CENWS-OD-TS-DM

MEMORANDUM FOR: RECORD

July 7, 2004
Updated October 1, 2004

SUBJECT: DETERMINATION ON THE SUITABILITY OF PROPOSED FEDERAL OPERATIONS AND MAINTENANCE DREDGED MATERIAL FROM THE **UPPER SNOHOMISH RIVER SETTLING BASIN AND UPSTREAM NAVIGATION CHANNEL (Reference: CENWS OD-TS-NS-22)** EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT (CWA) FOR OPEN-WATER DISPOSAL AT THE PORT GARDNER NONDISPERSIVE DISPOSAL SITE AND/OR FOR BENEFICIAL USE.

1. **Introduction**. 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 approximately 800,000 cy of sediment from the upper settling basin and adjacent navigational channel over the next five dredging seasons. Approximately 200,000 cy is scheduled for dredging and beneficial use in 2005, with the remainder dredged in two or three of the following four years (alternately with dredging in the downstream basin). This federal maintenance material from the **Upper Snohomish Navigation Channel** in Everett, Washington is proposed to be disposed at the Port Gardner DMMP unconfined open-water disposal site or at an approved beneficial use site.

This determination of suitability for open-water disposal is based on the acceptability of the sampling conducted by Seattle District, Corps of Engineers contractors and subcontractors in March 2004. All relevant test data from this sampling event is contained in a report submitted by Anchor Environmental dated June 2004. These data were considered sufficient and acceptable for decision-making by the agencies.

Table 1. Project Summary.

Time of proposed dredging	October 16 – February 14, as needed, throughout the 5-year public notice period (FY 2005 – 2009)
Proposed disposal sites	Port Gardner non-dispersive disposal site, or beneficial use
Sediment ranking	Low moderate, homogenous
Project last dredged	January 2002 (170,000 cy; upland beneficial use disposal)

Table 2. Regulatory Tracking Table.

Dredging Year	2005
SAP received	February 9, 2004
SAP Approval date	March 26, 2004
Sampling date(s)	March 29 - 31, 2004
Data report submittal date	June 15, 2004
DAIS Tracking # (DY05 Project)	EVEUS-1-A-F-194
Recency Determination Date: LM Concern (5-7 years)	March 2009 – 2011

2. **Background**. As part of the federal Snohomish River navigation channel the Upper settling basin provides a wide, deep spot in the river for sediments moving downstream to settle out. In general, settling basins allow navigation maintenance dredging to be concentrated in given areas, reducing the dredging footprint while continuing to provide depths necessary for navigation. Sediments in the Upper Snohomish Settling Basin are considered "homogenous" as they are dredged regularly and accumulate predictably on a seasonal basis.

The area proposed for maintenance dredging has not been previously characterized by the DMMP, as no previously dredged material has been disposed in open water. Dredging sediments have been used regularly for upland beneficial uses by local entities. Dredging was last performed in 2002 with disposal in a contained upland beneficial use site.

3. **Sampling**. The area proposed for dredging was ranked "low-moderate" by the DMMP agencies, based on results from downstream testing and a lack of upstream contaminant sources. For low-moderate homogenous material, the DMMP requires a minimum of one field sample for each 8,000 cy and one laboratory analysis for each 40,000 cy. For the current characterization, 21 core samples were combined into 12 composites for analysis. Each analysis represented one DMMU of between 27,000 and 38,000 cy of material (Table 3). Each DMMU also met the requirement of dredging independence, such that the area represented by each sample could be dredged independently from surrounding DMMUs should they have different suitabilities for open water disposal or beneficial use.

Sampling took place on March 29 – 31, 2004 aboard the Corps vessel *Puget*. The approved SAP was followed. Twenty-four core samples were taken with a Vibracore sampler and processed on board the vessel. The sampling equipment was unable to penetrate to the full depth of the dredge prism (see Table 3), so all sample material from a given DMMU came from the upper portion of the DMMU. Material from each core was composited with other cores from a given DMMU. No Z-samples were collected for any of the samples due to core the depth of the sampling prism.

Table 3. Sampling Details, Upper Snohomish Settling Basin, DY 2005.

PARAMETER	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Sampling Depth Interval	0-4 ft	0-4 ft	4-11.5 ft	4-9.5 ft	4-11 ft	4-10.5 ft	4-10.5 ft	4-9 ft	4-10 ft	4-10 ft	4-11.5 ft	4-9.2 ft
DMMO Depth Interval (to bottom of 2' overdepth)			18	16.5	17.6	19	24.4	23.2	36.7	35.8	35.5	34.3
Volume, cubic yards	27,500	27,300	37,300	37,900	37,500	37,800	37,900	37,700	38,000	38,000	36,800	36,700

4. **Conventional and Chemical Analysis**. The Agencies' approved sampling and analysis plan was followed. Conventional (Table 4) and chemical analyses (Appendix A) were performed by Columbia Analytical Services (CAS) of Kelso, Washington. Chemical analysis results demonstrated that there were no detected or non-detected SL exceedances of any DMMP chemical of concern in any sample. All data complied with general QA/QC requirements of the DMMP (Table 5) and were acceptable as qualified by the laboratory.

Because this material has been proposed for use as capping material, it was also tested for Atterberg limits--a test used to estimate strength and settling characteristics. All material tested was found to be "non-plastic" by the Atterberg limit testing.

Table 4. Conventional Results, Upper Snohomish Settling Basin, DY 2004.

PARAMETER		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Grain Size	Gravel	1.40	1.86	0.51	0.72	0.73	1.65	2.45	8.49	6.10	0.74	0.50	1.23
	Total Sand	89.7	94.4	96.3	82.3	71.3	81.8	90.4	78.8	90.8	93.5	96.9	97.1
	Silt	3.11	1.04	2.78	11.00	21.70	11.20	4.05	7.77	1.29	2.90	0.42	0.52
	Clay	1.35	0.78	1.94	6.21	5.47	2.66	1.73	2.51	0.70	1.64	0.64	0.60
	Fines (silt + clay)	**4.46**	**1.82**	**4.72**	**17.21**	**27.17**	**13.86**	**5.78**	**10.28**	**1.99**	**4.54**	**1.06**	**1.12**
Total Organic Carbon (%)		0.45	0.28	0.61	0.99	1.30	2.71	3.00	5.39	1.22	0.98	0.27	0.25
Total solids (%)		75.4	78.3	76.4	73.6	72.3	65.3	72.2	56.6	73.4	72.4	75.8	79.2
Total volatile solids (%)		2.06	1.53	2.3	2.81	4.42	8.05	5.32	10.6	3.97	3.18	1.77	1.29
N-Ammonia (mg/kg)		11.8	2.3	5.5	25.3	36.1	66.4	14.8	46.9	2.6	2.9	2.0	1.1
Sulfide (mg/kg)		23.7	17.8	10.3	86.3	20.3	30.9	189	272	1.3	33.1	38.6	1.8

Table 5. QA/QC Warning and Action Limits (DMMP Program).

	QA Element	Warning Limits	Action Limits
Precision	Metals	None	20% RPD or COV
	Organics	35% RPD or COV	50% COV or a factor of 2 for duplicates
Matrix Spikes	Metals	None	75-125% recovery
	Organics: Volatiles Semivolatiles and Pesticides	70-150% 50-150%	None (however, zero percent recovery may be cause for data rejection)
Reference Materials	Metals	None	95% CI if specified for a particular CRM; 80-120% recovery if not.
	Organics	None	95% CI for CRMs. No action limit for uncertified RMs.
Surrogate Spikes	Volatiles	85% minimum recovery	EPA CLP chemical-specific recovery limits
	Pesticides	60% minimum recovery	
	Semi-volatiles	50% minimum recovery	

5. **Comparison to SMS Guidelines.** All results of the chemical analyses were organic carbon normalized, if necessary, and compared to Washington State Sediment Management Standards (Appendix B). As shown in Table 4, there was a wide variation in total organic carbon (TOC) content in the twelve analyzed samples. Samples with a TOC content of greater than 0.5% but less than 3.0% were carbon normalized (Appendix B, Table 1). Samples with TOC outside these ranges typically have their dry weight concentrations compared with dry weight Apparent Effects thresholds Appendix B, Table 2).

The analyses showed that levels of all detected and most undetected contaminants were below the Sediment Quality Standards (SQS) set by Washington State. One chemical (hexachlorobenzene) was not detected, but the reporting limit of the carbon-normalized value (0.46 mg/kg-OC) exceeded the SMS guidelines (0.38 mg/kg-OC) in one DMMU (C3). Though the TOC content of this DMMU exceeded 0.5%, it still had very little TOC (0.61%) and thus most likely showed this elevated non-detect for reasons related to the low TOC (see Michelson and Bragdon-Cook 1993). The DMMP agencies agreed that there is no reason to believe that this non-detected chemical is actually present at any level of concern. Thus, this analysis indicates that all sediments tested are suitable for beneficial uses under Washington State Sediment Management Standards, including use as cap material.

6. **Suitability.** This memorandum documents the suitability of proposed dredged sediments from the upper Snohomish settling basin and adjacent navigation channel for disposal at a DMMP open-water disposal site, or at an approved beneficial use site. The data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP program. Based on the results of the previously described testing, the DMMP agencies concluded that all **430,000 cy are suitable** for open water disposal. This determination of suitability does not preclude the consideration of this material for an appropriate beneficial use. It does not constitute final agency approval of the project. During the public comment period that follows a public notice, the resource agencies will provide input on the overall project. 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.

7. **References.**

Anchor Environmental 2004. Data Report: Sediment characterization results for the Upper Snohomish River settling basin and upstream navigation channel. Prepared for the Seattle District, US Army Corps of Engineers, June 2004.

Michelson, T and Bragdon-Cook, K 1993. Technical Information Memorandum: Organic Carbon Normalization of Sediment Data. Washington State Dept. of Ecology.

Concur:

11/17/04
Date

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APPENDIX A

Detected chemicals of concern compared with DMMP guidelines for the Upper Snohomish Turning Basin, DY 05.

Upper Snohomish DY04 DMMP chemistry	SL	BT	ML	Surface		Subsurface (progressing upstream)									
				1 (downstream)	2 (upstream)	3	4	5	6	7	8	9	10	11	12
Metals (mg/kg)															
Antimony	150	--	200	0.08N	0.08N	0.07N	0.12N	0.16N	0.17N	0.13N	0.15N	0.13N	0.09N	0.24N	0.10N
Arsenic	57	507.1	700	5.9	5.7	5.5	6.6	7.3	7.2	6.5	7.7	5.0	5.7	5.1	5.9
Cadmium	5.1	--	14	0.10	0.10	0.08	0.15	0.14	0.16	0.15	0.24	0.09	0.13	0.08	0.09
Chromium	--	267	--	18.3	17.2	20.4	26.9	29.0	22.3	21.1	21.9	17.8	17.9	22.5	18.0
Copper	390	--	1300	20.2	16.9	16.9	24.8	28.4	26.0	24.4	26.7	17.2	18.9	18.2	18.0
Lead	450	--	1200	4.24	3.60	3.96	6.30	8.32	6.42	4.74	5.34	3.81	3.94	3.45	3.78
Mercury	0.41	1.5	2.3	0.02	0.02J	0.02	0.04	0.05	0.04	0.02	0.04	0.03	0.02	0.01J	0.02
Nickel	140	370	370	21.5	21.1	21.3	26.5	29.1	25.1	23.4	23.5	20.5	20.6	22.1	22.0
Selenium	--	3	--			0.3J			0.3J	0.4J	0.4J		0.3J		
Silver	6.1	6.1	8.4	0.05	0.04	0.03	0.10	0.10	0.08	0.06	0.08	0.04	0.04	0.05	0.04
Zinc	410	--	3800	37.5	36.8	34.4	43.4	44.7	42.1	41.3	102	36.0	37.7	39.7	37.3
LPAHs (µg/kg-DW)															
Total LPAH	**5200**	**--**	**29000**	**15J**	**2J**	**6J**	**46J**	**55J**	**444J**	**43J**	**67J**	**18J**	**21.3J**	**16.6J**	**0**
Naphthalene	2100	--	2400	3.2J	2.3J	2.5J	9.1J	14	370	5.0J	23	4.9J	7.5J	6.2J	
Acenaphthylene	560	--	1300				6.8J	3.4J	2.3J						
Acenaphthene	500	--	2000	1.6J			4.7J	6.8J	14	4.7J	9.4J	1.7J	2.0J	1.8J	
Fluorene	540	--	3600				4.0J	6.0J	12	5.5J	8.8J	2.4J			
Phenanthrene	1500	--	21000	6.4J		1.9J	13	16	37	18	22	6.9J	7.8J	6.3J	
Anthracene	960	--	13000	3.5J		1.9J	7.9J	8.8J	8.4J	9.5J	3.4J	2.1J	4.0J	2.3J	
2-Methylnaphthalene	670	--	1900				4.8J	5.8J	7.3J	2.2J	4.2J		1.8J	2.0J	
HPAHs (µg/kg-DW)															
Total HPAH	**12000**	**--**	**69000**	**11.6J**		**17J**	**225J**	**89J**	**200J**	**42J**	**32J**	**16J**	**17J**	**25J**	**10J**
Fluoranthene	1700	4600	30000	4.8J		7.9J	33	20	33	17	13	4.6J	6.5J	7.5J	
Pyrene	2600	11980	16000	4.4J		6.2J	40	19	30	12	10	3.6J	5.5J	8.2J	
Benzo(a)anthracene	1300	--	5100				26	9.4J	25	4.2J		3.0J	2.1J	5.0J	
Chrysene	1400	--	21000	2.4J		2.4J	30	12	29	6.5J	4.6J	4.4J	2.8J	4.3J	
Benzo(b)fluoranthene	--	--	--				13	6J	17						
Benzo(k)fluoranthene	--	--	--				13		11						3.4J

Upper Snohomish DY04 DMMP chemistry	SL	BT	ML	Surface		Subsurface (progressing upstream)									
				1 (downstream)	2 (upstream)	3	4	5	6	7	8	9	10	11	12
Total Benzofluoranthenes	3200	--	9900				26	6J	28						3.4J
Benzo(a)pyrene	1600	--	3600				21	8.7J	14	2.7J	4.0J				3.2J
Indeno(1,2,3-cd)pyrene	600	--	4400				11	4.5J	6.0J						
Dibenzo(a,h)anthracene	230	--	1900				3.4J		7.4J						
Benzo(g,h,i)perylene	670	--	3200				8.5J	3.3J							
Chlorinated Hydrocarbons (µg/kg-DW)															
1,3-Dichlorobenzene	170	--	--												
1,4-Dichlorobenzene	110	--	120												
1,2-Dichlorobenzene	35	--	110												
1,2,4-Trichlorobenzene	31	--	64												
Hexachlorobenzene	22	168	230												
Phthalates (µg/kg-DW)															
Dimethylphthalate	.1400	--	--												
Diethylphthalate	1200	--	--												
Di-n-butylphthalate	5100	--	--	9.2J	6.7J	4.5J	7.3J	7.8J	8.2J	13	6.7J	7.9J	16	8.5J	15
Butylbenzylphthalate	970	--	--												3.0J
bis(2-Ethylhexyl)phthalate	8300	--	--	6.2J	3.9J	4.9J	25J	5.1J	27J	3.9J	8.1J		6.1J	5.6J	5.6J
Di-n-octylphthalate	6200	--	--												
Phenols (µg/kg-DW)															
Phenol	420	--	1200	9.3J	8.2J	10J	11J			97	18J	13J			5.5J
2-Methylphenol	63	--	77										6.8J	7.4J	
4-Methylphenol	670	--	3600	14	7.6J	8.8J	15	20	64		49	23	25	17	
2,4-Dimethylphenol	29	--	210												
Pentachlorophenol	400	504	690												
Miscellaneous (µg/kg-DW)															
Benzyl alcohol	57	--	870					5.3J	12		31		13	10	
Benzoic acid	650	--	760												
Dibenzofuran	540	--	1700				2.7J	3.2J	6.7J	3.1J	5.6J		1.8J		
Hexachloroethane	1400	--	14000												
Hexachlorobutadiene	29	--	270												
n-Nitrosodiphenylamine	28	--	130												

Upper Snohomish DY04 DMMP chemistry	SL	BT	ML	Surface		Subsurface (progressing upstream)									
				1 (downstream)	2 (upstream)	3	4	5	6	7	8	9	10	11	12
Volatiles (µg/kg-DW)															
Trichloroethene	160	--	1600												
Tetrachloroethene	57	--	210												
Ethylbenzene	10	--	50												
m,p-Xylenes	--	--	--												
o-Xylene	--	--	--												
Xylene (total)	40	--	160												
PCBs/Pesticides (µg/kg-DW)															
DDT (total)	6.9	50	69				1.3	0.99J	0.27JP	1.15JP	1.4	1.2P	0.41J		
4,4'-DDD	--	--	--				0.54JP	0.99J	0.27JP				0.41J		
4,4'-DDE	--	--	--							0.32JP					
4,4'-DDT	--	--	--				0.8J			0.83J	1.4	1.2P			
Aldrin	10	--	--									0.94J			
Dieldrin	10	--	--												
gamma-BHC (Lindane)	10	--	--												
alpha-Chlordane	10	37	--												
Heptachlor	10	--	--												
Total PCBs	130	--	3100					8.6J	9.0J						
PCBs/Pesticides (mg/kg-OC)															
alpha-BHC	--	10	--												
Total PCBs	--	38	--												

Notes:

- J: The result is an estimated concentration based on either a laboratory quality control sample exceedance, or the reported concentration is less than the method reporting limit (MRL) but greater than the MDL.
- DW: Dry weight
- OC: Organic carbon
- 2-Methylnaphthalene is not added to other LPAHs as part of the total LPAH levels.

APPENDIX B

Table 1. SMS chemicals of concern for DMMUs with TOC greater than 0.5% and less than 3.9%, compared with Washington State guidelines for the Upper Snohomish Turning Basin, DY 05.

Upper Snohomish DY04 SMS chemistry - OC normalized	units	SQS	CSL	Subsurface (progressing upstream)					
				3	4	5	6	9	10
Conventionals									
Total Organic Carbon (%)	--	--	--	0.61	0.99	1.30	2.71	1.22	0.98
Metals									
Arsenic	mg/kg	57	93	5.5	6.6	7.3	7.2	5	5.7
Cadmium	mg/kg	5.1	6.7	0.08	0.15	0.14	0.16	0.09	0.13
Chromium	mg/kg	260	270	20.4	26.9	29	22.3	17.8	17.9
Copper	mg/kg	390	390	16.9	24.8	28.4	26	17.2	18.9
Lead	mg/kg	450	530	3.96	6.3	8.32	6.42	3.81	3.94
Mercury	mg/kg	0.41	0.59	0.02	0.04	0.05	0.04	0.03	0.02
Silver	mg/kg	6.1	6.1	0.03	0.1	0.1	0.08	0.04	0.04
Zinc	mg/kg	410	960	34.4	43.4	44.7	42.1	36	37.7
PCBs									
Total PCBs	mg/kg-OC	12	65	3.27 U	2.02 U	0.66	0.33	1.63 U	2.04 U
SVOCs									
LPAH									
2-Methylnaphthalene	mg/kg-OC	38	64	1.63 U	0.48 J	0.44 J	0.26 J	0.81 U	0.18 J
Acenaphthene	mg/kg-OC	16	57	1.63 U	0.47 J	0.52 J	0.51	0.13 J	0.2 J
Acenaphthylene	mg/kg-OC	66	66	1.63 U	0.68 J	0.26 J	0.08 J	0.81 U	1.01 U
Anthracene	mg/kg-OC	220	1200	0.31 J	0.79 J	0.67 J	0.3 J	0.17 J	0.4 J
Fluorene	mg/kg-OC	23	79	1.63 U	0.4 J	0.46 J	0.44	0.19 J	1.01 U
Naphthalene	mg/kg-OC	99	170	0.4 J	0.91 J	1.07	14	0.4 J	0.76 J
Phenanthrene	mg/kg-OC	100	480	0.31 J	1.31	1.23	1.36	0.56 J	0.79 J
Total LPAH	mg/kg-OC	370	780	1.03	4.59	4.23	16	1.47	2.17
HPAH									
Benzo(a)anthracene	mg/kg-OC	110	270	1.63 U	2.62	0.72 J	0.92	0.24 J	0.21 J
Benzo(a)pyrene	mg/kg-OC	99	210	1.63 U	2.12	0.66 J	0.51	0.81 U	1.01 U
Benzo(g,h,i)perylene	mg/kg-OC	31	78	1.63 U	0.85 J	0.25 J	0.36 U	0.81 U	1.01 U
Chrysene	mg/kg-OC	110	460	0.39 J	3.03	0.92	1.07	0.36 J	0.28 J
Dibenzo(a,h)anthracene	mg/kg-OC	12	33	1.63 U	0.34 J	0.76 U	0.27 J	0.81 U	1.01 U
Fluoranthene	mg/kg-OC	160	1200	1.29 J	3.33	1.53	1.21	0.37 J	0.66 J
Indeno(1,2,3-cd)pyrene	mg/kg-OC	34	88	1.63 U	1.11	0.34 J	0.22 J	0.81 U	1.01 U

Upper Snohomish DY04 SMS chemistry - OC normalized	units	SQS	CSL	Subsurface (progressing upstream)					
				3	4	5	6	9	10
Pyrene	mg/kg-OC	1000	1400	1.01 J	4.04	1.46	1.1	0.29 J	0.56 J
Total Benzofluoranthenes (b+j+k)	mg/kg-OC	230	450	1.63 U	2.62	0.46	1.03	0.81 U	1.01 U
Total HPAH	mg/kg-OC	960	5300	2.7	20	6.37	6.36	1.27	1.72
Chlorinated Hydrocarbons									
1,2,4-Trichlorobenzene	mg/kg-OC	0.81	1.8	0.33 U	0.21 U	0.16 U	0.09 U	0.17 U	0.21 U
1,2-Dichlorobenzene	mg/kg-OC	2.3	2.3	1.63 U	1.11 U	0.76 U	0.36 U	0.81 U	1.01 U
1,4-Dichlorobenzene	mg/kg-OC	3.1	9	1.63 U	1.11 U	0.76 U	0.36 U	0.81 U	1.01 U
Hexachlorobenzene	mg/kg-OC	0.38	2.3	*0.46 U*	0.29 U	0.23 U	0.12 U	0.24 U	0.31 U
Phthalates									
bis(2-Ethylhexyl)phthalate	mg/kg-OC	47	78	0.8 J	2.52 J	0.39 J	0.99 J	16 U	0.62 J
Butylbenzylphthalate	mg/kg-OC	4.9	64	1.63 U	1.11 U	0.76 U	0.36 U	0.81 U	1.01 U
Diethylphthalate	mg/kg-OC	61	110	1.63 U	1.11 U	0.76 U	0.36 U	0.81 U	1.01 U
Dimethylphthalate	mg/kg-OC	53	53	1.63 U	1.11 U	0.76 U	0.36 U	0.81 U	1.01 U
Di-n-butylphthalate	mg/kg-OC	220	1700	0.73 J	0.73 J	0.6 J	0.3 J	0.64 J	1.63
Di-n-octylphthalate	mg/kg-OC	58	4500	1.63 U	1.11 U	0.76 U	0.36 U	0.81 U	1.01 U
Phenols									
2,4-Dimethylphenol	ug/kg	29	29	7.2 U	7.5 U	7.7 U	8.5 U	7.5 U	7.6 U
2-Methylphenol	ug/kg	63	63	10 U	11 U	9.9 U	10 U	10 U	6.8 J
4-Methylphenol	ug/kg	670	670	8.8 J	15	20	64	23	25
Pentachlorophenol	ug/kg	360	690	50 U	51 U	50 U	50 U	50 U	50 U
Phenol	ug/kg	420	1200	10 J	11 J	11 J	30 U	13 J	30 U
Miscellaneous									
Dibenzofuran	mg/kg-OC	15	58	1.63 U	0.27 J	0.24 J	0.24 J	0.81 U	0.18 J
Hexachlorobutadiene	mg/kg-OC	3.9	6.2	1.63 U	1.11 U	0.76 U	0.36 U	0.81 U	1.01 U
n-Nitrosodiphenylamine	mg/kg-OC	11	11	1.63 U	1.11 U	0.76 U	0.36 U	0.81 U	1.01 U
Benzoic acid	ug/kg	650	650	200 U	210 U	200 U	200 U	200 U	200 U
Benzyl alcohol	ug/kg	57	73	10 U	11 U	5.3 J	12	10 U	13

Notes:

- U: The compound was analyzed for, but not detected ("Non-detect") at or above the method detection limit (MDL).
- OC: Organic carbon
- Values *shaded in yellow with italic font* are non-detects that exceed SQS levels when OC normalized. See text for explanation.

Table 2. SMS chemicals of concern for DMMUs with TOC less than 0.5% and greater than 3.9%, compared with Washington State dry wt. AETs, for the Upper Snohomish Turning Basin, DY 05.

Upper Snohomish DY04 SMS comparisons for dry wt. criteria	units	SQS	CSL	Surface		Subsurface (progressing upstream)			
				1 (down-stream)	2 (up-stream)	7	8	11	12
Conventionals									
Total Organic Carbon (%)	--	15	--	0.45	0.28	3.00	5.39	0.27	0.25
Metals									
Arsenic	mg/kg	57	93	5.9	5.7	6.5	7.7	5.1	5.9
Cadmium	mg/kg	5	6.7	0.1	0.1	0.15	0.24	0.08	0.09
Chromium	mg/kg	260	270	18.3	17.2	21.1	21.9	22.5	18
Copper	mg/kg	390	390	20.2	16.9	24.4	26.7	18.2	18
Lead	mg/kg	450	530	4.24	3.6	4.74	5.34	3.45	3.78
Mercury	mg/kg	0	0.59	0.02	0.02 B	0.02	0.04	0.01 B	0.02
Silver	mg/kg	6	6.1	0.05	0.04	0.06	0.08	0.05	0.04
Zinc	mg/kg	410	960	37.5	36.8	41.3	102	39.7	37.3
PCBs									
Total PCBs	ug/kg	130		20 U	20 U	20 U	20 U	20 U	20 U
SVOCs									
LPAH									
2-Methylnaphthalene	ug/kg	670		10 U	10 U	2.2 J	4.2 J	2.0 J	10 U
Acenaphthene	ug/kg	500		1.6 J	10 U	4.7 J	9.4 J	1.8 J	10 U
Acenaphthylene	ug/kg	560		10 U	10 U	10 U	10 U	9.9 U	10 U
Anthracene	ug/kg	960		3.5 J	10 U	9.5 J	3.4 J	2.3 J	10 U
Fluorene	ug/kg	540		10 U	10 U	5.5 J	8.8 J	9.9 U	10 U
Naphthalene	ug/kg	2,100		3.2 J	2.3 J	5.0 J	23	6.2 J	10 U
Phenanthrene	ug/kg	1,500		6.4 J	10 U	18	22	6.3 J	10 U
Total LPAH	ug/kg	5,200		14.7	2.3	42.7	66.6	16.6	10 U
HPAH	ug/kg								
Benzo(a)anthracene	ug/kg	1,300		10 U	10 U	4.2 J	10 U	5.0 J	10 U
Benzo(a)pyrene	ug/kg	1,600		10 U	10 U	2.7 J	4.0 J	3.2 J	10 U
Benzo(g,h,i)perylene	ug/kg	670		10 U	10 U	10 U	10 U	9.9 U	10 U
Chrysene	ug/kg	1,400		2.4 J	10 U	6.5 J	4.6 J	4.3 J	10 U
Dibenzo(a,h)anthracene	ug/kg	230		10 UJ	10 UJ	10 UJ	10 UJ	9.9 UJ	10 UJ
Fluoranthene	ug/kg	1,700		4.8 J	10 U	17	13	7.5 J	10 U
Indeno(1,2,3-cd)pyrene	ug/kg	600		10 U	10 U	10 U	10 U	9.9 U	10 U

Upper Snohomish DY04 SMS comparisons for dry wt. criteria	units	SQS	CSL	Surface		Subsurface (progressing upstream)			
				1 (down-stream)	2 (up-stream)	7	8	11	12
Pyrene	ug/kg	2,600		4.4 J	10 U	12	10	8.2 J	10 U
Total Benzofluoranthenes (b+j+k)	ug/kg	3,200		10 U	10 U	10 U	10 U	3.4	10 U
Total HPAH	ug/kg	12,000		11.6	10 U	42.4	31.6	31.6	10 U
Chlorinated Hydrocarbons									
1,2,4-Trichlorobenzene	ug/kg	31		2.0 U	2.0 U	2.1 U	2.7 U	2.0 U	1.9 U
1,2-Dichlorobenzene	ug/kg	35		10 U	10 U	10 U	10 U	9.9 U	10 U
1,4-Dichlorobenzene	ug/kg	110		10 U	10 U	10 U	10 U	9.9 U	10 U
Hexachlorobenzene	ug/kg	22		2.8 U	2.7 U	3.0 U	3.8 U	2.8 U	2.2 U
Phthalates									
bis(2-Ethylhexyl)phthalate	ug/kg	1,300		6.2 J	3.9 J	3.9 J	8.1 J	5.6 J	5.6 J
Butylbenzylphthalate	ug/kg	63		10 U	10 U	10 U	10 U	9.9 U	3.0 J
Diethylphthalate	ug/kg	48		10 U	10 U	10 U	10 U	9.9 U	10 U
Dimethylphthalate	ug/kg	71		10 U	10 U	10 U	10 U	9.9 U	10 U
Di-n-butylphthalate	ug/kg	1,400		9.2 J	6.7 J	13	6.7 J	8.5 J	15
Di-n-octylphthalate	ug/kg	420		10 U	10 U	10 U	10 U	9.9 U	10 U
Phenols									
2,4-Dimethylphenol	ug/kg	29	29	7.3 U	7.1 U	7.7 U	9.8 U	7.3 U	7.0 U
2-Methylphenol	ug/kg	63	63	10 U	10 U	10 U	10 U	7.4 J	10 U
4-Methylphenol	ug/kg	670	670	14	7.6 J	10 U	49	17	10 U
Pentachlorophenol	ug/kg	140	690	50 U	50 U	50 U	50 U	50 U	50 U
Phenol	ug/kg	420	1,200	9.3 J	8.2 J	97	18 J	30 U	5.5 J
Miscellaneous									
Dibenzofuran	ug/kg	540		10 U	10 U	3.1J	5.6 J	9.9 U	10 U
Hexachlorobutadiene	ug/kg	11		10 U	10 U	10 U	10 U	9.9 U	10 U
n-Nitrosodiphenylamine	ug/kg	28		10 U	10 U	10 U	10 U	9.9 U	10 U
Benzoic acid	ug/kg	650	650	200 U	200 U	200 U	200 U	200 U	200 U
Benzyl alcohol	ug/kg	57	73	10 U	10 U	10 U	31	10	10 U

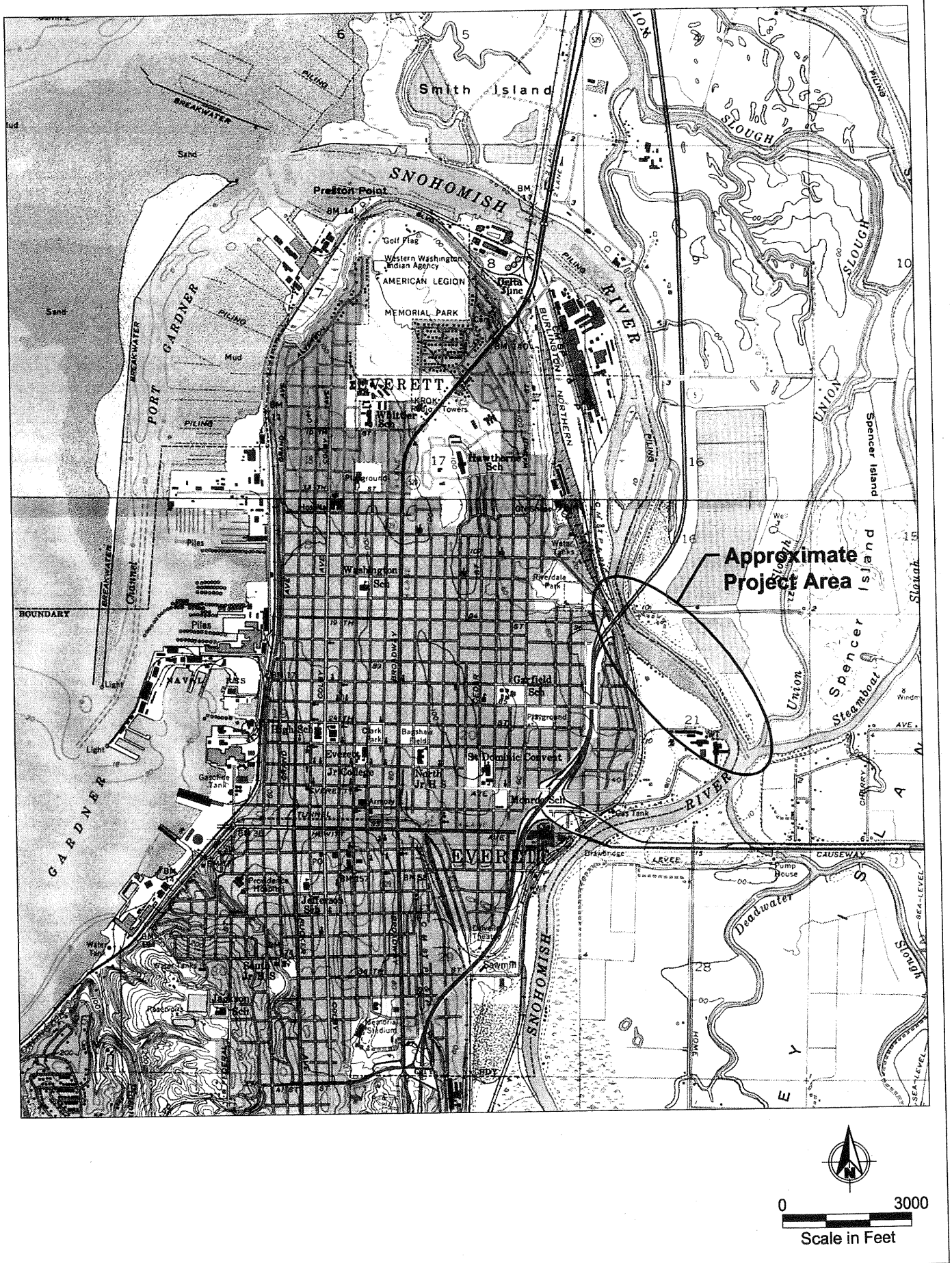

Figure 1
Vicinity Map
Upper Snohomish River Settling Basin

ANCHOR ENVIRONMENTAL, L.L.C.

Feb 04, 2004 10:18am sdekleva C:\Documents and Settings\sdekleva\Desktop\Steve's Temp CAD\020202-Seattle Corps\020202\020202-11.dwg FIG 1

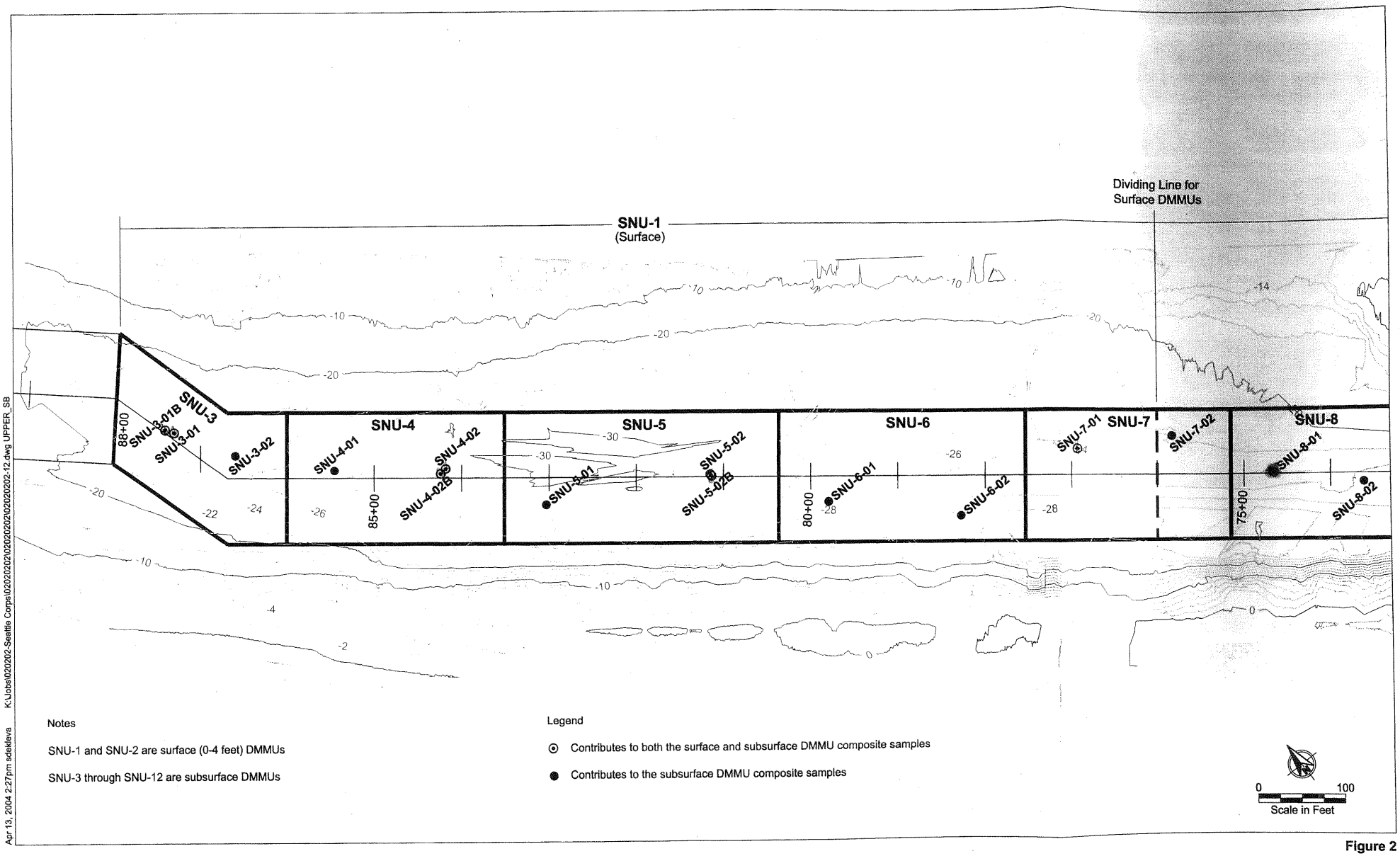

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Figure 2

DMMU Delineation and Proposed Sampling Locations in the Downstream Half of the Upper Snohomish River Settling Basin
Upper Snohomish River Settling Basin Sediment Testing

ANCHOR ENVIRONMENTAL, L.L.C.

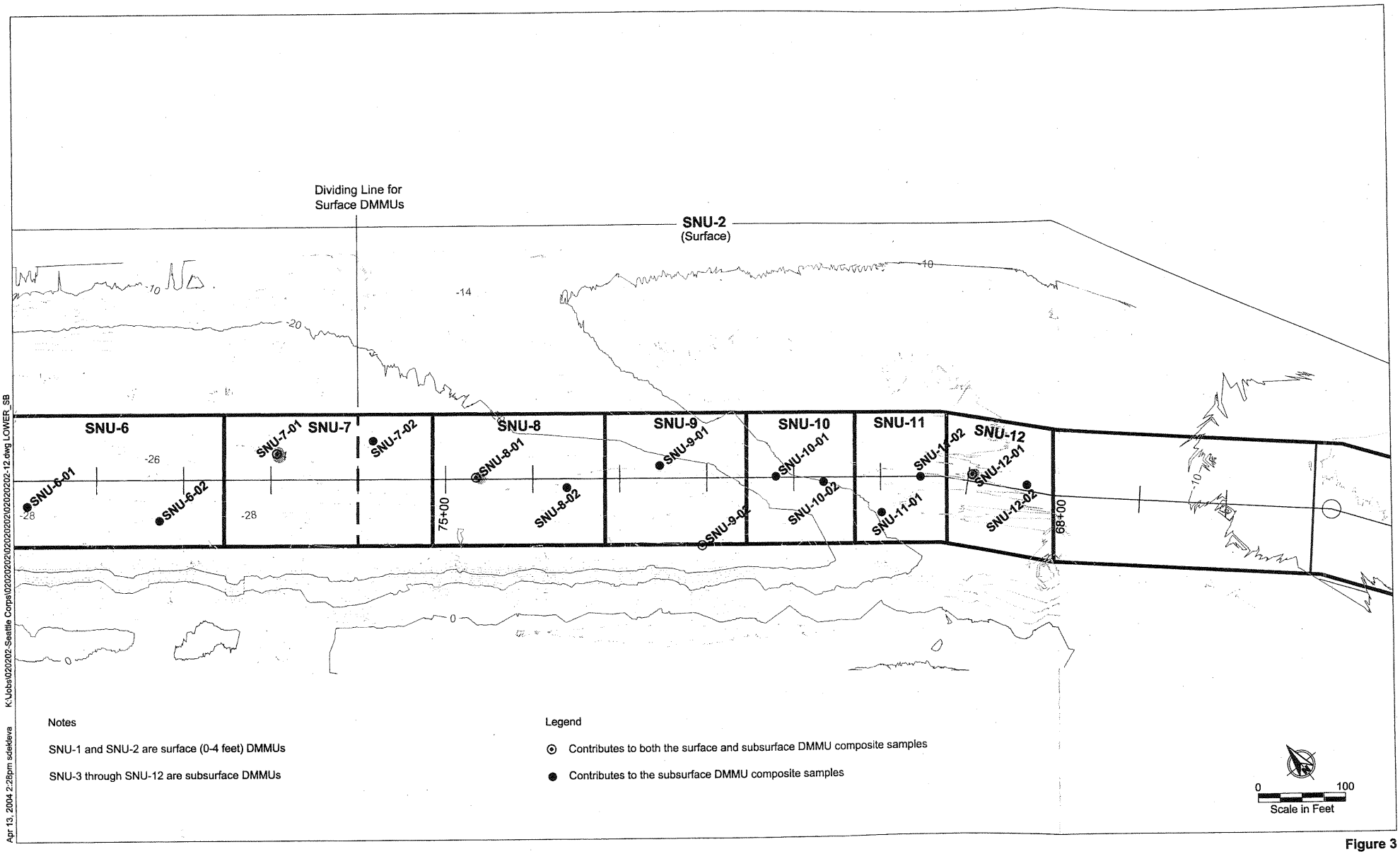

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Figure 3

DMMU Delineation and Proposed Sampling Locations in the Upstream Half of the Upper Snohomish River Settling Basin

Upper Snohomish River Settling Basin Sediment Testing

ANCHOR ENVIRONMENTAL, L.L.C.

Upper Snohomish River Settling Basin Sediment Testing

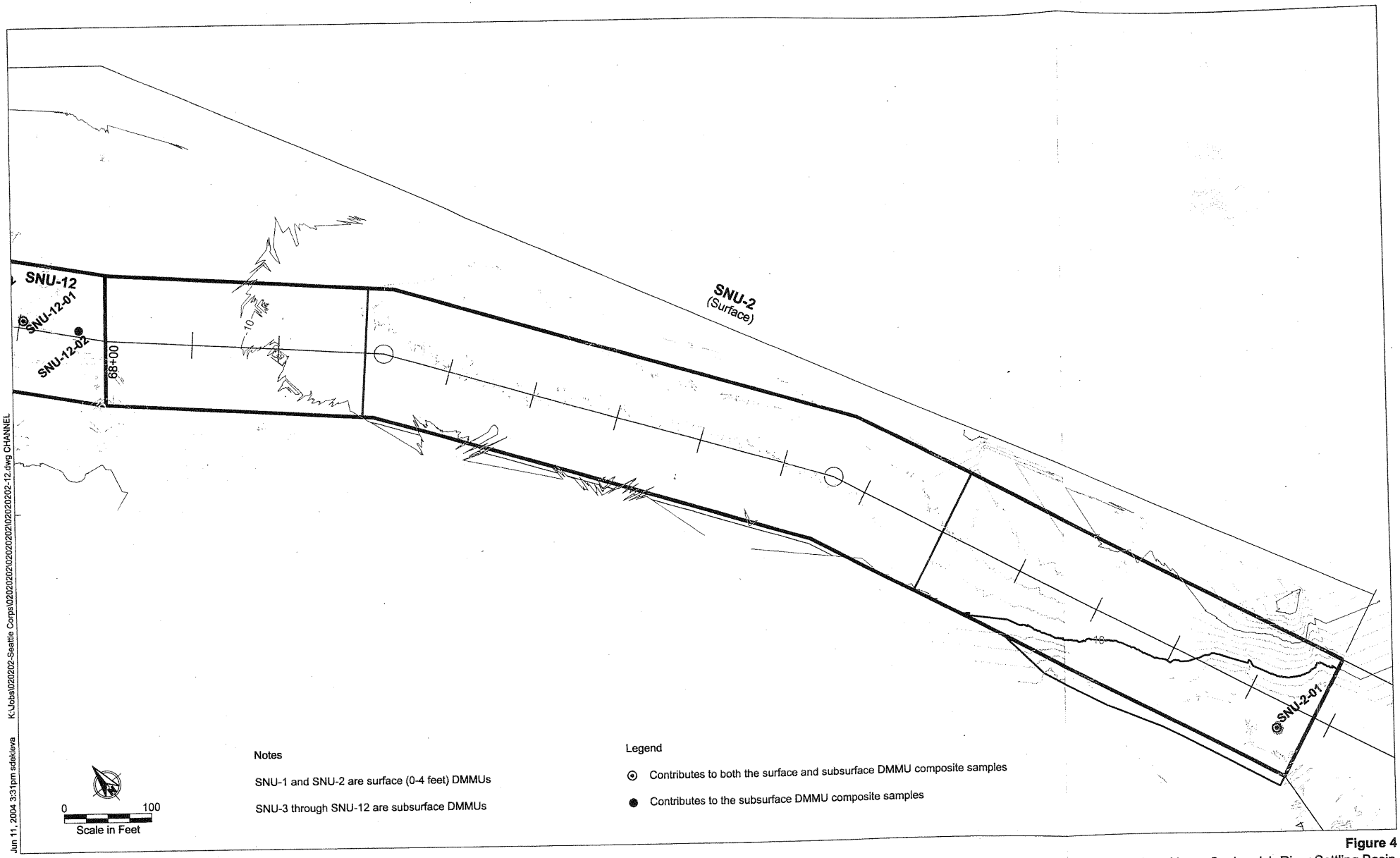

Figure 4

Actual Core Sampling Locations in the Navigation Channel Upstream of the Upper Snohomish River Settling Basin
Upper Snohomish River Settling Basin Sediment Testing

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