6,200		6,200	mg/kg-OC	58	4,500	20.0	2.31	U			
Phenol	ug/kg	420		1,200	ug/kg	420	1,200	20.0	2.31	U			
2-Methylphenol	ug/kg	63		77	ug/kg	63	63	6.2	0.72	U			
4-Methylphenol	ug/kg	670		3,600	ug/kg	670	670	20.0	2.31	U			
2,4-Dimethylphenol	ug/kg	29		210	ug/kg	29	29	6.2	0.72	U			
Pentachlorophenol	ug/kg	400		690	ug/kg	360	690	31.0	3.58	U			
Benzyl alcohol	ug/kg	57		87	ug/kg	57	73	31.0	3.58	UJ			
Benzoic acid	ug/kg	650		760	ug/kg	650	650	200.0	23.12	U			
Dibenzofuran	ug/kg	540		1,700	mg/kg-OC	15	58	20.0	2.31	U			
Hexachloroethane	ug/kg	600		1,600	mg/kg-OC			20.0		U			
Hexachlorobutadiene	ug/kg	29		270	mg/kg-OC	3.9	6.2	0.99	0.11	UJ			
N-Nitrosodiphenylamine	ug/kg	280		130	mg/kg-OC	11	11	20	2.31	U			
Trichloroethene	ug/kg	160		1,600	ug/kg	--	--	1.1		U			
Tetrachloroethene	ug/kg	57		210	ug/kg	--	--	1.1		U			
Ethylbenzene	ug/kg	10		50	ug/kg	--	--	1.1		U			
Total Zylene (sum of o-,m-,p-)	ug/kg	40		160	ug/kg	--	--	1.1		U			
Total DDT (sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT)	ug/kg	6.9	50	69		--	--	2.0		UJ			
Aldrin	ug/kg	10				--	--	0.99		UJ			
Chlordane	ug/kg	10	37			--	--	2.00		UJ			
Dieldrin	ug/kg	10				--	--	2.0		UJ			
Heptachlor	ug/kg	10				--	--	0.99		UJ			
Gamma-BHC (Lindane)	ug/kg	10				--	--	0.99		UJ			
Total PCBs	ug/kg	130	38***	3,100.0	mg/kg-OC	12	65	9.9	1.14	U			

Table 2. DesMoines Marina DMMP/SMS Characterization Summary

								DMMU ID:	DMMU-C3 (C3-D1)			Reference (CR-22)		
	DMMP				SMS				mg/kg-dry wgt	mg/kg-OC	VQ	mg/kg-dry wgt	mg/kg-OC	VQ
CHEMICAL NAME	Units	SL	BT	ML	Units	SQS	CSL		DMMP	SMS		DMMP	SMS	
Total Solids	%								75.1			71.8		
Total Volatile Solids	%								2.2			1.3		
Total Organic Carbon	%								0.9			0.2		
Total Ammonia (Nitrogen)	mg/kg								32.6			6.2		
Total Sulfides	mg/kg								188			88.0		
Gravel	%								36.8			0.1		
Sand	%								54.9			61.0		
Silt	%								5.1			36.2		
Clay	%								3.2			2.8		
Fines (percent silt + clay)	%								8.3			39.0		
Amphipod (*Eohaustorius estuarius*):	NH, 2H, 1H													
Juvenile *Neanthes* 20-day Growth:	NH, 2H, 1H													
Echinoderm Sediment Larval (*Dendraster excentricus*):	NH, 2H, 1H													
Bioassay Determination: (P/F)									NR					
BTs exceeded:									No					
Bioaccumulation conducted:									No					
ML Rule exceeded:									No					
PSDDA Determination:									PASS					
DMMU Volume:	cy								540					
Rank									M					
Mean Core sampling depth (includes Z-sample)	ft								8.3					
Maximum sampling depth (mudline) includes Z-sample	ft								8.3					
DMMU ID:									DMMU-C3			Reference (CR-22)		

Legend:

SL = Screening Level exceedance
BT = Bioaccumulation Trigger exceedance
P = Pass (Suitable for UCOWD)
F = Failure (Unsuitable for UCOWD)
SQS = Sediment Quality Standards exceedance (SMS)
CSL = Cleanup Screening Level exceedance (SMS)

VQ = Validation Qualifier
UCOWD = Unconfined ope
U = undetected at the repor
J = Estimated Concentratio
NT = Not Tested, laboratory
NR = Not Required

Table 3. DMMP BIOASSAY PERFORMANCE STANDARDS AND EVALUATION GUIDELINES

Bioassay	Negative Control Performance Standard	Reference Sediment Performance Standard	Dispersive Disposal Site Interpretation Guidelines		Nondispersive Disposal Site Interpretation Guidelines	
			1-hit rule	2-hit rule	1-hit rule	2-hit rule
Amphipod	$M_C < 10\%$	$M_R - M_C < 20\%$	$M_T - M_C > 20\%$ and M_T vs M_R SD (p=.05) and		$M_T - M_C > 20\%$ and M_T vs M_R SD (p=.05) and	
			$M_T - M_R > 10\%$	NOCN	$M_T - M_R > 30\%$	NOCN
Larval	$N_C \div I > 0.70$	$N_R > N_C > 0.65$	$N_T \div N_C < 0.80$ and N_T/N_C vs N_R/N_C SD (p=.10) and		$N_T \div N_C < 0.80$ and N_T/N_C vs N_R/N_C SD (p=.10) and	
			$N_R/N_C - N_T/N_C > 0.15$	NOCN	$N_R/N_C - N_T/N_C > 0.30$	NOCN
Neanthes growth	$M_C < 10\%$ and $MIG_C > 0.38$	$M_R < 20\%$ and $MIG_R \div MIG_C > 0.80$	$MIG_T \div MIG_C < 0.80$ and MIG_T vs MIG_R SD (p=.05) and		$MIG_T \div MIG_C < 0.80$ and MIG_T vs MIG_R SD (p=.05) and	
			$MIG_T/MIG_R < 0.70$	NOCN	$MIG_T/MIG_R < 0.50$	$MIG_T/MIG_R < 0.70$

M = mortality, N = normal survivors, I = initial count, MIG = mean individual growth rate (mg/individual/day)
SD = statistically different, NOCN = no other conditions necessary, N/A = not applicable
Subscripts: R = reference sediment, C = negative control, T = test sediment

Table 4. Summary of Bioassay Testing Results for DMMU-C2

Treatment	Amphipod (*Eohaustorius estuaries*)		Juvenile Polychaete Growth (*Neanthes* sp.)		Echinoderm Sediment Larval (*Dendraster excentricus*)	
	Mean Survival (%)	**Mean Mortality (%)**	**Survival (%)**	**MIG (mg/ind/day)**	**Mean NCMA**	**Mean Normal Larvae**
Control	91	9 ± 2.2	100	0.725 ± 0.0	8.2 ± 7.5 ($N_{C/I}$ = 0.92)	185
Reference (Car Inlet 22)	92	8 ± 4.5	100	0.746 ± 0.2	18.2 ± 10.6	151
DMMU-C2	90	10 ± 3.5 (**NH**)	100	0.489 ± 0.2 (MIG_T/MIG_R = 66%; < 70% of Ref = **2H)**	9.7 ± 10.1 (**NH**)	172

Legend: MIG = Mean Individual Growth; **NCMA** = Mean Normalized Mortality and Abnormality; **NH** = No Hit Response; **2H** = 2H response under non-dispersive interpretive guidelines (requires another corroborating response)

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			1-hit rule	2-hit rule	1-hit rule	2-hit rule
Amphipod	$M_C < 10\%$	$M_R - M_C < 20\%$	$M_T - M_C > 20\%$ and M_T vs M_R SD (p=.05) and		$M_T - M_C > 20\%$ and M_T vs M_R SD (p=.05) and	
			$M_T - M_R > 10\%$	NOCN	$M_T - M_R > 30\%$	NOCN
Larval	$N_C \div I > 0.70$	$N_R > N_C > 0.65$	$N_T \div N_C < 0.80$ and N_T/N_C vs N_R/N_C SD (p=.10) and		$N_T \div N_C < 0.80$ and N_T/N_C vs N_R/N_C SD (p=.10) and	
			$N_R/N_C - N_T/N_C > 0.15$	NOCN	$N_R/N_C - N_T/N_C > 0.30$	NOCN
Neanthes growth	$M_C < 10\%$ and $MIG_C > 0.38$	$M_R < 20\%$ and $MIG_R \div MIG_C > 0.80$	$MIG_T \div MIG_C < 0.80$ and MIG_T vs MIG_R SD (p=.05) and		$MIG_T \div MIG_C < 0.80$ and MIG_T vs MIG_R SD (p=.05) and	
			$MIG_T/MIG_R < 0.70$	NOCN	$MIG_T/MIG_R < 0.50$	$MIG_T/MIG_R < 0.70$

M = mortality, N = normal survivors, I = initial count, MIG = mean individual growth rate (mg/individual/day)
SD = statistically different, NOCN = no other conditions necessary, N/A = not applicable
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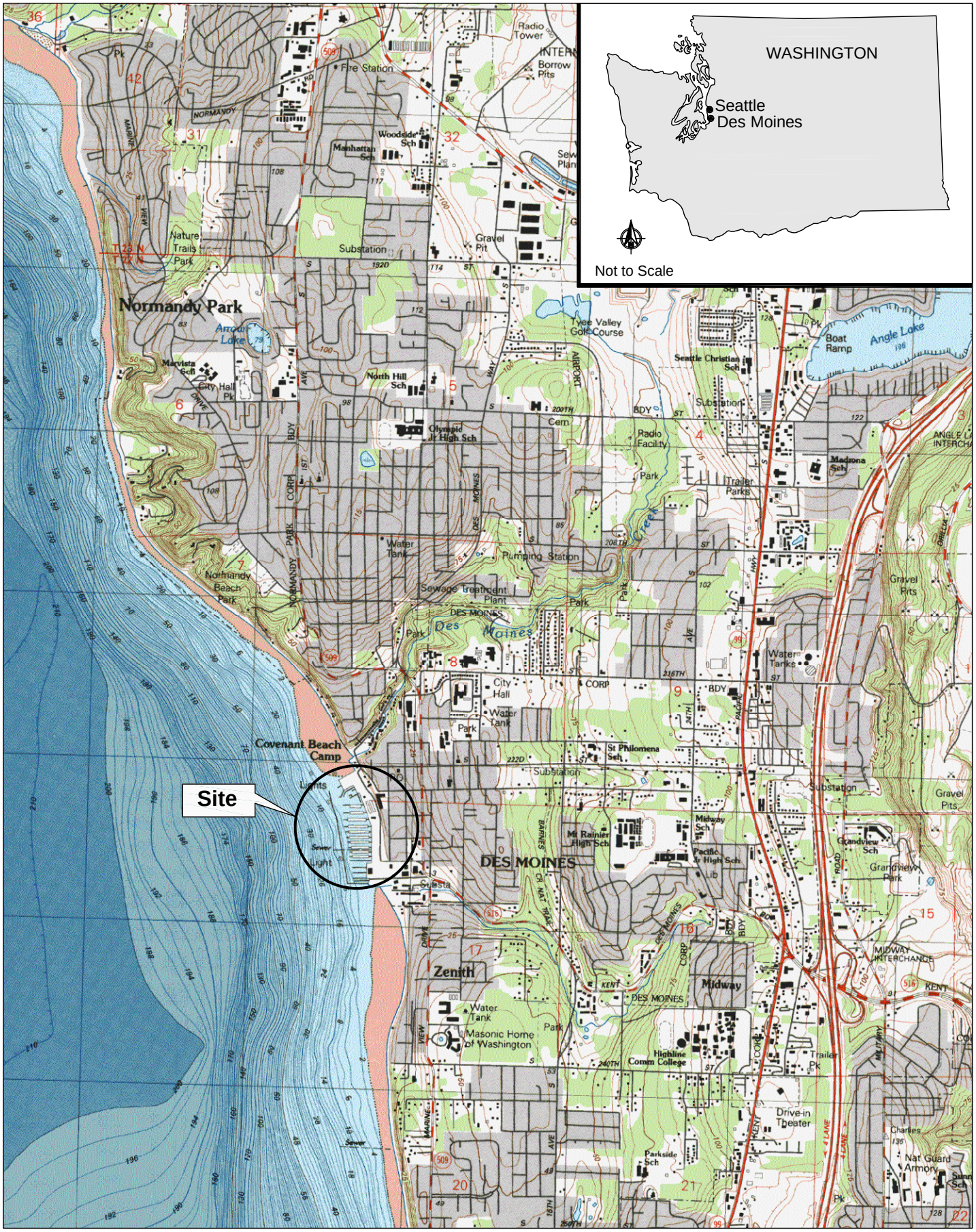


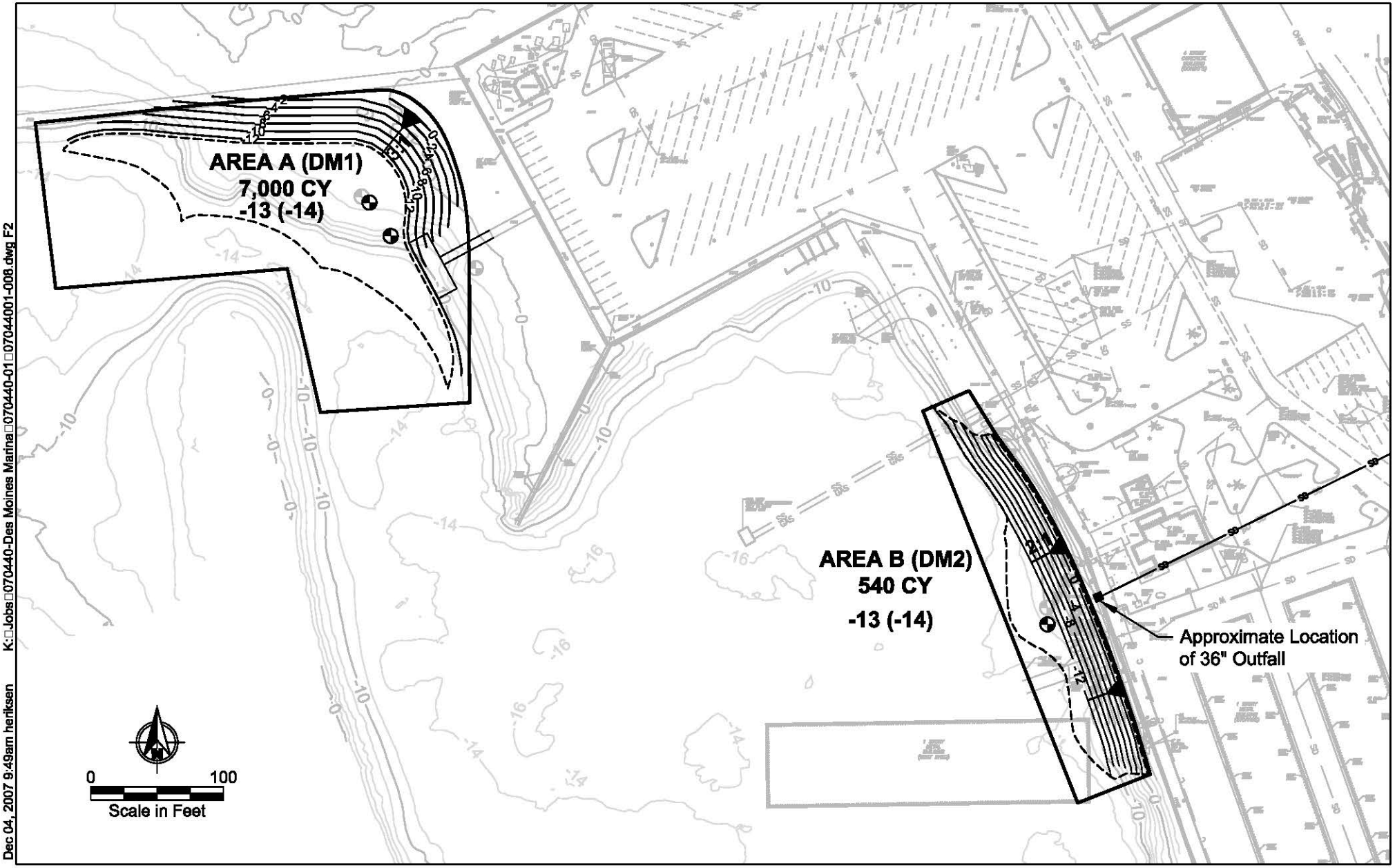
May 31, 2007 12:08pm heriksen K: Jobs 070440-Des Moines Marina 070440-01 07044001-002.dwg FIG 1

Note: Base map prepared from Terrain Navigator Pro
USGS 7.5 minute quadrangle map of Burien, WA.

0 1/2
Scale in Miles

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1
Vicinity Map
Des Moines Marina



Dec 04, 2007 9:49am heriksen K:□Jobs□070440-Des Moines Marina□070440-01□07044001-008.dwg F2

NOTE: Basemap prepared from "Des Moines Marina Topographic Map" by Moffat and Nichols dated July 22, 2004. Bathymetry contours based on survey data provided by GRS dated May 15, 2007.

-13 (-14) Required Dredge Elevation (Overdredge Elevation)

Proposed Sample Location

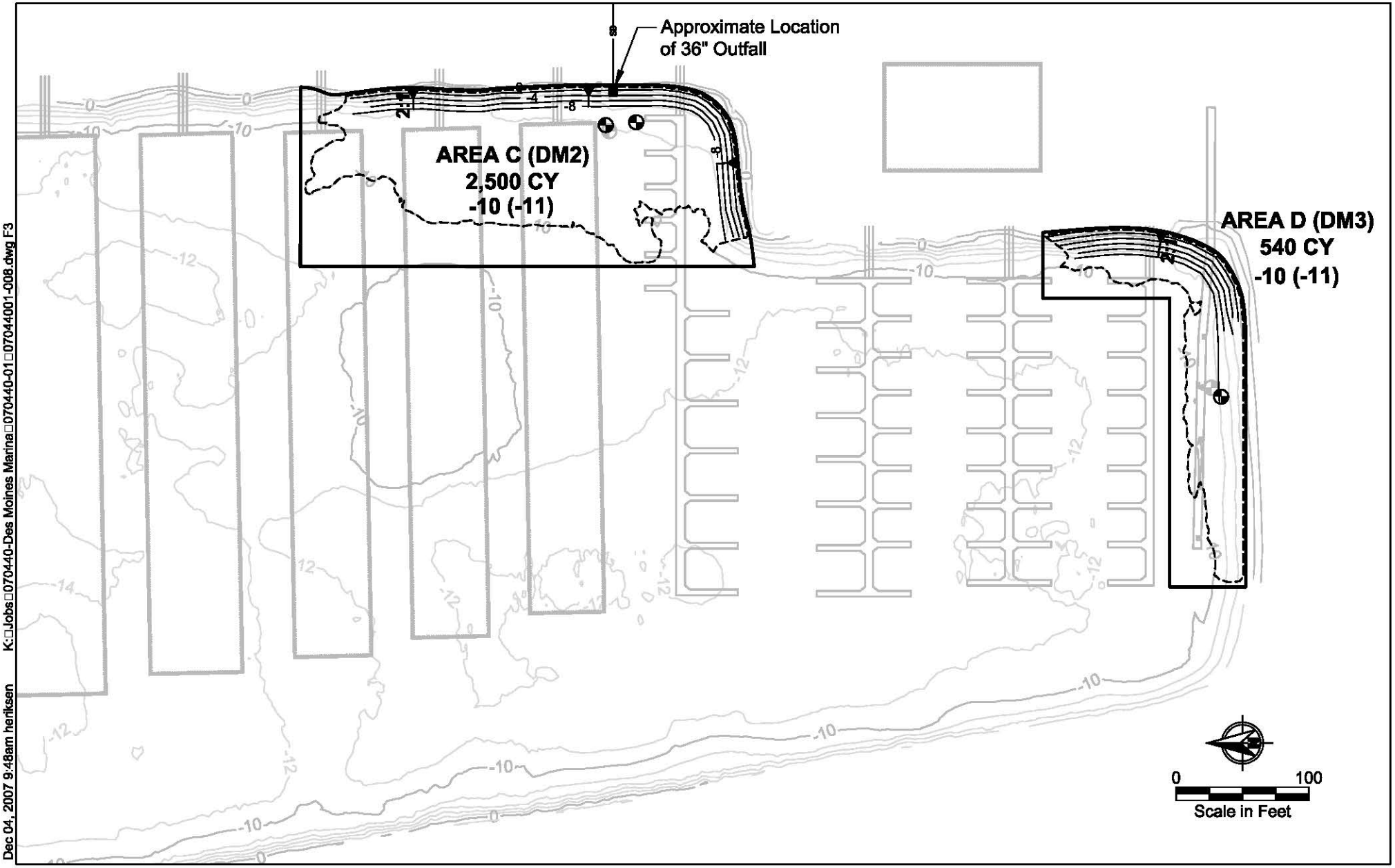
Actual Sample Location

Extent of Dredging

DMMU Designation

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 2
North Dredge Areas and Sample Locations
Entrance Channel and North Outfall
Des Moines Marina



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NOTE: Basemap prepared from "Des Moines Marina Topographic Map" by Moffat and Nichols dated July 22, 2004. Bathymetry contours based on survey data provided by GRS dated May 15, 2007.

-10 (-11) Required Dredge Elevation (Overdredge Elevation)

Proposed Sample Location

Actual Sample Location

Extent of Dredging

DMMU Designation

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 3
South Dredge Areas and Sample Locations
South Outfall and South End of Marina
Des Moines Marina