

3 April 1992

SUBJECT: DECISION ON THE SUITABILITY OF DREDGED MATERIAL TESTED UNDER PSDDA EVALUATION PROCEDURES FOR THE U.S. NAVY BREMERTON PIER-D DREDGING PROJECT (OYB-2-012791) FOR DISPOSAL AT THE ELLIOTT BAY OPEN-WATER DISPOSAL SITE.

1. The U.S. Navy proposes to maintenance dredge 171,400 cubic yards of material from its Bremerton Pier D project site. The following summary reflects the PSDDA agencies' (Corps of Engineers, Department of Ecology, Department of Natural Resources and the Environmental Protection Agency) consensus decision on the suitability of the proposed dredged material for disposal at the Elliott Bay nondispersive open-water disposal site.
2. Based on its location in Sinclair Inlet and previous characterization data, the sediments in the project area were ranked high. A total of twenty-eight dredged material management units (DMMUs) were tested to characterize the 171,400 cubic yards. Twenty DMMUs (S1 through S20), each representing 3,500 to 4,000 cubic yards were tested to characterize the 77,600 cubic yards of surface sediments. The subsurface sediments (>4 feet) were divided into eight DMMUs (C1 through C8), each representing 9,300 to 13,000 cubic yards, and consisting of four to six composited field samples. The total subsurface volume was 92,800 cubic yards.
3. A PSDDA sampling and analysis plan (SAP) was developed for this project. The PSDDA agencies reviewed the SAP and approved it on 22 February 1991. The SAP was followed in its essential elements, and quality assurance/quality control guidelines specified by PSDDA were generally complied with. The data gathered were deemed sufficient and acceptable for regulatory decision-making under the PSDDA program. Testing results and the interpretation of these results by the PSDDA agencies are contained in the following sections.
4. All DMMUs were subjected to concurrent chemical and biological testing. Chemistry data indicated that exceedances of the 1991 PSDDA screening levels (SL) occurred for twenty-six of the DMMUs (only C1 and C3 had no SL exceedances). Screening levels for six metals, total LPAH, total HPAH, and twenty-two individual organic chemicals-of-concern were exceeded (see Attachment 1). Seven DMMUs exceeded one or more bioaccumulation triggers (BTs): S7, S11, S12, S16, S18, S19, S20. Five DMMUs exceeded one or more maximum levels (MLs): S12, S16, S18, S19, S20. Of these, three DMMUs exceeded an ML by greater than 100 percent or had more than one exceedance of ML: S16, S18 and S20.
5. Concurrent biological testing was conducted for all twenty-eight DMMUs. The amphipod 10-day acute toxicity test, echinoderm sediment larval combined mortality and abnormality (effective mortality) test, the Neanthes 10-day acute toxicity test, and the Microtox bacterial luminescence test were conducted. PSDDA interpretation guidelines specified in the Phase II Management Plan Report (Sept 1989), modified by changes made at the second annual review meeting, were used to evaluate the bioassay data. West Beach sand was used for the negative control (amphipod and Neanthes) while two reference sediments were collected from Samish Bay (all bioassays). The reference sediments were identified as Samish 6 and Samish 12. See Attachment 1 for DMMU-specific bioassay results.

6. There were no hits for any of the test sediments for either the Neanthes or Microtox bioassays.
7. For the sediment larval and amphipod bioassays, the coarser-grained sediments were compared to the Samish 12 reference sediment (9.0% fines), while the finer-grained sediments were compared to the Samish 6 reference sediment (86.1% fines). The two reference sediments had a mean of 47.6% fines; all test sediments with fines content less than this number were considered coarse, while test sediments with fines content greater than this number were considered fine (see Attachment 2).
8. In the sediment larval test, the negative seawater control and both Samish Bay reference sediments met the established PSDDA performance standards. For the coarse-grained test sediments, none had effective mortalities greater than 20% over the negative control. There were, therefore, no hits for these sediments. Of the fine-grained sediments, 12 had effective mortalities greater than 20% over the negative control and were therefore compared statistically with the Samish 6 reference sediment. Of these, 9 test sediments (S7, S9, S11, S14, S15, S16, S17, S19 and S20) had statistically greater effective mortality, but none were greater than 30% over the reference sediment. They were, therefore, all scored as hits under the two-hit rule, requiring a corroborating hit under another bioassay to fail the sediment (see Attachment 3).
9. In the amphipod bioassay, the negative control sediment and the Samish 12 reference sediment met the established PSDDA performance standards. For the coarse-grained sediments, three test sediments (S6, C3 and C6) exhibited mortalities greater than 20% over the negative control and were therefore compared statistically with the Samish 12 reference sediment. All three were statistically different, but only C6 exceeded the reference mortality by greater than 30%. S6 and C3, therefore, exhibited hits under the two-hit rule while C6 exhibited a hit under the single-hit rule (see Attachment 3).

For the fine-grained sediments, the reference sediment, Samish 6, exhibited a mortality of 47% mortality and failed to meet the established performance standard of 20% or less over the negative control, which exhibited 7% mortality. However, a highly significant correlation was found for this project between percent fines and percent mortality (see Attachment 4). The PSDDA Management Plan Report (MPR) - Phase II (page 5-33) recognizes this correlation. When the reference sediment mortality exceeds the nominal performance standard, the MPR recommends comparison to the grain size/mortality model presented in "Effects of Natural Sediment Features on Survival of the Phoxocephalid Amphipod, Rhepoxynius abronius", DeWitt, et al, Marine Environmental Research (1988).

DeWitt's model is based on a linear regression of amphipod survival, in the 10-day acute toxicity test, versus the percent fines (<62.5 microns) in the sediment. The model predicts the number of survivors (out of 20 organisms at the beginning of the test), given the fines content of the sediment. The model also includes the 95% confidence interval bracketing this regression line. The lower limit of the 95% confidence interval is referred to as the lower prediction limit (LPL). Any sediment with amphipod survival falling below this line is presumed to be demonstrating toxicity beyond that attributable to grain size, or a covarying sediment conventional parameter such as total organic carbon.

The survival rate exhibited by Samish 6 was compared to DeWitt's LPL. The LPL for a fines content of 86.1% (equal to that of Samish 6) equates to a survival rate of 11.8/20 organisms (41.1% mortality). The Samish 6 reference mortality (47%) exceeds this value. Therefore, consistent with the MPR-Phase II, the PSSDDA agencies considered the Samish 6 reference sediment results invalid for use in test interpretation.

The PSSDDA agencies looked at two options relative to the amphipod bioassay. One was to resample test and reference sediments and rerun the test. The other was to use the DeWitt model to interpret the results of the original test. The consensus decision was to 1) provide the Navy with the option of resampling and conducting a retest of the amphipod bioassay, and in the absence of this resampling effort, 2) use DeWitt's model to interpret the data. The Navy, in a letter dated 17 March 1992, decided not to pursue additional sampling and testing. Therefore, the PSSDDA agencies interpreted the amphipod bioassay results using DeWitt's model.

The PSSDDA agencies agreed to use DeWitt's model in the following way: 1) if the observed survival for a test sediment falls above the LPL defined by the model then no hit would be scored; 2) if the observed survival falls below the LPL but the percent survival is not greater than 30% absolute below the value predicted by the model's line of regression, then a hit under the two-hit rule would be scored; 3) if the observed survival both falls below the LPL and is greater than 30% absolute below the value predicted by the model's line of regression, then a hit under the single-hit rule would be scored. This interpretation parallels the interpretation normally used under PSSDDA evaluation procedures to assign hits.

Attachment 5 shows DeWitt's model plotted on the same graph as the Pier D data points. Attachment 6 includes the survivors (out of 20) predicted by DeWitt's line of regression (see column labelled "DeWitt predicted survivors"), the percent mortality corresponding to this number ("DeWitt percent predicted mortality"), as well as the LPL in terms of both survival and percent mortality (two columns labelled "DeWitt 95% lower prediction limit") for the percent fines associated with each of the fine-grained test sediments. Hits were assigned for each test sediment according to the rules presented in the previous paragraph. Following are examples of how these rules were applied (see Attachment 6 for the numbers used in these examples):

- No Hit: DMMU S8 had a "mean reported percent mortality" of 30%. This falls below the 40.3% mortality corresponding to the "DeWitt 95% lower prediction limit" for a fines content of 83.2%. Therefore, there were no hits for S8.

- Hit under the two-hit rule: For DMMU S2, the "mean reported percent mortality" of 41% is greater than the 38.6% mortality corresponding to the "DeWitt 95% lower prediction limit" for a fines content of 76.2%. The "DeWitt percent predicted mortality" for this fines content is 23.4%, and the reported mortality of 41% does not exceed this value by greater than 30%. Therefore, only a hit under the two-hit rule was assigned.

- Hit under the single-hit rule: DMMU S9 had a "mean reported percent mortality" of 68%, which is greater than the 38% mortality corresponding to the "DeWitt 95% lower prediction limit" for a fines content of 74.1%. The "DeWitt percent predicted mortality" for this fines content is 22.9%, so the reported mortality of 68% exceeds this value by greater than 30%. Therefore, a hit under the single-hit rule was assigned.

The final bioassay interpretation is presented in Attachment 3, which combines the interpretation of sediment larval bioassay results with coarse and fine-grained amphipod results. The overall interpretation is presented in the last column. A total of 69,400 cubic yards, represented by S1, S2, S5, S6, S8, S15, C1, C2, C3 and C5, passed PSDDA evaluation guidelines using the interpretation outlined previously. The DMMUs S3, S4, S7, S9, S10, S11, S13, S14, S16, S17, S19, S20, C4, C6, C7 and C8 all failed bioassay testing, representing 94,200 cubic yards. DMMU S18 (3800 CY) passed bioassay testing but is assumed unacceptable for open-water disposal, in the absence of an implemented test to assess chronic sublethal effects, due to the high level of DDT, which exceeded the ML by greater than 100%. Additionally, although S12 (4,000 cubic yards) passed standard bioassay testing, the total DDT concentration for this DMMU was above the BT. The Navy opted not to pursue bioaccumulation testing and, in the absence of bioaccumulation data, S12 was found unacceptable for open-water disposal.

10. In summary, the PSDDA agencies accepted the data as sufficient and acceptable for regulatory decision-making under the PSDDA program. Based on the results of the chemical and biological testing, the following consensus decision was made by the PSDDA agencies:

In the absence of additional data, the PSDDA agencies determined that the 69,400 cubic yards represented by DMMUs S1, S2, S5, S6, S8, S15, C1, C2, C3 and C5 were suitable for open-water disposal at the Elliott Bay non-dispersive site, while the 102,000 cubic yards, represented by DMMUs S3, S4, S7, S9, S10, S11, S12, S13, S14, S16, S17, S18, S19, S20, C4, C6, C7, C8 were unsuitable for open-water disposal. See Attachment 7 for a plan view of the surface and subsurface DMMUs which are unacceptable for open-water disposal.

11. If a section 404 permit is issued for this project, a dredging plan must be developed and submitted prior to dredging to the Enforcement Section of the Regulatory Branch of the Seattle District Corps of Engineers. This plan must include technology and methodology which is technically adequate to separate acceptable from unacceptable sediments.

12. This memorandum documents the suitability of proposed dredged sediments for disposal at a PSDDA open-water disposal site. It does not constitute final agency approval of the project. A public notice will be issued for this project. During the public comment period which follows the public notice, the resource agencies will provide input on the overall project. A final permit 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:

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U.S. NAVY BREMERTON PIER D - DY92
 OYB-2-012791
 CHEMICALS-OF-CONCERN EXCEEDING
 PSDDA GUIDELINE VALUES,
 BIOASSAY DATA AND INTERPRETATION

Guideline Values

METALS (ppm dry wgt):	SL	BT	ML	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Cadmium	0.96	---	9.6		1.4	1.2		1.1		2.4	1.6	1.5	1.2	1.7	1.8
Copper	81	---	810				91			180	240	230	150	170	310
Lead	66	---	660							250	190	130	200	210	210
Mercury	0.21	1.5	2.1	1.02			1.47		0.765	0.876	1.37	0.651	0.792	1.71	1.36
Silver	1.2	4.6	6.1												1.6
Zinc	160	---	1600							730	330	570	300	400	480

ORGANICS (ppb dry wgt):

Acenphthene	63	---	630												
Fluorene	64	---	640												
Phenanthrene	320	---	3200							350					
Anthracene	130	---	1300												
Total LPAH	610	---	6700												
Fluoranthene	630	4600	6300												
Pyrene	430	---	7300				1000			1100	1100	1300	630	1900	1500
Benzo(a)anthracene	450	---	4500												
Chrysene	670	---	6700												
Benzofluoranthenes	800	---	8000				1160			1000		820		870	900
Benzo(a)pyrene	680	4964	6800												
Indeno(1,2,3-c,d)pyrene	69	---	5200				320		81	300	210	150	120	260	220
Total HPAH	1800	---	51000				4380			4256	3650	4180	2060	4420	4070
Hexachlorobenzene	23	168	230				24 U				26 U	24 U			
Pentachlorophenol	100	504	---				120 U	110 U		110 U	130 U	120 U	110 U	110 U	
Dibenzofuran	54	---	540												
Hexachlorobutadiene	29	212	290		30 U	34 U	40 U	36 U		35 U	43 U	39 U	38 U	38 U	35 U
N-Nitrosodiphenylamine	28	161	220												
Total DDT	6.9	50	69				12.1		21.5	55	37.3	13 U	7.2	31	99*
Dieldrin	10	37	---							26				12	13
Chlordane	10	37	---							15 U	19 U	13 U		15 U	30 U
Heptachlor	10	37	---												15 U
Lindane	10	---	---												
Total PCBs	130	---	2500				150		160	670	450	700	180	920	920
TOC-normalized PCBs (ppm)	---	38	---												

CONVENTIONALS:

Percent Fines	14.7	76.2	82.6	89.5	90.2	16.6	72.2	83.2	74.1	83	88.9	59.9
Percent Silt	11.4	55.7	55.6	62.5	67.7	12	53.2	55.2	56.1	61	68.9	43.9
Percent Clay	3.3	20.5	27	27	22.5	4.6	19	28	18	22	20	16
Bulk Ammonia (mg/kg)	160	190	85	27	150	26	120	99	39	83	69	25
Bulk Sulfides (mg/kg)	21	32	67	270	130	86	56	320	1200	160	960	250
TOC (%)	0.33	1.7	2.4	3.3	2	0.69	2.7	2.5	3.7	2.3	2.7	2.9

BIOASSAYS:

Amphipod (% mortality)	14	41	86	85	49	33	53	30	68	71	65	36
Sediment Larval (% eff mort)	5.8	5	13.2	8.9	22.5	15.7	24.4	12.7	27.9	8.3	29.8	19.1
Neanthes (% mortality)	0	2	14	2	6	4	12	4	6	4	8	14
Microtox (% light diminution)	-32.5	-20.7	-37.6	-27.4	-25.2	-13.6	-31.2	-42.8	-36.2	-53.1	-38	-30.8

INTERPRETATION:

Volume (cubic yards):	3900	3900	3700	3900	3500	4000	4000	3900	3900	3800	3500	4000
Pass/Fail:	Pass	Pass	Fail	Fail	Pass	Pass	Fail	Pass	Fail	Fail	Fail	Fail(B)

Underlined values exceed the bioaccumulation trigger

Fail(B) = Fails in the absence of bioaccumulation testing data

* = Exceeds ML

** = Exceeds ML by >100%

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 CHEMICALS-OF-CONCERN EXCEEDING
 PSDDA GUIDELINE VALUES,
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Guideline Values

METALS (ppm dry wgt):	SL	BT	ML	S13	S14	S15	S16	S17	S18	S19	S20	C1	C2	C3	C4
Cadmium	0.96	---	9.6	1.4	1.9	2.3	1.7		1.7	1.6	1.1		1.4		1.1
Copper	81	---	810	190	380	88	250	130	160	130	190				
Lead	66	---	660	71	70	190	260	110	110	85	110				
Mercury	0.21	1.5	2.1	0.26	0.743	0.825	3.64*	1	1.72	1.22	0.809				
Silver	1.2	4.6	6.1		1.5	1.9	2.9			1.4					
Zinc	160	---	1600	220	400	440	420	190	260	180	250				

ORGANICS (ppb dry wgt):

Acenphthene	63	---	630			66									
Fluorene	64	---	640			180									
Phenanthrene	320	---	3200			1200									
Anthracene	130	---	1300		180	690									
Total LPAH	610	---	6700			2269									
Fluoranthene	630	4600	6300			4400									
Pyrene	430	---	7300		1500	6700	1700	1600	970	600	620				
Benzo(a)anthracene	450	---	4500		490	2300									
Chrysene	670	---	6700		800	3700									
Benzofluoranthenes	800	---	8000		1320	5000	940								
Benzo(a)pyrene	680	4964	6800			1400									
Indeno(1,2,3-c,d)pyrene	69	---	5200	79	290	600	330	200	160		160				
Total HPAH	1800	---	51000		5680	24643	4636	3390	2790	1839	2250				
Hexachlorobenzene	23	168	230		31 U	33 U									
Pentachlorophenol	100	504	---		150 U	170 U			110 U	110U					
Dibenzofuran	54	---	540			94	56								
Hexachlorobutadiene	29	212	290	33 U	51 U	55 U	33 U		37 U	36 U	34 U		31 U		31 U
N-Nitrosodiphenylamine	28	161	220		31 U	33 U									
Total DDT	6.9	50	69			23 U	98*	20.9	829**	157**	76.5*				
Dieldrin	10	37	---				44		13 U						
Chlordane	10	37	---			23 U	28 U		32 U	15 U	14 U				
Heptachlor	10	37	---			12 U	14 U		16 U						
Lindane	10	---	---												
Total PCBs	130	---	2500		290		1690	180	360	380	290				
TOC-normalized PCBs (ppm)	---	38	---				52.8								

CONVENTIONALS:

Percent Fines	75.2	68.4	73	73.7	50.7	82.3	85.3	64	22.2	83.3	27.3	83.4
Percent Silt	53.7	49.4	48.5	59.7	35.2	62.3	57.8	42	15.9	64.3	19	62.4
Percent Clay	21.5	19	24.5	14	15.5	20	27.5	22	6.3	19	8.3	21
Bulk Ammonia (mg/kg)	20	49	44	74	17	40	41	33	25	120	45	120
Bulk Sulfides (mg/kg)	850	590	270	580	240	820	71	100	21	31	46	71
TOC (%)	2.1	4.3	4.3	3.2	1.6	2.6	2.4	1.7	0.42	2	0.68	1.9

BIOASSAYS:

Amphipod (% mortality)	61	39	17	51	47	35	47	36	27	40	30	64
Sediment Larval (% eff mort)	6.2	31	34.5	28.1	23.7	22.2	27.1	32.7	11.4	17.2	9.9	20.9
Neantes (% mortality)	10	6	4	4	2	4	20	2	0	18	10	14
Microtox (% light diminution)	-52.1	-31.2	-27.6	-28.8	-49.8	-40	-22	-24.8	-27.6	0.5	-29.6	-39.8

INTERPRETATION:

Volume (cubic yards):	4000	4000	4000	4000	4000	3800	3900	3900	11600	13000	12300	12800
Pass/Fail:	Fail	Fail	Pass	Fail	Fail	Fail(C)	Fail	Fail	Pass	Pass	Pass	Fail

Underlined values exceed the bioaccumulation trigger

Fail(C) = Fails in the absence of an implemented test to assess chronic sublethal effects.

* = Exceeds ML

** = Exceeds ML by >100%

ATTACHMENT 1

U.S. NAVY BREMERTON PIER D - DY92
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 CHEMICALS-OF-CONCERN EXCEEDING
 PSSDA GUIDELINE VALUES,
 BIOASSAY DATA AND INTERPRETATION

Guideline Values

METALS (ppm dry wgt):	SL	BT	ML	C5	C6	C7	C8	SAMISH 6	SAMISH 12	WEST BEACH
Cadmium	0.96	---	9.6			1.2	1.2			
Copper	81	---	810	150						
Lead	66	---	660	70						
Mercury	0.21	1.5	2.1	1.17						
Silver	1.2	4.6	6.1							
Zinc	160	---	1600	190						

ORGANICS (ppb dry wgt):

Acenphthene	63	---	630							
Fluorene	64	---	640							
Phenanthrene	320	---	3200							
Anthracene	130	---	1300							
Total LPAH	610	---	6700							
Fluoranthene	630	4600	6300							
Pyrene	430	---	7300	1300						
Benzo(a)anthracene	450	---	4500							
Chrysene	670	---	6700							
Benzo(a)fluoranthene	800	---	8000							
Benzo(a)pyrene	680	4964	6800							
Indeno(1,2,3-c,d)pyrene	69	---	5200	100						
Total HPAH	1800	---	51000	2397						
Hexachlorobenzene	23	168	230							
Pentachlorophenol	100	504	---							
Dibenzofuran	54	---	540							
Hexachlorobutadiene	29	212	290			30 U	33 U			
N-Nitrosodiphenylamine	28	161	220							
Total DDT	6.9	50	69	24.2	35.3					
Dieldrin	10	37	---							
Chlordane	10	37	---							
Heptachlor	10	37	---							
Lindane	10	---	---		14					
Total PCBs	130	---	2500	160						
TOC-normalized PCBs (ppm)	---	38	---							

CONVENTIONALS:

Percent Fines	24.5	32.8	78.7	72.4	86.1	9	NA
Percent Silt	17.5	20.8	57.7	48.4	56	2.9	NA
Percent Clay	7	12	21	24	30.1	6.1	NA
Bulk Ammonia (mg/kg)	6	7.4	160	44	3	5.7	NA
Bulk Sulfides (mg/kg)	78	340	100	49	5.1	12	NA
TOC (%)	1.7	0.4	1.7	2.2	1.1	0.64	NA

BIOASSAYS:

Amphipod (% mortality)	24	44	62	60	47	7	7
Sediment Larval (% eff mort)	13	8.1	9.2	14.6	10.6	11.5	NA
Neanthes (% mortality)	0	2	10	6	0	2	6
Microtox (% light diminution)	-26	-26.4	-33	-32.5	-35	-31.7	NA

INTERPRETATION:

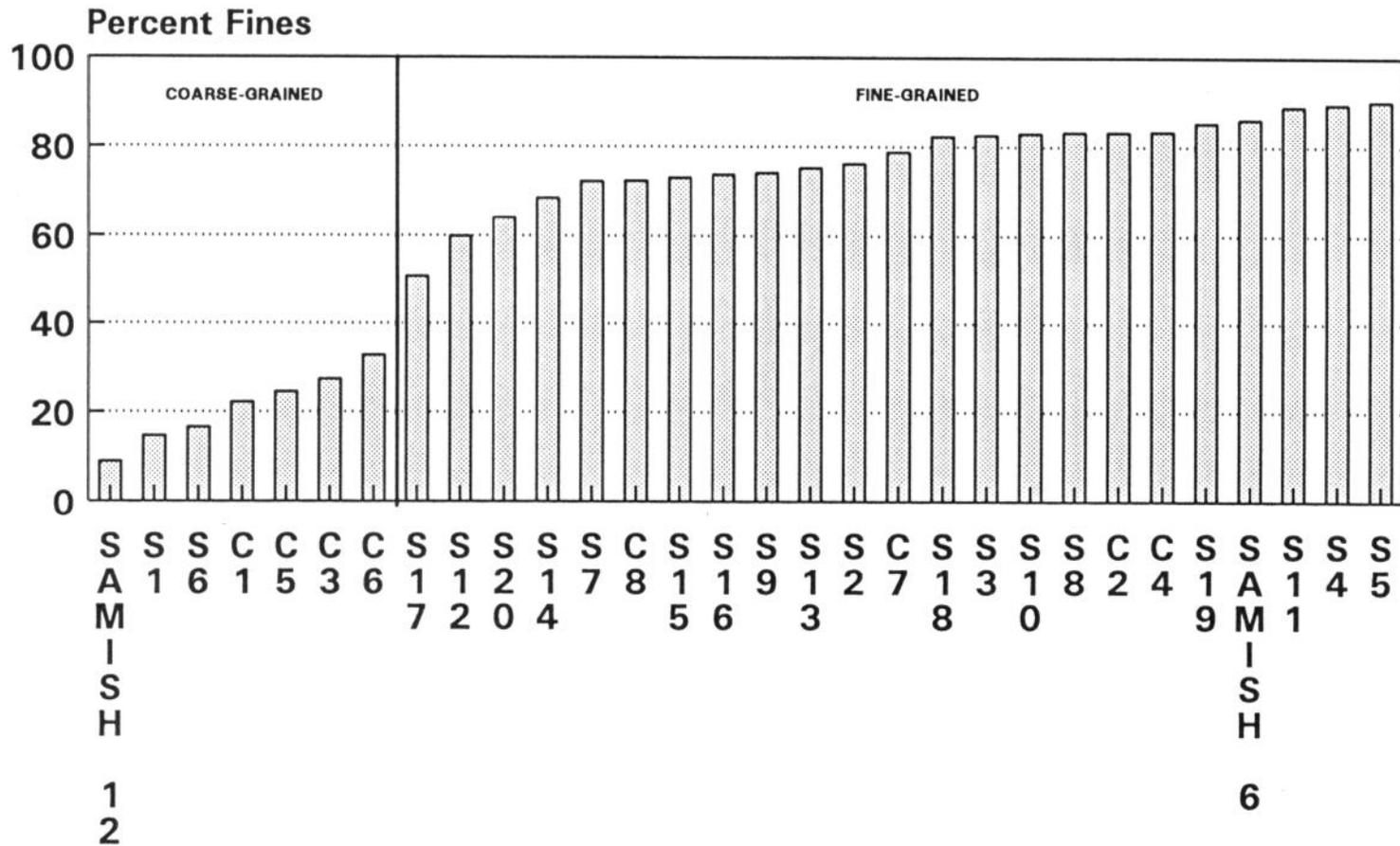
Volume (cubic yards):	9300	11100	12700	11300			
Pass/Fail:	Pass	Fail	Fail	Fail			

Underlined values exceed the bioaccumulation trigger

* = Exceeds ML

** = Exceeds ML by >100%

U.S. NAVY BREMERTON PIER D PERCENT FINES BY STATION



ATTACHMENT 2

Attachment 3
US Navy Bremerton Pier D
Bioassay Interpretation

Sample	Percent Fines	Chemistry Results	Bioassay Reference Sediment Comparison	Sediment Larval (% effective mortality)	Sediment Larval Hits	Coarse-grained Amphipod interpretation	Fine-grained Amphipod interpretation using DeWitt's model (1)	Overall Amphipod interpretation	Overall bioassay interpretation
S1	14.7		Samish 12	5.8					Pass
S2	76.2		Samish 6	5.0			*	*	Pass
S3	82.6		Samish 6	13.2			**	**	Fail
S4	89.5		Samish 6	8.9			**	**	Fail
S5	90.2		Samish 6	22.5			*	*	Pass
S6	16.6		Samish 12	15.7		*		*	Pass
S7	72.2	B	Samish 6	24.4	*		**	**	Fail
S8	83.2		Samish 6	12.7					Pass
S9	74.1		Samish 6	27.9	*		**	**	Fail
S10	83.0		Samish 6	8.3			**	**	Fail
S11	88.9	B	Samish 6	29.8	*		**	**	Fail
S12	59.9	B	Samish 6	19.1			*	*	Fail(B)
S13	75.2		Samish 6	6.2			**	**	Fail
S14	68.4		Samish 6	31.0	*		*	*	Fail
S15	73.0		Samish 6	34.5	*				Pass
S16	73.7	BM	Samish 6	28.1	*		*	*	Fail
S17	50.7		Samish 6	23.7	*		*	*	Fail
S18	82.3	BM	Samish 6	22.2					Fail(C)
S19	85.3	BM	Samish 6	27.1	*		*	*	Fail
S20	64.0	B	Samish 6	32.7	*		*	*	Fail
C1	22.2		Samish 12	11.4					Pass
C2	83.3		Samish 6	17.2					Pass
C3	27.3		Samish 12	9.9		*		*	Pass
C4	83.4		Samish 6	20.9			**	**	Fail
C5	24.5		Samish 12	13.0					Pass
C6	32.8		Samish 12	8.1		**		**	Fail
C7	78.7		Samish 6	9.2			**	**	Fail
C8	72.4		Samish 6	14.6			**	**	Fail
SAMISH 6	86.1			10.6					
SAMISH 12	9.0			11.5					
BEACH	NA								

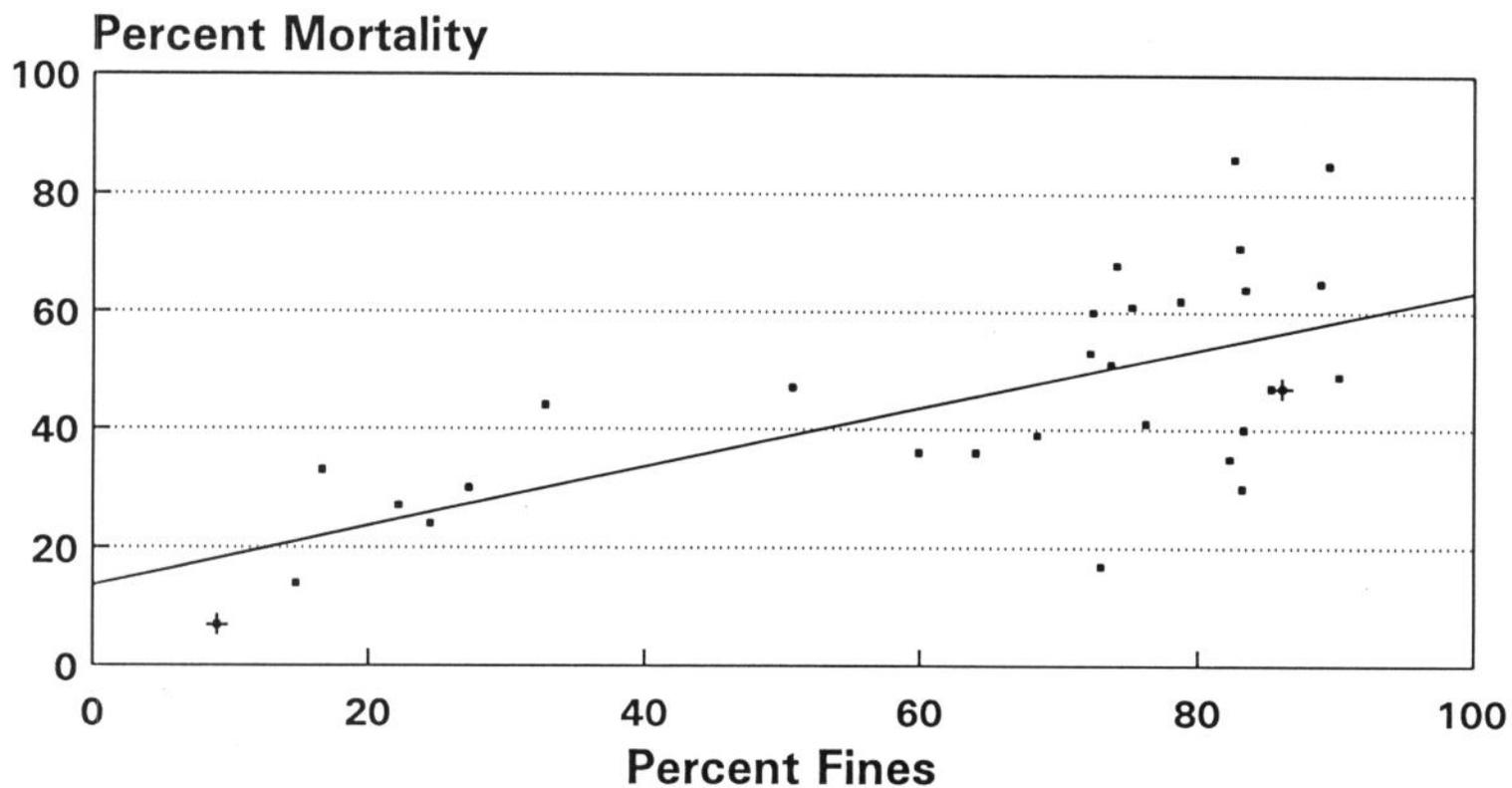
B = One or more bioaccumulation trigger exceedance
M = ML exceeded by >100% or >2 exceedances of ML

* hit under the two-hit rule
** hit under the single-hit rule

(1) DeWitt's model: test sediments below 95% LPL but less than 30% below DeWitt's predicted value were given hits under the two-hit rule; those below 95% LPL and greater than 30% below DeWitt's predicted value were given hits under the single-hit rule. See Attachment 6 for details.

Fail(B) = Fails in the absence of bioaccumulation testing data
Fail(C) = Fails in the absence of an implemented test to assess chronic sublethal effects

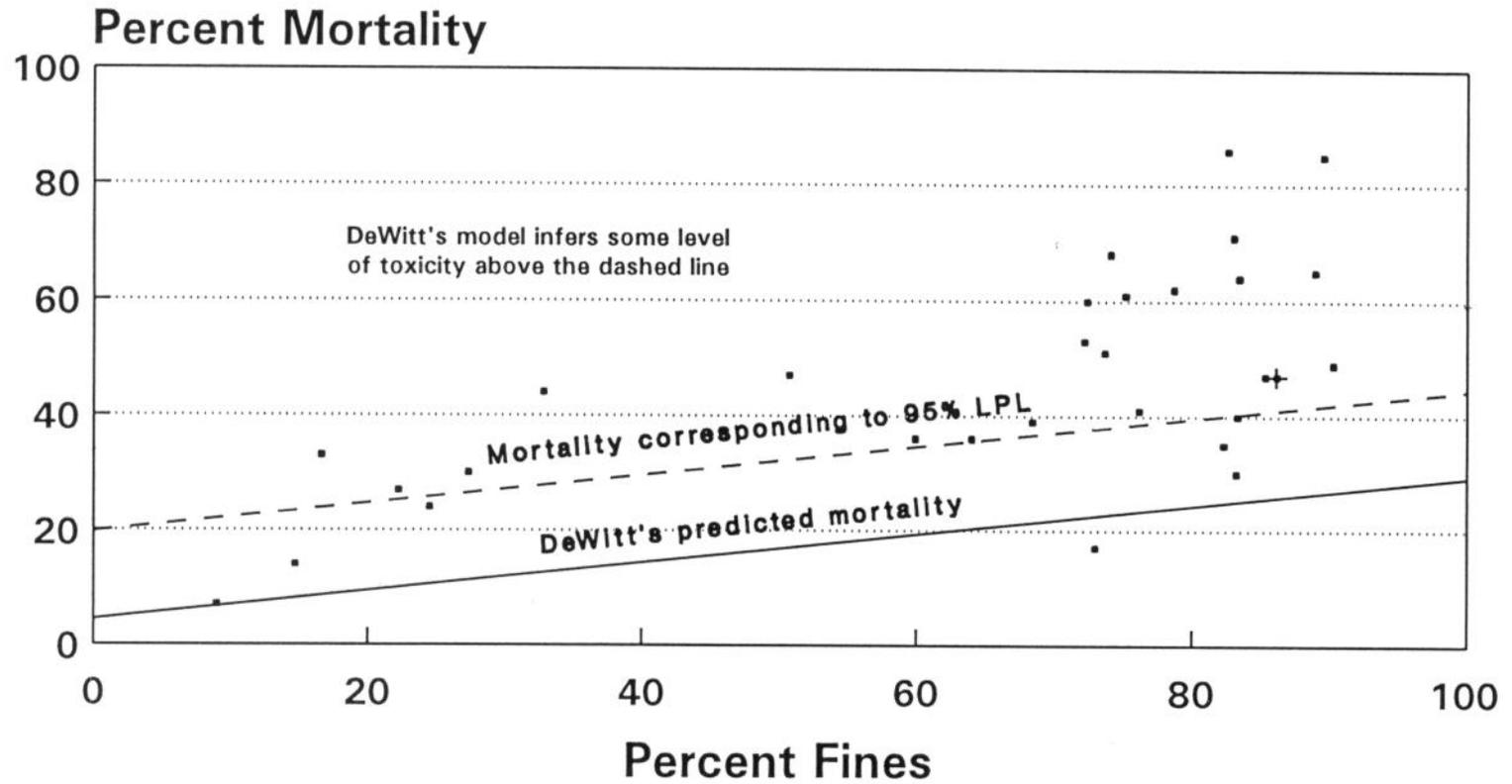
Attachment 4
U.S. Navy Pier D
Amphipod Mortality vs. Fines



+ Samish Reference

$r = .662, p < .01$

Attachment 5
Pier D Amphipod Mortality
Plotted Against DeWitt's Model



+ Samish 6

Attachment 6

U.S. NAVY - BREMERTON - PIER D

Interpretation of fine-grained amphipod results using DeWitt's model

SAMPLE	Percent fines (<62.5 microns)	Mean reported survivors (#/20)	Mean reported percent mortality	DeWitt predicted survivors (#/20)	DeWitt percent predicted mortality	DeWitt 95% lower prediction limit (#/20)	DeWitt 95% lower prediction limit (% mortality)	Hits
S2	76.2	11.8	41	15.3	23.4	12.3	38.6	*
S3	82.6	2.8	86	15.0	25.0	12.0	40.2	**
S4	89.5	3.0	85	14.7	26.7	11.6	41.9	**
S5	90.2	10.2	49	14.6	26.9	11.6	42.1	*
S7	72.2	9.4	53	15.5	22.4	12.5	37.5	**
S8	83.2	14.0	30	15.0	25.2	11.9	40.3	
S9	74.1	6.4	68	15.4	22.9	12.4	38.0	**
S10	83.0	5.8	71	15.0	25.1	11.9	40.3	**
S11	88.9	7.0	65	14.7	26.6	11.6	41.8	**
S12	59.9	12.8	36	16.1	19.3	13.1	34.5	*
S13	75.2	7.8	61	15.4	23.2	12.3	38.3	**
S14	68.4	12.2	39	15.7	21.5	12.7	36.6	*
S15	73.0	16.6	17	15.5	22.6	12.5	37.7	
S16	73.7	9.8	51	15.4	22.8	12.4	37.9	*
S17	50.7	10.6	47	16.6	17.0	13.6	32.2	*
S18	82.3	13.0	35	15.0	24.9	12.0	40.1	
S19	85.3	10.6	47	14.9	25.7	11.8	40.9	*
S20	64.0	12.8	36	15.9	20.4	12.9	35.5	*
C2	83.3	12.0	40	15.0	25.2	11.9	40.4	
C4	83.4	7.2	64	15.0	25.2	11.9	40.4	**
C7	78.7	7.6	62	15.2	24.0	12.2	39.2	**
C8	72.4	8.0	60	15.5	22.5	12.5	37.6	**
SAMISH 6	86.1	10.6	47	14.8	25.9	11.8	41.1	N/A
SAMISH 12	9.0	18.6	7	18.7	6.6	15.6	21.9	N/A

* Hit under the two-hit rule. Survival falls below DeWitt's 95% LPL, but the corresponding mortality is less than or equal to 30% absolute over that predicted by the DeWitt regression.

** Hit under the single-hit rule. Survival falls below DeWitt's 95% LPL, and the corresponding mortality is greater than 30% absolute over that predicted by the DeWitt regression.

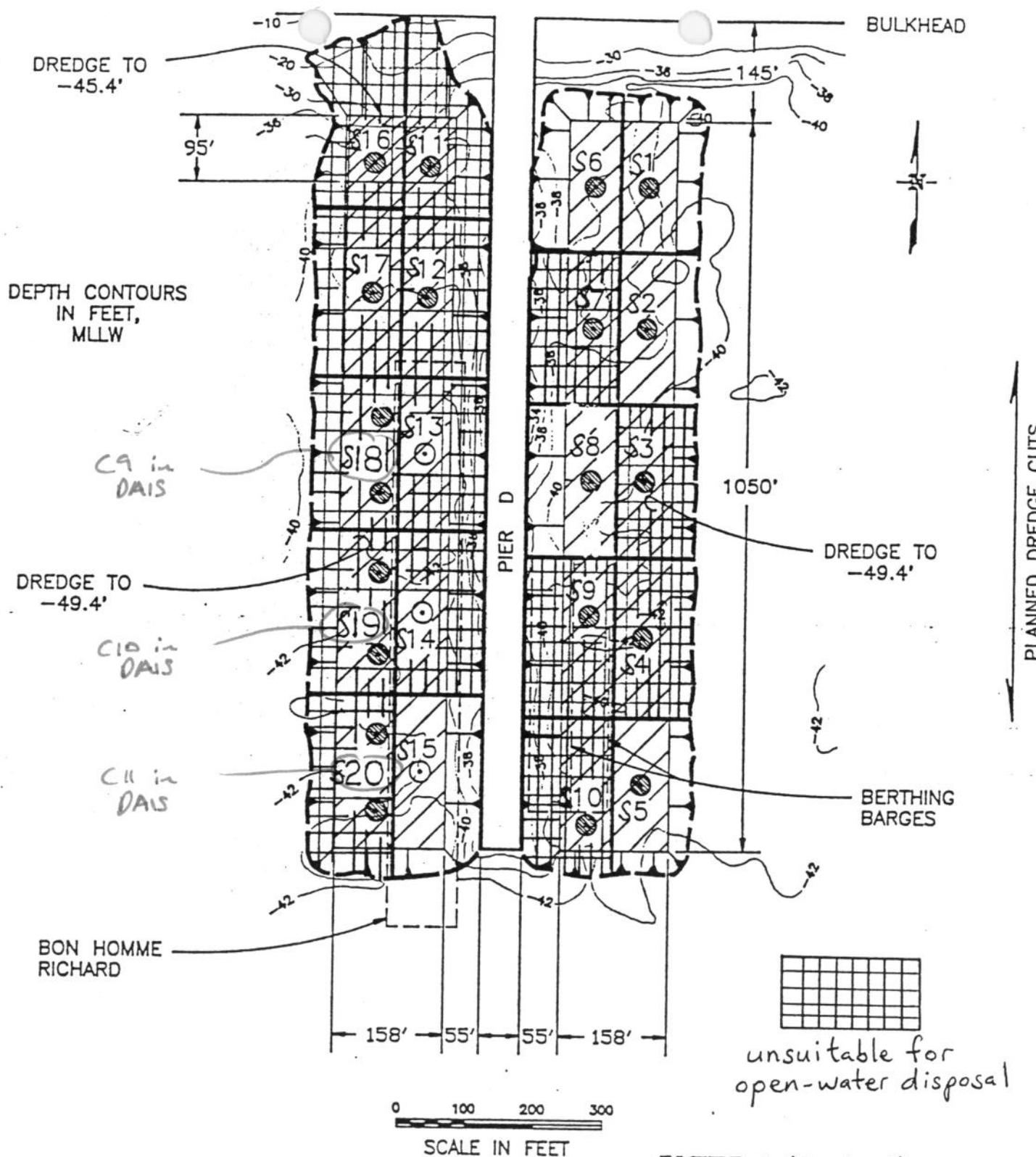


FIGURE 1 (Revised)

USN PUGET SOUND NAVAL SHIPYARD
BREMERTON, WA

PIER D DREDGING
SEDIMENT UNITS & SAMPLING LOCATIONS

FIGURE 1

(REVISED 3/18/91)

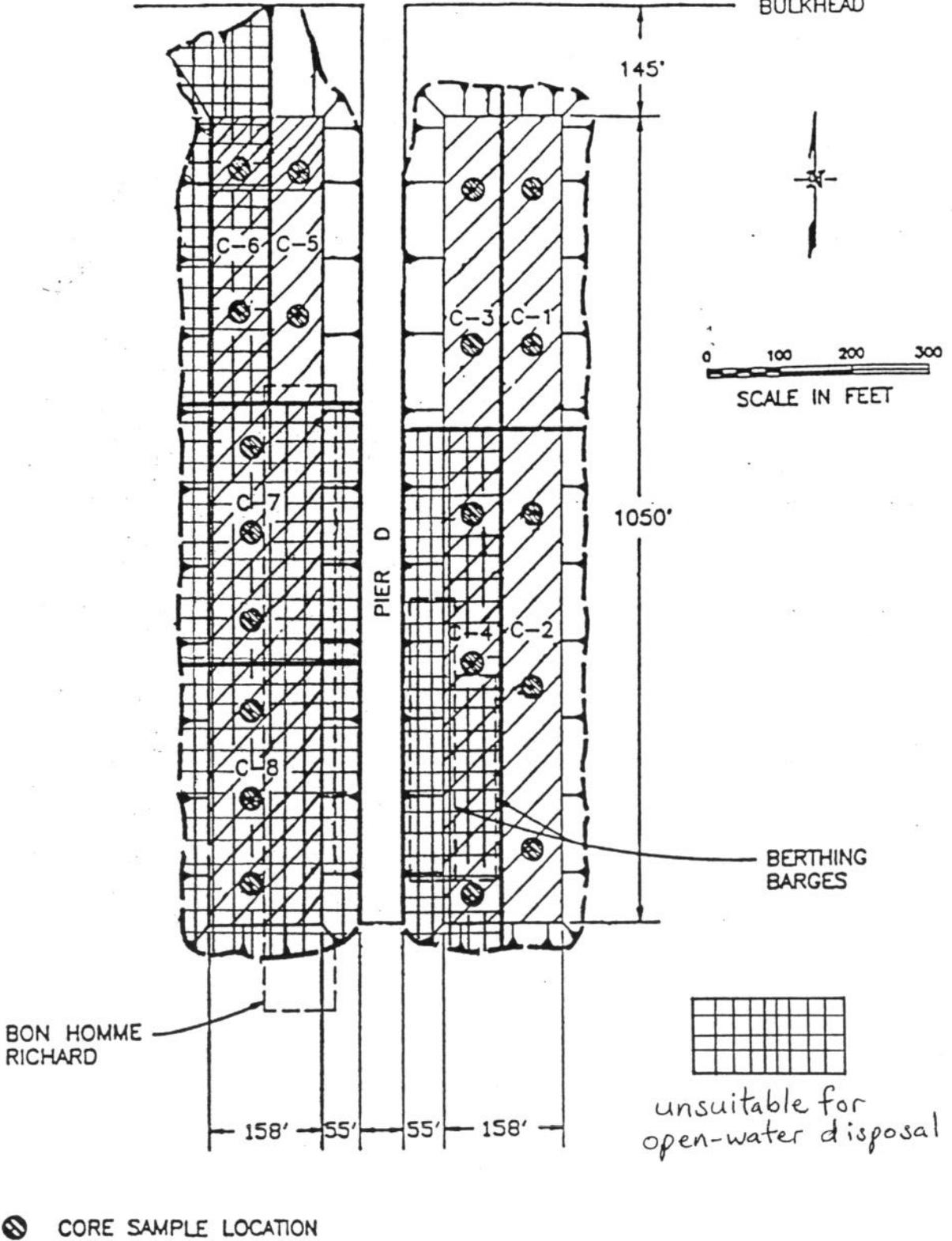
SURFACE

- SURFACE CORE (TOP 4')
- FULL DEPTH CORE (SURFACE & SUBSURFACE)

0144-104-B03 SLF:DB 05/03/91

WYCOFF AVE

BULKHEAD

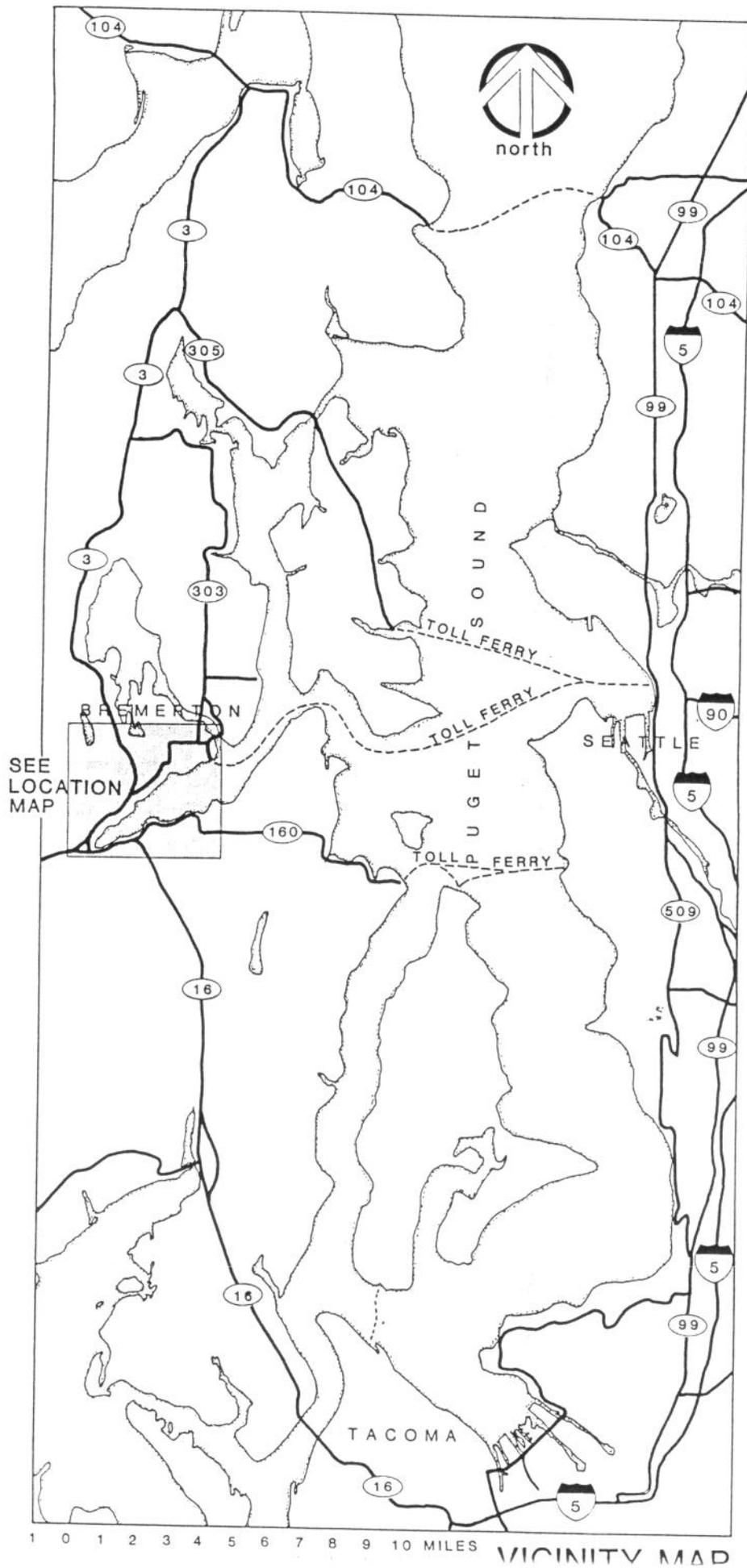


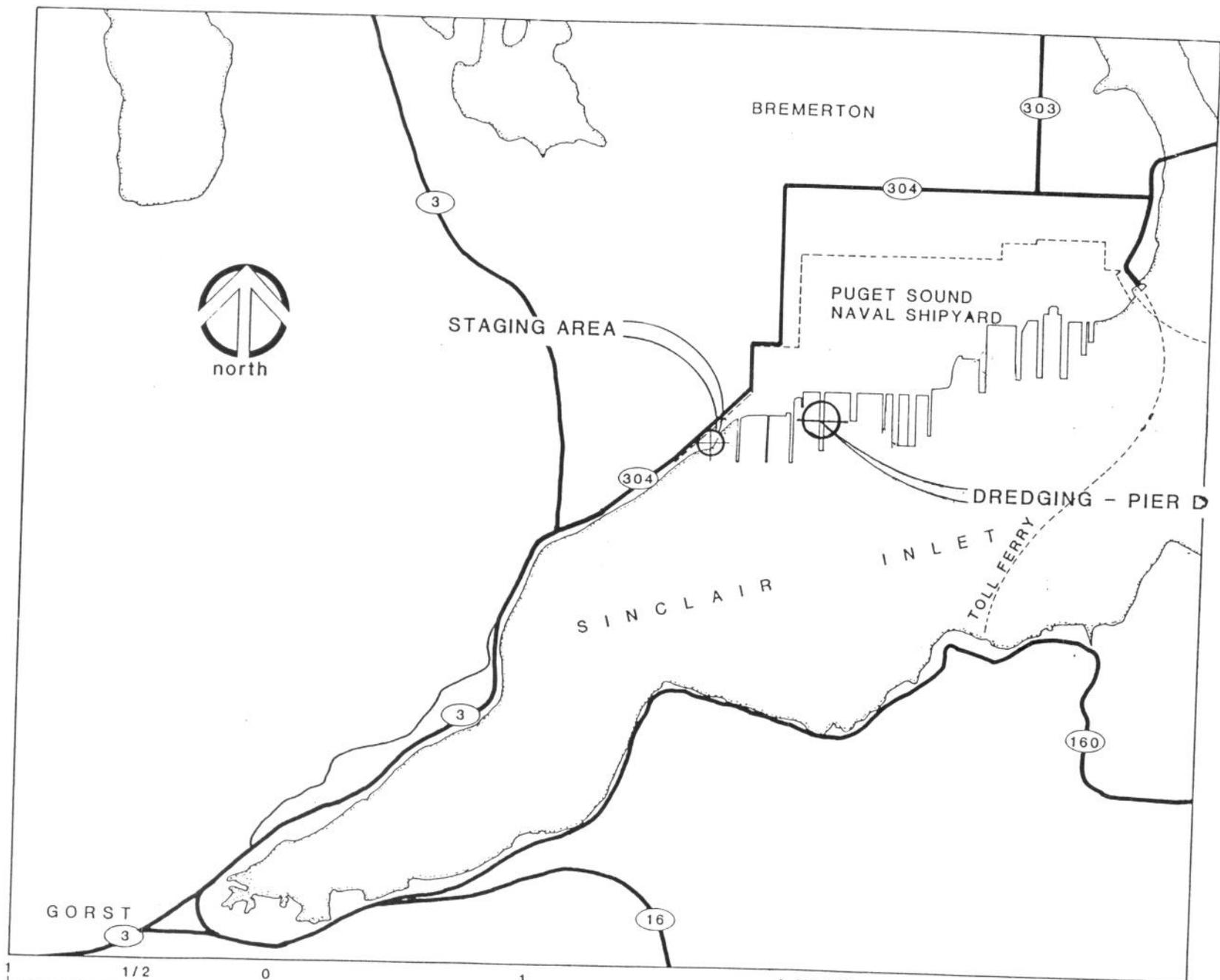
BON HOMME RICHARD

BERTHING BARGES

unsuitable for open-water disposal

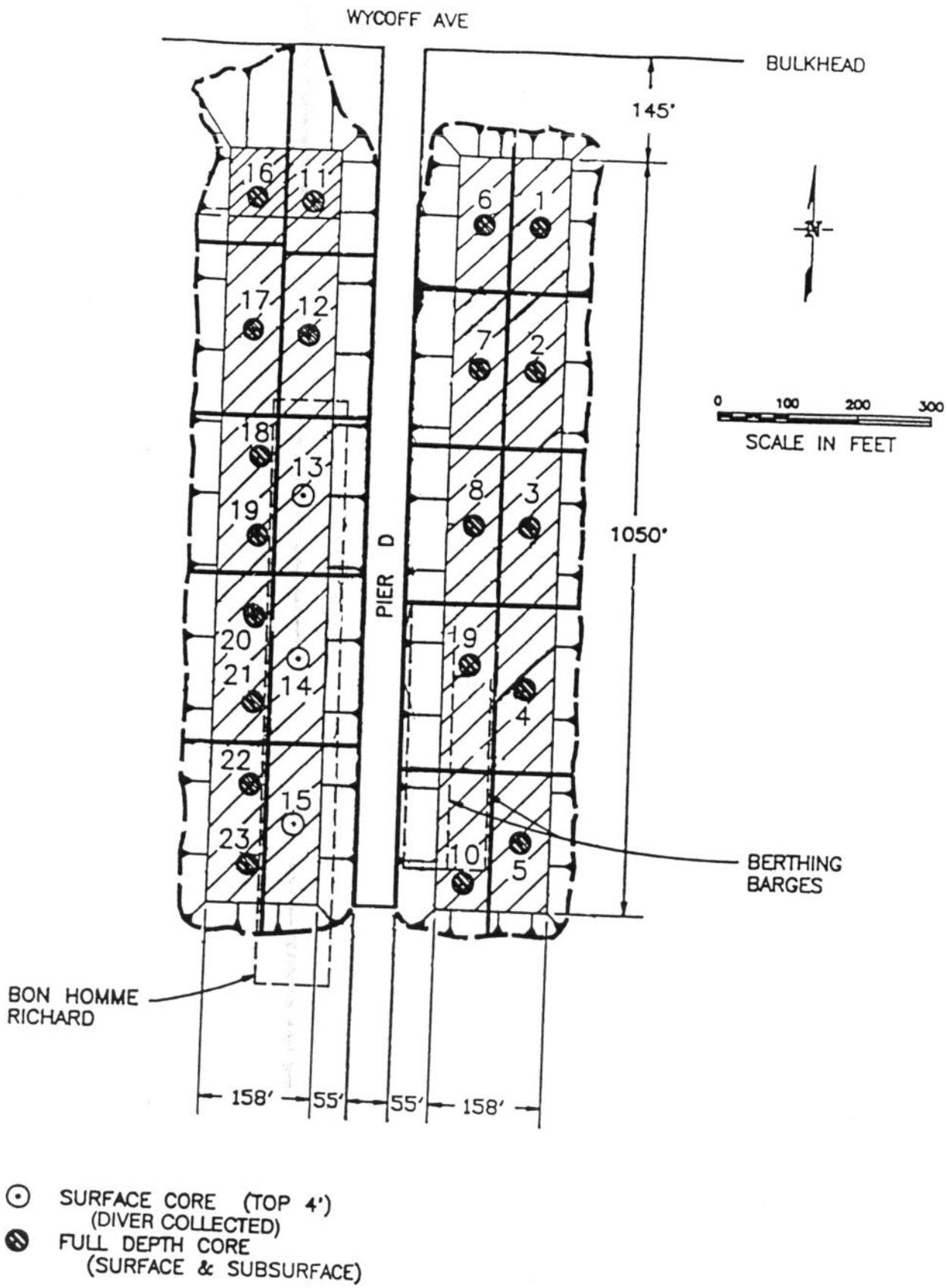
⊗ CORE SAMPLE LOCATION





LOCATION MAP

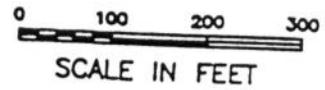
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WYCOFF AVE

BULKHEAD

145'



SCALE IN FEET

1050'

PIER D

BERTHING BARGES

BON HOMME RICHARD

158' 55' 55' 158'

● FULL DEPTH CORE
(SURFACE & SUBSURFACE)

SLF:DB

05/03/91

0144-104-B03