

10 February 2000

SUBJECT: DETERMINATION ON THE SUITABILITY OF DREDGED MATERIAL EVALUATED FOR THE NEARSHORE CONFINED-AQUATIC-DISPOSAL (CAD) SITE, PUGET SOUND NAVAL SHIPYARD'S OPERATIONAL UNIT-B (CERCLA) RESPONSE ACTION EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT (CWA) FOR EITHER OPEN-WATER DISPOSAL AT THE ELLIOTT BAY DISPOSAL SITE OR AS A BENEFICIAL USE UNDER THE SEDIMENT MANAGEMENT STANDARDS.

1. The following summary reflects the consensus determination of the Dredged Material Management Program (DMMP) Agencies' (U.S. Army Corps of Engineers, Department of Ecology, Department of Natural Resources, and the Environmental Protection Agency) with jurisdiction on dredging and disposal on the suitability of the estimated 900,000 cubic yards of dredged material proposed for dredging from the U.S. Navy's proposed pit-CAD footprint area in Sinclair Inlet, at Bremerton, Washington. The dredged material would be disposed at either the PSDDA unconfined open-water disposal site in Elliott Bay, or used beneficially.
2. This determination of suitability is based on the acceptability of the sampling conducted between November 16-19, 1999 and all relevant test data contained in Data Summary Report submitted by the U.S. Navy's contractor Foster Wheeler Environmental Corporation to the Dredged Material Management Office (DMMO)/DMMP agency representatives on February 1, 2000 for review by the DMMP agencies.
3. The Sampling and Analysis plan (SAP) was submitted to the DMMP agencies on October 30, 1999 and was approved by the DMMP agencies on November 8, 1999. The sampling conducted between November 16-19, 1999 generally followed the specifications in the approved SAP. The data collected from these analyses were sufficient and acceptable for decision making by the Agencies based on best professional judgement.
4. Relevant dates for regulatory tracking purposes are included in Table 1.

Table 1. Regulatory Tracking Dates

SAP Submittal date:	October 30, 1999
SAP Approval date:	November 8, 1999
Sampling date(s):	November 16 -19, 1999
Data report submittal date:	February 1, 2000
Recency Determination Dates:	
Surface (0-3 ft) = High (2 years)	November 2001
Subsurface (> 3 ft) = Low-Moderate (7 years)	November 2006

5. The DMMP-approved conceptual sampling and analysis plan included a total dredging footprint from the proposed CAD site project area of an estimated 900,000 cubic yards, which lies outside of the CERCLA sediment cleanup units (see Figure 1). The characterized volume encapsulated 390,100 cubic yards of the proposed total dredging volume of 900,000 cubic yards, and included samples extending down to 11 feet below the mud line. Sample collections (Figure 2) involved collecting 30 uncomposited core (Mudmole™) samples from the high ranked surface (0-3 feet depths) DMMUs. All surface DMMUs underwent concurrent chemical and bioassay testing. Additionally, a subset of 10 randomly selected surface DMMUs also underwent TBT testing. Subsurface sampling occurred in two separate strata, 3-7 feet depths and 7-11 feet depths as agreed to by the DMMP agencies in the approved SAP. Twenty subsurface cores were composited into four DMMUs from each of the depth strata (e.g., 3-7 feet, and 7-11 feet)(see Table 2). The four DMMUs from the 3-7 feet depth strata underwent tiered testing, including chemical testing, whereas the four DMMUs from the 7-11 foot strata were archived pending the results of the 0-7 foot chemical testing.
6. Appendix I provides a summary of the sediment conventional parameters including grain size and total organic carbon contents for all 34 DMMUs undergoing initial testing. The results for surface and subsurface sediment analyzed indicated the sediments were predominately fine grained (71.1 – 97%), exhibiting relatively high clay contents (15.7-48.4%).
7. The results of chemical analyses of the 30 surface DMMUs indicated that all detected/undetected chemicals were below the PSDDA screening level (SL) guidelines except mercury, which had exceedances of SL in 18 DMMUs, ranging from 0.42 – 1.0 ppm (dry weight). Ten of the surface DMMUs exhibited mercury exceedances of the Washington State Sediment Management Standards Minimum Cleanup Level (MCUL = 0.59 ppm-dry weight). There were no TBT SL exceedances among the 10 random surface DMMUs analyzed. Subsurface chemical analyses indicated that there were no detected/undetected chemical SL exceedances among the four 3-7 foot depth strata DMMUs. Because there were no SL exceedances among the 3-7 foot depth strata DMMUs, the archived 7-11 foot depth strata DMMUs were not analyzed based on best professional judgement by the DMMP agencies. Concurrent biological testing results for the surface DMMUs are summarized below.
8. Standard bioassay testing was conducted on all thirty surface DMMUs within the 56 day biological holding time. Appendix 2 summarizes the solid phase bioassay Quality Control (QC) performance guidelines and also summarizes the solid phase bioassay interpretative guidelines for nondispersive sites, which were used to evaluate the bioassay data discussed below. Appendix 3 summarizes the batch specific bioassay toxicity testing outcomes (e.g., Appendix 3a: amphipod (*Ampelisca abdita*); Appendix 3b: bivalve larval (*Mytilus galloprovincialis*); Appendix 3c: *Neanthes arenaceodentata*-growth) for all thirty DMMUs. Two reference samples were collected from Carr Inlet to block for grain size effects. In general, all negative control and reference sediments met the DMMP performance limits for each of the batch specific bioassay tests to assess toxicity. Summary bioassay results for each DMMU are depicted in Appendix I relative to the DMMP nondispersive interpretative guidelines. These bioassay results are discussed below for each of the bioassay tests.

Table 2. CAD Facility sample collection and compositing scheme

Surface DMMUs (0-3 feet)	Sample Core Section	DMMU Volume (cubic yards)
S1	1A	2400
S2	2A	3200
S3	3A	3700
S4	4A	3700
S5	5A	3700
S6	6A	3700
S7	7A	3800
S8	8A	4000
S9	9A	4000
S10	10A	4000
S11	11A	4000
S12	12A	4000
S13	13A	3800
S14	14A	4000
S15	15A	4000
S16	16A	4000
S17	17A	4000
S18	18A	4000
S19	19A	3500
S20	20A	3700
S21	21A	3700
S22	22A	3700
S23	23A	3700
S24	24A	3700
S25	25A	3950
S26	26A	3950
S27	27A	3400
S28	28A	3400
S29	29A	3400
S30	30A	3400
Subtotal:	0-3 foot depth	111,500 cy
Subsurface DMMUs (3-7 feet)	Composited Sample Core Sections	DMMU Volume (cubic yards)
C1	1B, 3B, 4B, 7B, 9B, 10B	43,800
C2	13B, 15B, 16B, 19B, 21B, 22B	45,400
C3	6B, 12B, 18B, 24B, 25B, 26B	40,000
C4	27B, 30B	12,400
Subtotal:	3-7 foot depth	141,600 cy
Subsurface DMMUs (7-11 feet)	Composited Sample Core Sections	DMMU Volume (cubic yards)
C5	1C, 3C, 4C, 7C, 9C, 10C	42,700
C6	13C, 15C, 16C, 19C, 21C, 22C	44,300
C7	6C, 12C, 18C, 24C, 25C, 26C	38,900
C8	27C, 30C	11,100
Subtotal:	7-11 foot depth	137,000 cy
Cumulative Total:	0-11 foot depth	390,100 cy

- a) **Amphipod Bioassay (*Ampelisca abdita*).** Amphipod bioassay results showed no toxicity among the 30 DMMU as noted in Appendix 3a and Appendix I. Twenty-eight of the thirty DMMUs exhibited mortalities less than 20% absolute relative to the negative control sediment, which are considered non-toxic responses. Of the two DMMUs that were subsequently compared to the reference sediment (S19, S28), both exhibited mortalities within the two-hit interpretation response range (<30% over reference), but neither DMMU exhibited a statistically significant response relative to the reference sample, and are therefore not considered a toxic response.
 - b) **Bivalve Larval Bioassay (*Mytilus galloprovincialis*).** The results of the larval bivalve test (Appendix 3b and Appendix I) showed two-hit level toxicity responses in twenty-four of the thirty DMMUs tested. All thirty DMMUs exhibited responses greater than 20% absolute over the seawater control, and were therefore directly compared with the appropriate reference samples. Of those comparisons, twenty-four exhibited statistically significant responses relative to the reference sediment, and were considered two-hit responses relative to the DMMP nondispersive guidelines. None of the test sediment responses were greater than 30% over the reference sediment (one-hit response).
 - c) ***Neanthes* 20-day Growth Bioassay (*Neanthes arenaceodentata*).** The results of the *Neanthes* growth bioassay (Appendix 3c and Appendix I) showed low toxicity among the thirty DMMUs characterized, with only one DMMU exhibiting a two-hit toxicity response. Seventeen of thirty DMMUs exhibited responses greater than 20% absolute over the negative control responses. Comparing the test sediment responses directly with the reference sediment, only DMMU S3 was statistically significant relative to the reference, and registered a two-hit response. No test sediments exceeded the one-hit response guidelines for the *Neanthes* test.
 - d) **DMMP Bioassay Determination.** Overall interpretation of the bioassay responses (See Appendices 1 and 3a-c) indicates that 29 of the surface DMMUs passed the DMMP unconfined-open-water disposal guidelines, and only a single DMMU (S3) registered an unsuitable response relative to the nondispersive interpretation guidelines, with two-hit responses relative to the bivalve larval bioassay and the *Neanthes* 20-day growth bioassay.
9. The agencies concluded that all but one DMMU were suitable for unconfined open-water-disposal at the Elliott Bay non-dispersive site (see Appendix 1 for a complete inventory of suitable and unsuitable DMMU). The total volume of unsuitable dredged material is 3,700 cubic yards represented by DMMU S3. Therefore, based on these testing results, approximately 896,300 cubic yards of dredged material is suitable for placement at the Elliott Bay disposal site.
 10. The proposed dredged material was also evaluated and compared to the Washington State Sediment Management Standards for its suitability for a potential beneficial use project(s). The results of this analysis indicates that ten of thirty surface DMMUs exceeded the mercury

"Cleanup Screening Level: (CSL). All ten of these DMMUs were subject to biological testing, and all the DMMUs with mercury CSL exceedances passed the SQS biological testing interpretation guidelines. However one DMMU, S3, with no SQS exceedances (or DMMP SL exceedances) failed the SMS bioassay CSL interpretation guidelines. Therefore, all the material except the 3,700 cubic yards represented by DMMU S3 are also suitable for potential beneficial use projects.

11. This memorandum documents the suitability of the dredged material within the proposed U.S. Navy CERCLA Cleanup/Navigation dredging project at the CAD excavation site in Sinclair Inlet for either disposal at the Elliott Bay non-dispersive open-water disposal site or use as a beneficial uses 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.

Concur:

3/9/2000

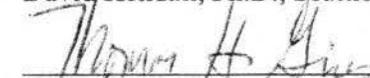
Date



David Kendall, Ph.D., Seattle District Corps of Engineers

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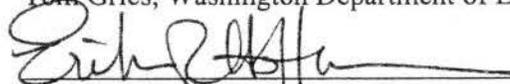
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Tom Gries, Washington Department of Ecology

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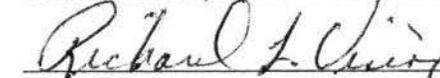
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Erika Hoffman, Environmental Protection Agency

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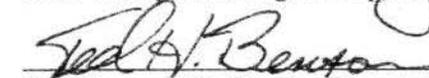
Date



Rick Vining, Washington Department of Ecology

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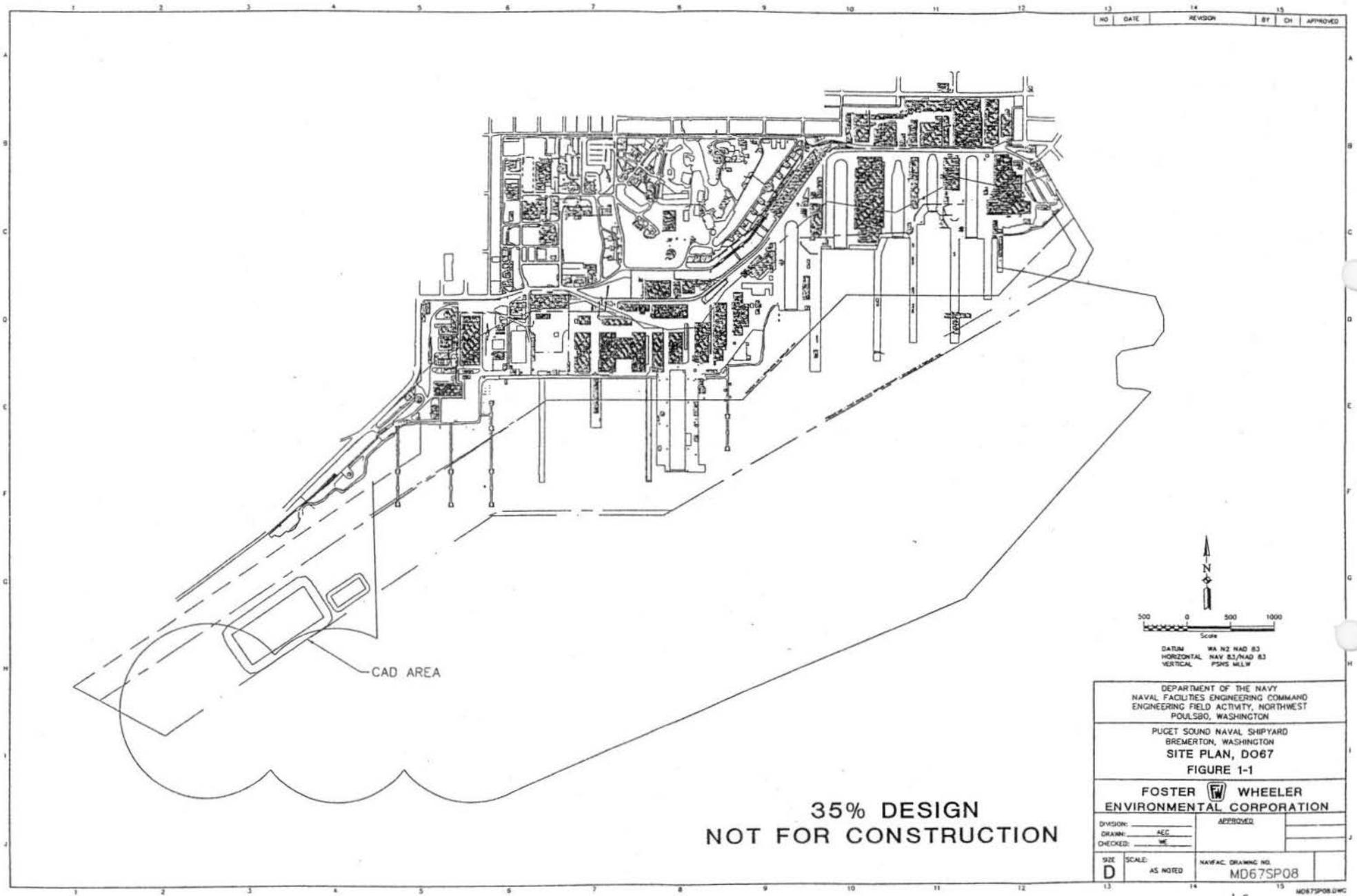


Figure 1

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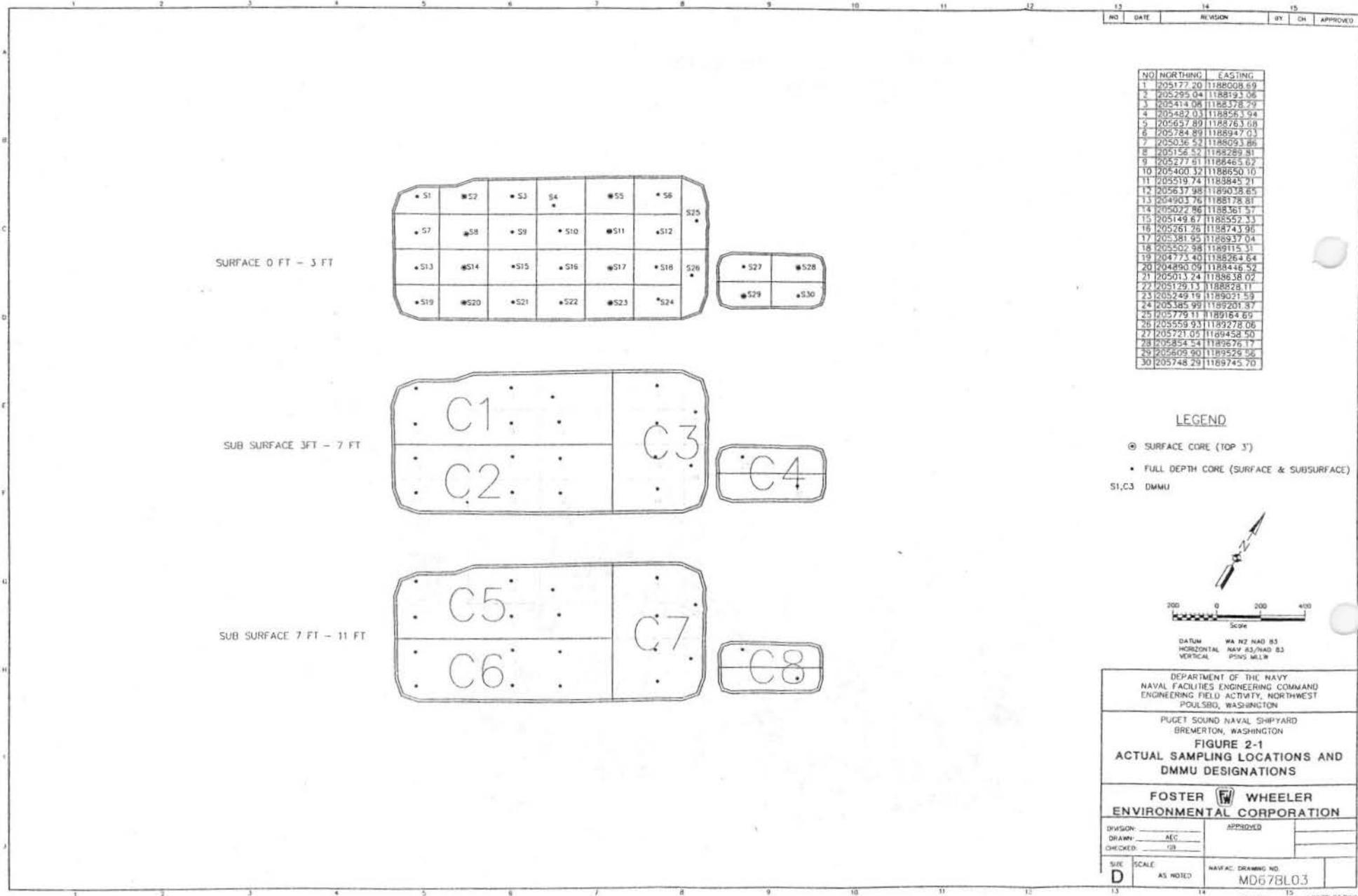


Figure 2.

Appendix I. Pit-CAD Sediment Characterization Testing Summary / DMMP Suitability Determination

				DMMU ID:	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10		
				Rank:	H	H	H	H	H	H	H	H	H	H		
				Depth:	0-3 ft											
CHEMICAL NAME	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ								
Mercury	mg/kg	0.41	1.5	2.3	0.43	0.94					0.64	1.00		0.45	0.54	
Total Solids	%				51.9	60.3	66.4	65.0	60.5	43.5	50.4	39.2	47.0	42.9		
Total Volatile Solids	%				4.3	3.4	2.2	2.0	2.9	5.7	4.9	6.4	4.9	5.5		
Total Organic Carbon	%				1.5	1.2	0.68	0.77	0.88	1.5	1.3	1.9	1.4	1.6		
Total Sulfides	mg/kg				110	28.0	16.0	28.0	47.0	59.0	220	110	180	100		
Total Ammonia (as N)	mg/kg				16.4	E 5.4	E 2.3	E 3.0	E 4.6	E 12.2	E 28.0	E 67.4	E 24.8	E 22.9		
Gravel (Percent)	%				-	-	2.8	-	0.7	0.6	2.6	-	-	-		
Sand (Percent)	%				22.9	46	55.6	69.0	42.6	5.4	14.7	2.6	11.1	5.4		
Silt (Percent)	%				47.9	30	22.8	15.6	41.0	63.5	49.2	49.1	52.5	62.8		
Clay (Percent)	%				29.2	24.1	18.7	15.5	15.7	30.6	48.4	48.4	36.4	31.8		
Fines (Percent silt + clay)	%				77.1	54.5	41.5	31.1	56.7	94.1	97.5	97.5	88.9	94.6		
Preferred reference match:					80.4	80.4	80.4	80.4	80.4	94.3	94.3	94.3	94.3	94.3		
Ampelisca abdita					NH											
Mytilus galloprovincialis hits:					2H	2H	2H	2H	2H	NH	2H	2H	NH	2H		
Neanthes arenaceodentata hits:					NH	NH	2H	NH								
Bioassay: Pass/Fail:					Pass	Pass	Fail	Pass								
BTs exceeded: No/Yes					No											
Bioaccumulation conducted:					No											
ML Rule exceeded: No/Yes					No											
PSDDA Determination: Pass/Fail					Pass	Pass	Fail	Pass								
DMMU Volume:	cy				2,400	3,200	3,700	3,700	3,700	3,700	3,800	4,000	4,000	4,000		
DMMU ID:					S1	S2	S3	S4	S5	S6	S7	S8	S9	S10		
Pass:					2,400	3,200		3,700	3,700	3,700	3,800	4,000	4,000	4,000		
Fail:							3,700									

Legend:

- NH = no hit response
- 2H = two hit Failure (DMMP Guidelines)
- UCOWD = Unconfined open-water disposal
- NP = not performed (no chem. guideline exceedances)
- E = estimated value
- Exceeds CSL

Appendix I. Pit-CAD Sediment Characterization Testing Summary / DMMP Suitability Determination

				DMMU ID:	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20		
				Rank:	H	H	H	H	H	H	H	H	H	H		
				Depth:	0-3 ft											
CHEMICAL NAME	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ								
Mercury	mg/kg	0.41	1.5	2.3	0.42		0.89				0.46		0.51		0.81	
Total Solids	%				47.0		41.0		41.5		45.9		44.5		45.7	
Total Volatile Solids	%				6.2		5.9		5.7		5.0		4.9		4.7	
Total Organic Carbon	%				3.5		2.2		2.4		1.9		1.7		1.8	
Total Sulfides	mg/kg				38.0		86.0		53.0		70.0		130		100	
Total Ammonia (as N)	mg/kg				25.7	E	29.9	E	39.6	E	41.2	E	18.7	E	41.0	E
Gravel (Percent)	%				0.2		-		0.5		-		-		-	
Sand (Percent)	%				6.9		2.6		5.0		10.0		6.6		9.4	
Silt (Percent)	%				54.4		60.4		50.7		52.3		54.2		52.1	
Clay (Percent)	%				38.6		37.0		43.7		37.8		39.2		38.5	
Fines (Percent silt + clay)	%				93.0		97.4		94.4		90.1		93.4		90.6	
Preferred reference match:					94.3		94.3		94.3		94.3		94.3		94.3	
Ampelisca abdita					NH		NH		NH		NH		NH		NH	
Mytilus galoprovincialis hits:					NH		NH		2H		2H		2H		2H	
Neanthes arenaceolata hits:					NH		NH		NH		NH		NH		NH	
Bioassay: Pass/Fail:					Pass		Pass		Pass		Pass		Pass		Pass	
BTs exceeded: No/Yes					No		No		No		No		No		No	
Bioaccumulation conducted:					No		No		No		No		No		No	
ML Rule exceeded: No/Yes					No		No		No		No		No		No	
PSDDA Determination: Pass/Fail					Pass		Pass		Pass		Pass		Pass		Pass	
DMMU Volume:	cy				4,000		4,000		3,800		4,000		4,000		4,000	
DMMU ID:					S11		S12		S13		S14		S15		S16	
Pass:					4,000		4,000		3,800		4,000		4,000		4,000	
Fail:																

Legend:

NH = no hit response

2H = two hit Failure (DMMP Guidelines)

UCOWD = Unconfined open-water disposal

NP = not performed (no chem. guideline exceedances)

E = estimated value

Exceeds CSL

Appendix I. Pit-CAD Sediment Characterization Testing Summary / DMMP Suitability Determination

				DMMU ID:	S21	S22	S23	S24	S25	S26	S27	S28	S29	S30										
				Rank:	H	H	H	H		H	H	H	H	H										
				Depth:	0-3 ft																			
CHEMICAL NAME	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ																
Mercury	mg/kg	0.41	1.5	2.3			0.42		0.59		0.64		0.78		0.53		0.81		0.59					
Total Solids	%				44.3		41.5		41.5		39.1		43.2		39.7		40.1		47.2		37.2		47.6	
Total Volatile Solids	%				5.6		6.0		6.0		6.6		5.6		6.4		6.5		4.8		6.5		4.8	
Total Organic Carbon	%				2.1		23.0		5.4		3.1		1.7		2.0		2.1		2.3		2.7		1.5	
Total Sulfides	mg/kg				85.0		210		84.0		64.0		31.0		140		190		92.0		300		140	
Total Ammonia (as N)	mg/kg				33.6	E	44.6	E	36.0	E	31.6	E	16.4	E	40.1	E	50.0	E	18.7	E	30.1		34.4	E
Gravel (Percent)	%				-		-		-		-		-		-		-		-		98.3	E	-	
Sand (Percent)	%				2.6		2.7		2.1		1.4		4.7		0.8		2.0		7.7		1.6		5.0	
Silt (Percent)	%				54.0		59.9		66.9		59.7		64.2		55.1		62.1		63.8		60.1		66.9	
Clay (Percent)	%				43.3		37.4		31.1		38.9		31.1		44.1		35.9		28.4		38.2		28.1	
Fines (Percent silt + clay)	%				97.3		97.3		98.0		98.6		95.3		99.2		98.0		92.2		98.3		95.0	
Preferred reference match:					94.3		94.3		94.3		94.3		94.3		94.3		94.3		94.3		94.3		94.3	
Ampelisca abdita					NH		NH		NH		NH		NH		NH		NH		NH		NH		NH	
Mytilus galloprovincialis hits:					NH		2H		2H		2H		2H		2H		2H		2H		2H		2H	
Neanthes arenaceodentata hits:					NH		NH		NH		NH		NH		NH		NH		NH		NH		NH	
Bioassay: Pass/Fail:					Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
BTs exceeded: No/Yes					No		No		No		No		No		No		No		No		No		No	
Bioaccumulation conducted:					No		No		No		No		No		No		No		No		No		No	
ML Rule exceeded: No/Yes					No		No		No		No		No		No		No		No		No		No	
PSDDA Determination: Pass/Fail					Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
DMMU Volume:	cy				3,700		3,700		3,700		3,700		3,950		3,950		3,400		3,400		3,400		3,400	
DMMU ID:					S21		S22		S23		S24		S25		S26		S27		S28		S29		S30	
Pass:					3,700		3,700		3,700		3,700		3,950		3,950		3,400		3,400		3,400		3,400	
Fail:																								

Legend:

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UCOWD = Unconfined open-water disposal

NP = not performed (no chem. guideline exceedances)

E = estimated value

Exceeds CSL

Appendix I. Pit-CAD Sediment Characterization Testing Summary / DMMP Suitability Determination

				DMMU ID:	C1	C2	C3	C4	Ref_10	Ref_24	C5	C6	C7	C8	DMMU				
				Rank:	LM	LM	LM	LM			LM	LM	LM	LM	exceed. Freq				
				Depth:	3-7 ft	3-7 ft	3-7 ft	3-7 ft			7-11 ft	7-11 ft	7-11 ft	7-11 ft					
CHEMICAL NAME	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ					
Mercury	mg/kg	0.41	1.5	2.3											18 / 34				
Total Solids	%				56.1		44.1		49.8		47.5								
Total Volatile Solids	%				3.6		5.6		4.6		4.8								
Total Organic Carbon	%				1.3		2.1		1.8		2.2								
Total Sulfides	mg/kg				33.0		58.0		34.0		89.0								
Total Ammonia (as N)	mg/kg				23.2		26.2		32.7		44.4								
Gravel (Percent)	%				-		-		-		95.5								
Sand (Percent)	%				28.9		3.0		15.2		4.5		5.7		19.6				
Silt (Percent)	%				44.2		63.4		55.3		56.3		75.1		65.2				
Clay (Percent)	%				26.9		33.6		29.5		39.2		19.2		15.2				
Fines (Percent silt + clay)	%				71.1		97.0		84.8		95.5		94.3		80.4				
Preferred reference match:																			
Ampelisca abdita																			
Mytilus galloprovincialis hits:																			
Neanthes arenaceodentata hits:																			
Bioassay: Pass/Fail:					NP		NP		NP		NP								
BTs exceeded: No/Yes					No		No		No		No								
Bioaccumulation conducted:					No		No		No		No								
ML Rule exceeded: No/Yes					No		No		No		No								
PSDDA Determination: Pass/Fail					Pass		Pass		Pass		Pass		Pass		Pass				
DMMU Volume:	cy				43,800		45,400		40,000		12,400		42,700		44,300	38,900	11,100	390,100	
DMMU ID:					C1		C2		C3		C4		Ref_10		Ref_24	C5	C6	C7	C8
Pass:					43,800		45,400		40,000		12,400					42,700	44,300	38,900	11,100
Fail:																			

Archived, not tested
 Archived, not tested
 Archived, not tested
 Archived, not tested

386,400 cy Suitable for UCOWD
 3,700 cy Unsuitable for UCOWD

Legend:
 NH = no hit response
 2H = two hit Failure (DMMP Guidelines)
 UCOWD = Unconfined open-water disposal
 NP = not performed (no chem. guideline exceedances)
 E = estimated value
 Exceeds CSL

APPENDIX 2. PSDDA EVALUATION GUIDELINES (BIOASSAYS)

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	$M_C \leq 10\%$	$M_R - M_C \leq 20\%$	$M_T - M_C > 20\%$ 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	$N_{C+I} \geq 0.70$	$N_R \div N_C \geq 0.65$	$N_T \div N_C < 0.80$ 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
<i>Neanthes</i> mortality	$M_C \leq 10\%$	$M_R - M_C \leq 20\%$	$M_T - M_C > 20\%$ 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
<i>Neanthes</i> growth	$M_C \leq 10\%$ $MIG \geq 0.38$ mg/ind/day	$MIG_R \div MIG_C \geq 0.80$	$MIG_T \div MIG_C < 0.80$ 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	$MIG_T/MIG_R < 0.50$	$MIG_T/MIG_R < 0.70$
Microtox	N/A	$BLD_R \leq 20\%$	N/A		$BLD_T > 20\%$ and BLD_T vs BLD_R SD (p=.05) and	
			N/A	N/A	N/A	NOCN

M = mortality, N = normals, I = initial count, MIG = mean individual growth rate, BLD = blank-corrected light decrease
 SD = statistically different, NOCN = no other conditions necessary, N/A = not applicable
 Subscripts: R = reference sediment, C = negative control, T = test sediment

Appendix 3a

Table 25. Summary of Results of the *Ampelisca abdita* Bioassays

Station ID	Test Batch ^{1/}	Reference Station ^{1/}	Mean Mortality ^{2/} (%)	M _{Test} - M _{Con} > 20%	Statistical Significance ^{3/}		Single-Hit Rule	Two-Hit Rule
					Significant Difference?	M _{Test} - M _{Ref} > 30%		
FWS01	A	FWREF24	10.0 ± 9.4%	No	No	No	Pass	Pass
FWS02	A	FWREF24	5.0 ± 7.1%	No	No	No	Pass	Pass
FWS03	A	FWREF24	9.0 ± 8.9%	No	No	No	Pass	Pass
FWS04	A	FWREF24	10.0 ± 7.1%	No	No	No	Pass	Pass
FWS05	A	FWREF24	12.0 ± 11.5%	No	No	No	Pass	Pass
FWS06	A	FWREF10	8.0 ± 7.6%	No	No	No	Pass	Pass
FWS07	A	FWREF24	1.0 ± 2.2%	No	No	No	Pass	Pass
FWS08	A	FWREF10	11.0 ± 4.2%	No	No	No	Pass	Pass
FWS09	A	FWREF10	6.0 ± 4.2%	No	No	No	Pass	Pass
FWS10	A	FWREF10	7.0 ± 2.7%	No	No	No	Pass	Pass
FWS11	A	FWREF10	5.0 ± 7.1%	No	No	No	Pass	Pass
FWS12	A	FWREF10	4.0 ± 4.2%	No	No	No	Pass	Pass
FWS13	A	FWREF10	7.0 ± 5.7%	No	No	No	Pass	Pass
FWS14	A	FWREF10	7.0 ± 6.7%	No	No	No	Pass	Pass
FWS15	A	FWREF10	8.0 ± 2.7%	No	No	No	Pass	Pass
FWS16	A	FWREF10	8.0 ± 2.7%	No	No	No	Pass	Pass
FWS17	A	FWREF10	12.0 ± 5.7%	No	No	No	Pass	Pass
FWS18	A	FWREF10	13.0 ± 11.0%	No	No	No	Pass	Pass
FWS19	B	FWREF10	33.0 ± 13.5%	Yes	No	No	Pass	Pass
FWS20	B	FWREF10	24.0 ± 12.4%	No	No	No	Pass	Pass
FWS21	B	FWREF10	29.0 ± 12.4%	No	No	No	Pass	Pass
FWS22	B	FWREF10	26.0 ± 15.6%	No	No	No	Pass	Pass
FWS23	B	FWREF10	19.0 ± 14.3%	No	No	No	Pass	Pass
FWS24	B	FWREF10	22.0 ± 12.5%	No	No	No	Pass	Pass
FWS25	B	FWREF10	22.0 ± 17.5%	No	No	No	Pass	Pass
FWS26	B	FWREF10	26.0 ± 18.2%	No	No	No	Pass	Pass
FWS27	B	FWREF10	23.0 ± 16.4%	No	No	No	Pass	Pass
FWS28	B	FWREF10	42.0 ± 18.9%	Yes	No	No	Pass	Pass
FWS29	B	FWREF10	7.0 ± 6.7%	No	No	No	Pass	Pass
FWS30	B	FWREF10	24.0 ± 5.5%	No	No	No	Pass	Pass
FWREF10	A	NA	7.0 ± 5.7%	NA	NA	NA	NA	NA
FWREF24	A	NA	9.0 ± 6.5%	NA	NA	NA	NA	NA
FWREF10	B	NA	26.0 ± 23.3%	NA	NA	NA	NA	NA
FWREF24	B	NA	33.0 ± 9.1%	NA	NA	NA	NA	NA
Control	A	NA	3.0 ± 6.7%	NA	NA	NA	NA	NA
Control	B	NA	9.0 ± 7.4%	NA	NA	NA	NA	NA

NOTE: Single-Hit & Two-Hit Rules as defined in Table 6-1 of DMMP User's Manual (DMMP 1998) for nondispersive disposal site.

^{1/} Corresponding reference station with similar grain size.

^{2/} Mean and standard deviation for five replicate samples.

^{3/} Statistically significant increases in percent mortality compared to reference as determined by a t-test (normally distributed data) at $\alpha = 0.05$.

M_{Test} = mortality in test stations.

M_{Con} = mortality in negative control.

M_{Ref} = mortality in reference station.

Appendix 3b.

Table 3-6. Summary of Results of the *Mytilus galloprovincialis* Bioassays

Station ID	Reference Station ^{1/}	Mean Normal Survival ^{2/} (%)	N _{Test} / N _{Con} < 80%	Statistical Significance ^{3/}	% Reference Normal Survival -		Single-Hit Rule	Two-Hit Rule
				Significant Difference?	% Test Normal Survival > 30 %			
FWS01	FWREF24	52.2 ± 6.9 %	Yes	Yes	No		Pass	Fail
FWS02	FWREF24	50.0 ± 8.9%	Yes	Yes	No		Pass	Fail
FWS03	FWREF24	62.8 ± 6.6%	Yes	Yes	No		Pass	Fail
FWS04	FWREF24	65.5 ± 4.0%	Yes	Yes	No		Pass	Fail
FWS05	FWREF24	60.5 ± 14.2%	Yes	Yes	No		Pass	Fail
FWS06	FWREF10	66.6 ± 10.8%	Yes	No	No		Pass	Pass
FWS07	FWREF24	52.1 ± 8.7%	Yes	Yes	No		Pass	Fail
FWS08	FWREF10	58.2 ± 11.4%	Yes	Yes	No		Pass	Fail
FWS09	FWREF10	63.0 ± 7.1%	Yes	No	No		Pass	Pass
FWS10	FWREF10	51.7 ± 6.2%	Yes	Yes	No		Pass	Fail
FWS11	FWREF10	67.5 ± 7.8%	Yes	No	No		Pass	Pass
FWS12	FWREF10	63.7 ± 8.1%	Yes	No	No		Pass	Pass
FWS13	FWREF10	49.7 ± 13.4%	Yes	Yes	No		Pass	Fail
FWS14	FWREF10	55.8 ± 10.5%	Yes	Yes	No		Pass	Fail
FWS15	FWREF10	59.8 ± 13.0%	Yes	No	No		Pass	Pass
FWS16	FWREF10	53.3 ± 9.5%	Yes	Yes	No		Pass	Fail
FWS17	FWREF10	53.5 ± 12.4%	Yes	Yes	No		Pass	Fail
FWS18	FWREF10	57.1 ± 4.8%	Yes	Yes	No		Pass	Fail
FWS19	FWREF10	56.2 ± 3.6%	Yes	Yes	No		Pass	Fail
FWS20	FWREF10	58.8 ± 12.2%	Yes	Yes	No		Pass	Fail
FWS21	FWREF10	65.2 ± 8.1%	Yes	No	No		Pass	Pass
FWS22	FWREF10	58.3 ± 7.0%	Yes	Yes	No		Pass	Fail
FWS23	FWREF10	55.5 ± 9.4%	Yes	Yes	No		Pass	Fail
FWS24	FWREF10	58.7 ± 6.3%	Yes	Yes	No		Pass	Fail
FWS25	FWREF10	58.9 ± 8.1%	Yes	Yes	No		Pass	Fail
FWS26	FWREF10	57.6 ± 12.3%	Yes	Yes	No		Pass	Fail
FWS27	FWREF10	58.3 ± 13.7%	Yes	Yes	No		Pass	Fail
FWS28	FWREF10	53.2 ± 10.6%	Yes	Yes	No		Pass	Fail
FWS29	FWREF10	58.6 ± 13.7%	Yes	Yes	No		Pass	Fail
FWS30	FWREF10	60.5 ± 8.7%	Yes	Yes	No		Pass	Fail
FWREF10		70.9 ± 11.7%						
FWREF24		70.8 ± 4.5%						
Control(SW)		90.8 ± 7.4%						

NOTE: Single-Hit and Two-Hit Rules as defined in Table 6-1 of DMMP User's Manual (DMMP 1998) for nondispersive disposal site.

^{1/} Corresponding reference station with similar grain size.

^{2/} Mean and standard deviation for five replicate samples. Reported values are normalized to seawater control mean normal survival = 289.4 (raw counts).

^{3/} Statistically significant decreases in normalized percent normal survival compared to reference as determined by a t-test (normally distributed data) at $\alpha = 0.1$.

N_{Test} = number of normal survivors in test station.

N_{Con} = number of normal survivors in negative control.

Appendix 3c

Table 3-7. Summary of Results of the *Neanthes arenaceodentata* Bioassays

Station ID	Reference Station ^{1/}	Mean Individual Growth Rate (MIG)		Statistical Significance ^{3/}		Single-Hit Rule	Two-Hit Rule
		(mg/organism/ day, dry wt) ^{2/}	MIG _{Test} /MIG _{Con} < 0.80	Significant Difference?	MIG _{Test} /MIG _{Ref} < 0.50		
FWS01	FWREF24	1.04 ± 0.19	No	No	No	Pass	Pass
FWS02	FWREF24	0.84 ± 0.18	Yes	No	No	Pass	Pass
FWS03	FWREF24	0.65 ± 0.16	Yes	Yes	No	Pass	Fail
FWS04	FWREF24	1.01 ± 0.24	No	No	No	Pass	Pass
FWS05	FWREF24	0.80 ± 0.21	Yes	No	No	Pass	Pass
FWS06	FWREF10	0.81 ± 0.21	Yes	No	No	Pass	Pass
FWS07	FWREF24	0.84 ± 0.33	Yes	No	No	Pass	Pass
FWS08	FWREF10	0.89 ± 0.30	Yes	No	No	Pass	Pass
FWS09	FWREF10	0.90 ± 0.31	Yes	No	No	Pass	Pass
FWS10	FWREF10	0.91 ± 0.18	Yes	No	No	Pass	Pass
FWS11	FWREF10	0.97 ± 0.19	No	No	No	Pass	Pass
FWS12	FWREF10	0.89 ± 0.25	Yes	No	No	Pass	Pass
FWS13	FWREF10	1.00 ± 0.33	No	No	No	Pass	Pass
FWS14	FWREF10	1.04 ± 0.30	No	No	No	Pass	Pass
FWS15	FWREF10	0.94 ± 0.34	Yes	No	No	Pass	Pass
FWS16	FWREF10	0.99 ± 0.18	No	No	No	Pass	Pass
FWS17	FWREF10	1.04 ± 0.15	No	No	No	Pass	Pass
FWS18	FWREF10	0.80 ± 0.31	Yes	No	No	Pass	Pass
FWS19	FWREF10	0.74 ± 0.25	Yes	No	No	Pass	Pass
FWS20	FWREF10	0.87 ± 0.35	Yes	No	No	Pass	Pass
FWS21	FWREF10	0.84 ± 0.27	Yes	No	No	Pass	Pass
FWS22	FWREF10	0.93 ± 0.25	Yes	No	No	Pass	Pass
FWS23	FWREF10	0.90 ± 0.37	Yes	No	No	Pass	Pass
FWS24	FWREF10	1.04 ± 0.22	No	No	No	Pass	Pass
FWS25	FWREF10	0.99 ± 0.37	No	No	No	Pass	Pass
FWS26	FWREF10	1.04 ± 0.11	No	No	No	Pass	Pass
FWS27	FWREF10	1.07 ± 0.24	No	No	No	Pass	Pass
FWS28	FWREF10	0.91 ± 0.10	Yes	No	No	Pass	Pass
FWS29	FWREF10	1.06 ± 0.15	No	No	No	Pass	Pass
FWS30	FWREF10	0.97 ± 0.24	No	No	No	Pass	Pass
FWREF10		0.98 ± 0.26					
FWREF24		0.99 ± 0.23					
Control(SW)		1.19 ± 0.37					

NOTE: Single-Hit and Two-Hit Rules as defined in Table 6-1 of DMMP User's Manual (DMMP 1998) for nondispersive disposal site.

^{1/} Corresponding reference station with similar grain size.

^{2/} Mean and standard deviation for five replicate samples.

^{3/} Statistically significant decreases in individual growth rate compared to reference as determined by a t-test (normally distributed data) at the $\alpha = 0.05$ level.

MIG_{Test} = mean individual growth rate in test station.

MIG_{Con} = mean individual growth rate in negative control.

MIG_{Ref} = mean individual growth rate in reference station.