CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD December 9, 2014

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF PROPOSED DREDGED MATERIAL FROM THE SHELTER BAY MARINA, LACONNER, WA, EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT FOR UNCONFINED OPEN-WATER DISPOSAL AT THE ROSARIO STRAIT DISPOSAL SITE.

1. Introduction. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington State Department of Ecology, Washington State Department of Natural Resources, and the Environmental Protection Agency) regarding the suitability of up to 37,400 cubic yards (cy) of dredged material from Shelter Bay Marina for unconfined open-water disposal at the Rosario Strait dispersive site.

2. Background. Shelter Bay Marina is within Shelter Bay harbor, which consists of a single main entrance from the Swinomish Channel and three internal basins, known as the central, north and south basins (Figure 1). The marina was originally developed in 1970 and has since undergone minor improvements and expansion. Over the years, areas in the marina basins and harbor entrance have experienced sedimentation, and now require maintenance dredging to restore adequate navigation depths in the marina. Some minor maintenance dredging was conducted in the past few years around individual docks in the north basin.

   Previous sediment sampling was conducted by the Swinomish Indian Tribal Community (SITC) in 2009, north of the currently planned dredging and sampling, in the area known as the North Bay. Three grab samples (presumably shallow, although no information on sample depth was available) showed elevated polycyclic aromatic hydrocarbons (PAH) and benzoic acid concentrations, exceeding Dredged Material Management Program (DMMP) screening levels and bioaccumulation triggers.

   On February 21, 2014, a fire burned several boats and some docks at the marina. Sunken boats and all large debris has since been removed or cleaned up (HWA Geosciences, 2014a).

   Dredging of 37,400 cy of material from the main basins of the marina and the entrance channel is now proposed.

3. Project Summary. Table 1 includes project summary and tracking information.

Table 1. Project Summary

Project ranking	Moderate
Proposed dredging volume	37, 400 cubic yards (CU)
Proposed dredging depth	-9 ft MLLW (plus 1 ft of overdepth)
1st draft SAP received	April 14, 2014

Comments provided on 1st draft SAP	May 1, 2014
Final SAP received	May 28, 2014
SAP approved	May 28, 2014
Sampling dates	June 18-19, 2014
Draft data report received	September 9, 2014
Comments provided on draft report	September 29, 2014
Final data report received	November 4, 2014
EIM Study ID	SHEBA14
USACE Permit Application Number	
Recency Determination (moderate rank = 5 years)	June 2019

4. Project Ranking and Sampling Requirements. This project was ranked 'moderate' by the DMMP agencies according to the guidelines set out in the DMMP User Manual for marinas. In a moderate-ranked area the number of samples and analyses are calculated using the following guidelines (DMMP, 2013):
    - Maximum volume of sediment represented by each field sample = 4,000 cubic yards
    - Maximum volume of sediment represented by each analysis in the upper 4-feet of the dredging prism (surface sediment) = 16,000 cubic yards
    - Maximum volume of sediment represented by each analysis in the subsurface portion of the dredging prism = 24,000 cubic yards

    The project was divided into four DMMUs, with two or three sediment cores per DMMU as required by the sampling intensity outlined above. See Figure 2 for DMMU configurations and sample locations, and Table 3 for the compositing information for each DMMU.

5. Sampling. Sampling took place June 18-19th, 2014 aboard the R/V Carolyn Dow with a vibracore sampler. Table 2 provides the sample coordinates in NAD83. The target penetration depth was -12 feet MLLW, including the dredge prism with one foot of overdepth (to -10 ft MLLW) and z-sample intervals (-10 to -12 feet MLLW). The target percent recovery was 75%.

    The approved SAP was followed with the following deviations.
    - Cores were not put on ice for transport from the sampling boat to the laboratory for processing, as is standard practice. Sediment from the cores remained at ambient temperatures (maximum of 17.2°C on June 18, 2014) for up to 24 hours after collection. After processing cores the sediment samples were also not stored on ice for transport to the laboratory. Hence, the samples were received by the laboratory at 17.9 – 19.4°C, well outside the storage temperature threshold of 2-6°C.
    - Multiple coring attempts at stations 3B and 3C were necessary to achieve the required 75% recovery. Low recovery was possibly due to compaction of the loose surface sediments or to a layer of dense sediment that acted as plug, preventing material from getting pushed into the core barrel as the coring device descended into the sediment. There was no evidence that the core hit debris. The final sampling location for station 3B was located 41feet from the target location and had only 74% recovery.
    - Measured mudline elevations differed from the design bathymetry by an average of 0.4 feet, but

no adjustments to the composited core depths were made (HWA Geosciences, 2014b). As a result, the depths of the cores collected and composited into the DMMUs were up to a foot deeper than the design of the dredge prism (Table 3).

The DMMP agencies reviewed these deviations and determined that the data collected is still representative of the material to be dredged.

6. Chemical Analysis. The sediment conventional and chemistry results can be found in Table 4. The grain size data show that the material ranges from loam to silty loam to silty clay loam, with 55.6 – 95.8% fines. DMMUs 1,2, and 4 consisted of primarily silt (54 – 69%), while DMMU 3 consisted primarily of sand (44%). The total organic carbon concentration ranged from 0.9 to 1.4%. The sulfides concentrations were high, ranging from 1,910 to 4,080 mg/kg.

   All chemical and sediment conventional analytical results were subjected to EPA Stage 2B (EPA, 2009) validation and dioxin/furan results were subjected to EPA Stage IV validation by EcoChem, Inc.. Sample holding temperatures (2 to 6°C) were not met during transport of the samples from the sampling vessel to the laboratory. The laboratory received the sample coolers with temperatures outside control limits, ranging from 17.9 to 19.4°C. Therefore, during data validation, ammonia, sulfides, TOC, mercury, all SVOCs, all non-detected pesticides, and non-detected TBT results were flagged as estimated (J or UJ) concentrations. PCBs and dioxin/furans were not flagged due to the known stability of those compounds at elevated temperatures (EcoChem, 2014).

   The DMMP agencies determined that the analytical results, as qualified, were acceptable for decision-making. Chemical-specific discussions are provided in the following sections:

   Antimony

   Antimony results in all four DMMUs were flagged as undetected by the laboratory. These results were validated by EcoChem, who rejected the data for the following combination of reasons:

   - An Environmental Resource Associates (ERA) reference material was analyzed. The recovery for antimony was less than 50% of the reference value.
   - The matrix spike recovery for antimony was less than 30%. This is common when analyzing for this element in a sediment matrix. The lab did not analyze a post-digestion spike as required by the method. Antimony was not detected in any sample; results for all samples are rejected (R-8L) due to the significant low bias.

   Rejected data should not be used for any purpose. Using best professional judgement, the DMMP agencies determined that antimony did not present a concern in these sediments for the following reasons:

   - Antimony levels in recent projects from the vicinity, including the Swinomish Channel Federal navigation project and LaConner Marina, were all well below the DMMP SL. Antimony was undetected in the Swinomish Channel characterization at 6 mg/kg (UJ) in all DMMUs, and was found ranging from 1.45 – 4 mg/kg (J) in LaConner Marina (DMMP, 2009; DMMP,2014). The DMMP SL for antimony is 150 mg/kg.
   - Correcting the antimony results for the matrix spike recoveries would not cause the antimony levels to exceed the DMMP screening level. The matrix spike recovery for antimony was 12.8%. Using a worst case assumption that only 12.8% of the antimony in the sediment sample

was recovered, the corrected values would range from 55 to 70 mg/kg, still all well below the DMMP SL of 150 mg/kg.

- Antimony has never been the sole chemical exceeding DMMP SLs in any project. In the history of DMMP there have only been two projects that exceeded the SL for antimony, US Navy Pier D in Bremerton, WA and Konoike-Pacific Terminal on the Blair Waterway in Tacoma, WA. Both projects were in Dredging Year 1994, and both had multiple other chemicals exceeding SLs, including other metals, PCBs and PAHs.

Benzyl Alcohol

The chemical results indicated there were no exceedances of DMMP screening levels for the standard DMMP chemicals of concern, with the exception of benzyl alcohol. Benzyl alcohol was detected at an estimated concentration of 81 in DMMU 1, above the screening level value of 57, but below the maximum level of 870 μg/kg. Typically, detected or undetected exceedances of even one chemical would result in the requirement to conduct bioassays. However, several recent projects (DMMP, 2012; DMMP, 2014) have encountered a similar situation with benzyl alcohol being the only COC exceeding screening levels, and in those projects the DMMP agencies determined that bioassay testing was not necessary due to the presence of plant material and woody debris in the sediment samples and the lack of anthropogenic sources. Benzyl alcohol is produced naturally by the decay of many plants and is often associated in marine sediments with plant material and woody deposits. Anthropogenic sources of benzyl alcohol include pharmaceuticals, soap, perfume and flavor products.

The core logs for Shelter Bay Marina indicate that trace root material and shell fragments were found in eight of ten cores. This is similar to what was found at La Conner Marina, but the plant material was less obvious than in the samples taken from the Snohomish downstream settling basin in 2011. The sulfides concentrations in Shelter Bay Marina were similar to the sulfides concentrations found in La Conner Marina, 1,910 to 4,080 mg/kg and 1,950-3,640 mg/kg, respectively. Hydrogen sulfide is generated by the bacterial decomposition of organic material under anoxic conditions. The high sulfides concentrations at Shelter Bay Marina provide indirect evidence of the possible presence of decomposed plant material in the sediment. TOC concentrations were similar at all three projects, ranging from 0.9 - 1.4% at Shelter Bay Marina, to 0.8 - 1.1% at La Conner Marina and 0.9 - 1.2% in the Snohomish downstream settling basin.

The DMMP agencies used best professional judgment in determining that the benzyl alcohol found in Shelter Bay Marina was most likely derived from natural sources and was unlikely to be anthropogenic in nature. Therefore, the DMMP agencies determined that bioassay testing would not be required.

Dioxins/Furans

Due to the boat fire in the marina in February 2014, the DMMP agencies were concerned about the potential for dioxin/furans in the sediment near the fire. Additionally, limited dioxin/furan testing is required for all projects using dispersive disposal sites (DMMP, 2010). For these reasons the DMMP agencies agreed to a tiered dioxin/furan testing framework in which the DMMU representing the area where the fire occurred (DMMU 3) would be tested first. If dioxin/furans were found to be present above 4 pptr TEQ in this sample, then the other three DMMUs would also be analyzed. Dioxin/furan results from DMMU 3 were 1.6 pptr TEQ (with U= ½ DL), well below the DMMP site

management objective. Therefore, no additional dioxin analysis was required.

7. Sediment Exposed by Dredging. The sediment to be exposed by dredging must either meet the State of Washington Sediment Quality Standards (SQS) or the State's antidegradation standard (Ecology, 2013) as outlined by DMMP guidance (DMMP, 2008).

   Comparison of the dredged material results to SQS serves as a first tier indicator for this purpose. Table 5 shows that the only detected exceedance of SQS was for benzyl alcohol. As discussed above, the DMMP agencies have determined that benzyl alcohol is likely from a natural plant source and therefore does not present a concern for sediment quality. There were also undetected exceedances of SQS for hexachlorobenzene and 1,2,4-trichlorobenzene in all four DMMUs. However, since the exceedances were undetected and the same chemicals were less than the DMMP screening level, the DMMP agencies determined using best professional judgment that these chemical do not present a concern at these levels.

   As demonstrated by the results of the above analysis, the sediment to be exposed by dredging is not considered to be degraded relative to the currently exposed sediment surface. On this basis the DMMP agencies conclude that this project is in compliance with the State of Washington anti-degradation policy.

8. Suitability Determination. This memorandum documents the evaluation of the suitability of sediment proposed for dredging from Shelter Bay Marina for unconfined open-water disposal at the Rosario Strait dispersive disposal site. The approved sampling and analysis plan was generally followed. The data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP program.

   No debris is allowed to be disposed of at DMMP disposal sites. Due to the recent fire within the marina, there is a high likelihood that debris may be encountered in the dredged material. The dredging contractor must be prepared and able to remove any anthropogenic debris, including debris smaller than 2" x 2", from the dredged material. If significant amounts of debris are encountered, dredged material may be required to by screened using a 2" x 2" steel mesh grid.

   In summary, based on the results of the previously described testing, the DMMP agencies conclude that all 37,400 cy of dredged material from Shelter Bay Marina are suitable for unconfined open-water disposal at the Rosario Strait dispersive site.

   This suitability determination 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.

   A pre-dredge meeting with DNR, Ecology and the Corps of Engineers is required at least 7 days prior to dredging. A dredging quality control plan must be developed and submitted to the Regulatory Branch of the Seattle District Corps of Engineers at least 7 days prior to the pre-dredge meeting. A DNR site use authorization must also be acquired.

9. References.

DMMP, 2014. *Determination Regarding the Suitability of Proposed Dredged Material from La Conner Marina for Unconfined Open-Water Disposal at the Port Gardner Non-Dispersive Site.* Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program. October 20, 2014.

DMMP, 2013. *Dredged Material Evaluation and Disposal Procedures (Users Manual)*. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program, July 2013.

DMMP, 2012. *DMMP Suitability Determination for the Proposed Maintenance Dredged Material from the Snohomish River, Everett, Snohomish County, for Unconfined Open-Water Disposal at the Port Gardner nondispersive Site or at an Approved Beneficial Use or Upland Site.* Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program. January 30, 2012

DMMP, 2011. *Marine Sediment Quality Screening Levels: Adopting RSET Marine SLs for Use in DMMP.* A Clarification Paper prepared by Laura Inouye (Ecology) and David Fox (USACE) for the Dredged Material Management Program, June 2011.

DMMP, 2010. *Dredged Material Management Program New Interim Guidelines for Dioxins*. December 6, 2010.

DMMP, 2009. *Determination on the Suitability of Proposed Dredged Material Tested for the Federal Swinomish Channel Navigation Dredging Project Evaluated Under Section 404 of the Clean Water Act for Either Open-Water Disposal at the Rosario Strait Dispersive Disposal Site, or an Appropriate Beneficial Use Site.* Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program. December 11, 2009.

DMMP, 2008. *Quality of Post-Dredge Sediment Surfaces (Updated).* A Clarification Paper Prepared by David Fox (USACE), Erika Hoffman (EPA) and Tom Gries (Ecology) for the Dredged Material Management Program, June 2008.

EcoChem, 2014. *Data Validation Report, Shelter Bay Marina Maintenance Dredging*. Prepared for HWA Geosciences Inc. August 29, 2014.

Ecology, 2013. *Sediment Management Standards – Chapter 173-204 WAC*. Washington State Department of Ecology, February 2013.

HWA Geosciences, 2014a. Sampling and Analysis Plan Shelter Bay Marina Maintenance Dredging, Laconner, Washington. Prepared for Shelter Bay Company. May 28, 2014.

HWA Geosciences, 2014b. Sediment Sampling and Analysis Report Shelter Bay Marina Maintenance Dredging, Laconner, Washington. Prepared for Shelter Bay Company. October 13, 2014

10. Agency Signatures.

The signed document is on file in the Dredged Material Management Office.

Concur:

_____	_____
Date	Kelsey van der Elst - Seattle District Corps of Engineers
_____	_____
Date	Justine Barton - Environmental Protection Agency
_____	_____
Date	Laura Inouye, Ph.D. - Washington Department of Ecology
_____	_____
Date	Celia Barton - Washington Department of Natural Resources

Copies furnished:

DMMP signatories
Arnie Sugar, HWA Geosciences
Erin Legge, Corps Regulatory PM
David Franklin, Shelter Bay Co.

Table 2. Sample Coordinates

		Latitude	Longitude
Station	S-1A	48.382067	-122.509661
	S-1B	48.38225	-122.50829
	S-2A	48.382247	-122.510431
	S-2B	48.381621	-122.510643
	S-2C	48.381668	-122.509931
	S-3A	48.381305	-122.510206
	S-3B	48.381189	-122.509669
	S-3C	48.380658	-122.509961
	S-4A	48.381668	-122.512747
	S-4B	48.381838	-122.51163

Table 3. DMMU Volumes and Compositing Information.

		DMMU 1	DMMU 2	DMMU 3	DMMU 4	Total
SAP volume (CY):		6,700	11,700	10,800	8,200	37,400
Station	S-1A	-8.25 to -10.25	---	---	---	
	S-1B	-7.6 to -10.6	---	---	---	
	S-2A		-5.5 to -10.5			
	S-2B		-6.1 to -10.6			
	S-2C		-7.6 to -10.6			
	S-3A			-8 to -11		
	S-3B	---	---	-7.1 to 11.1	---	
	S-3C	---	---	-7 to -10.5	---	
	S-4A	---	---	---	-8.7 to -10.7	
	S-4B	---	---	---	-8.2 to -10.2	

Notes:

1) The design depth is -10 ft MLLW, including one foot of overdepth

Table 4. Chemical results compared to DMMP regulatory guidelines.

CHEMICAL	DMMP Guidelines			DMMU 1		DMMU 2		DMMU 3		DMMU 4	
	SL	BT	ML								
CONVENTIONALS				conc	LQ	conc	LQ	conc	LQ	conc	LQ
Gravel, %				0		0.1		0.5		0	
Sand, %				19.9		9.1		43.9		4.2	
Silt, %				54		69		34.2		58.5	
Clay, %				26.1		21.8		21.4		37.3	
Fines (Silt + Clay), %				80.1		90.8		55.6		95.8	
Total Solids, %				62.9		53.5		59.6		46.9	
Volatile Soilids, %				4		5.2		3.3		5.1	
Total Organic Carbon, %				0.937	J	1.02	J	1.14	J	1.4	J
Total Sulfides, mg/kg				25.8	J	44.6	J	29.9	J	37	J
Total Ammonia, mg N/kg				2180	J	1910	J	2620	J	4080	J
METALS (mg/kg dry)											
Antimony	150	---	200	8	R	9	R	7	R	9	R
Arsenic	57	507	700	10		15		9		15	
Cadmium	5.1	11.3	14.0	0.6		0.8		0.5		0.7	
Chromium	260	260	---	61.4		86.6		54.2		75.2	
Copper	390	1,027	1,300	46.5		63.5		38.1		60.1	
Lead	450	975	1,200	8		12		7		10	
Mercury	0.41	1.5	2.3	0.07	J	0.11	J	0.06	J	0.11	J
Selenium	---	3	---	0.7	U	0.9	U	0.7	U	0.8	U
Silver	6.1	6.1	8.4	0.5	U	0.5	U	0.4	U	0.5	U
Zinc	410	2,783	3,800	84		109		70		98	
ORGANOMETALLIC COMPOUNDS (ug/L interstitial water)											
Tributyltin (ion)	0.15	0.15	---	0.005	UJ	0.005	UJ	0.005	UJ	0.005	UJ
PAHs (ug/kg dry)											
Total LPAH	5,200	---	29,000	19	UJ	32.8	J	73	J	22	J
Naphthalene	2,100	---	2,400	19	UJ	20	UJ	14	J	20	UJ
Acenaphthylene	560	---	1,300	19	UJ	20	UJ	20	UJ	20	UJ
Acenaphthene	500	---	2,000	19	UJ	20	UJ	20	UJ	20	UJ
Fluorene	540	---	3,600	19	UJ	9.8	J	13	J	20	UJ
Phenanthrene	1,500	---	21,000	19	UJ	23	J	34	J	22	J
Anthracene	960	---	13,000	19	UJ	20	UJ	12	J	20	UJ
2-Methylnaphthalene	670	---	1,900	19	UJ	20	UJ	12	J	20	UJ
Total HPAH	12,000	---	69,000	160	J	283	J	291	J	312	J
Fluoranthene	1,700	4,600	30,000	64	J	81	J	83	J	92	J
Pyrene	2,600	11,980	16,000	42	J	91	J	94	J	83	J
Benzo(a)anthracene	1,300	---	5,100	12	J	17	J	17	J	18	J
Chrysene	1,400	---	21,000	22	J	27	J	36	J	45	J
Total benzofluoranthenes	3,200	---	9,900	20	J	56	J	48	J	58	J
Benzo[a]pyrene	1,600	---	3,600	19	UJ	11	J	13	J	16	J
Indeno(1,2,3-c,d)pyrene	600	---	4,400	19	UJ	20	UJ	20	UJ	20	UJ
Dibenzo(a,h)anthracene	230	---	1,900	19	UJ	20	UJ	20	UJ	20	UJ
Benzo(g,h,i)perylene	670	---	3,200	19	UJ	20	UJ	20	UJ	20	UJ
CHLORINATED BENZENES (ug/kg dry)											
1,2-Dichlorobenzene	35	---	110	19	UJ	20	UJ	20	UJ	20	UJ
1,4-Dichlorobenzene	110	---	120	19	UJ	20	UJ	20	UJ	20	UJ
1,2,4-Trichlorobenzene	31	---	64	19	UJ	20	UJ	20	UJ	20	UJ
Hexachlorobenzene	22	168	230	19	UJ	20	UJ	20	UJ	20	UJ

CHEMICAL	SL	BT	ML	DMMU 1		DMMU 2		DMMU 3		DMMU 4	
PHTHALATE ESTERS (ug/kg dry)											
Dimethyl phthalate	71	---	1,400	19	U	19	U	19	U	20	U
Diethyl phthalate	200	---	1,200	19	U	20	U	20	U	20	U
Di-n-butyl phthalate	1,400	---	5,100	19	U	20	U	20	U	20	U
Butyl benzyl phthalate	63	---	970	19	U	20	U	20	U	20	U
Bis(2-ethylhexyl)phthalate	1,300	---	8,300	48	U	49	U	49	U	50	U
Di-n-octyl phthalate	6,200	---	6,200	19	U	20	U	20	U	20	U
PHENOLS (ug/kg dry)											
Phenol	420	---	1,200	79	J	96	U	31	J	50	J
2 Methylphenol	63	---	77	19	UJ	20	UJ	20	UJ	20	UJ
4 Methylphenol	670	---	3,600	23	J	17	U	20	UJ	19	J
2,4-Dimethylphenol	29	---	210	24	UJ	25	UJ	25	UJ	25	UJ
Pentachlorophenol	400	504	690	97	UJ	98	UJ	99	UJ	100	UJ
MISCELLANEOUS EXTRACTABLES (ug/kg dry)											
Benzoic acid	650	---	760	240	J	65	J	200	UJ	200	UJ
Benzyl alcohol	57	---	870	81	J	39	J	19	J	30	J
Dibenzofuran	540	---	1,700	19	UJ	20	UJ	20	UJ	20	UJ
Hexachlorobutadiene	11	---	270	0.97	UJ	0.97	UJ	0.96	UJ	0.97	UJ
Hexachloroethane	---	---	---								
N-Nitrosodiphenylamine	28	---	130	19	UJ	20	UJ	20	UJ	20	UJ
PESTICIDES (ug/kg dry)											
Aldrin	10	---	---	0.49	UJ	1.4	UJ	0.87	UJ	0.69	UJ
Total Chlordane	3	37	---	0.97	UJ	0.97	UJ	0.96	UJ	2.5	J
Dieldrin	2	---	---	0.97	UJ	0.97	UJ	0.96	UJ	0.97	UJ
Heptachlor	2	---	---	0.49	UJ	0.48	UJ	0.48	UJ	0.48	UJ
p,p'-DDE	9	---	---	0.97	UJ	0.97	UJ	0.96	UJ	0.97	UJ
p,p'-DDD	16	---	---	0.97	UJ	0.97	UJ	0.96	UJ	0.97	UJ
p,p'-DDT	5	---	---	0.97	UJ	0.97	UJ	0.96	UJ	0.97	UJ
Total DDT		50	69	0.97	UJ	0.97	UJ	0.96	UJ	0.97	UJ
PCBs (ug/kg dry)											
Total PCBs	130	---	3,100	18	U	23	U	9.9	U	15	U
Total PCBs (mg/kg OC)	---	38	---	1.92	U	2.25	U	0.87	U	1.07	U
SUMMARY											
DMMP determination				pass		pass		pass		pass	
DMMU volume											
Rank				modearte		modearte		modearte		modearte	
Mean sample depth				1.25		1.92		2.1		1	
Maximum sampling depth				3		5		5.5		2	
	SL	BT	ML	DMMU 1		DMMU 2		DMMU 3		DMMU 4	

J = estimated concentration
U = undetected
OC = organic carbon
SL = screening level
BT = bioaccumulation trigger
ML = maximum level
above SL

Table 5. Dioxin Results and TEQ calculation

CHEMICAL	TEF	DMMU 3			
DIOXINS/FURANS		conc	VQ	TEQ (U = 0)	TEQ (U = 1/2 RL)
2,3,7,8-TCDD	1	0.127	U	0	0.0635
1,2,3,7,8-PeCDD	1	0.238	U	0	0.119
1,2,3,4,7,8-HxCDD	0.1	0.944	U	0	0.0472
1,2,3,6,7,8-HxCDD	0.1	2.62		0.262	0.262
1,2,3,7,8,9-HxCDD	0.1	1.72	U	0	0.086
1,2,3,4,6,7,8-HpCDD	0.01	45.9		0.459	0.459
OCDD	0.0003	325		0.0975	0.0975
2,3,7,8-TCDF	0.1	0.546		0.0546	0.0546
1,2,3,7,8-PeCDF	0.03	0.768	U	0	0.01152
2,3,4,7,8-PeCDF	0.3	0.484		0.1452	0.1452
1,2,3,4,7,8-HxCDF	0.1	0.669		0.0669	0.0669
1,2,3,6,7,8-HxCDF	0.1	0.498		0.0498	0.0498
1,2,3,7,8,9-HxCDF	0.1	0.569		0.0569	0.0569
2,3,4,6,7,8-HxCDF	0.1	0.153		0.0153	0.0153
1,2,3,4,6,7,8-HpCDF	0.01	5.98		0.0598	0.0598
1,2,3,4,7,8,9-HpCDF	0.01	0.226	U	0	0.00113
OCDF	0.0003	15.7		0.00471	0.00471
TOTAL TEQ				1.272	1.600

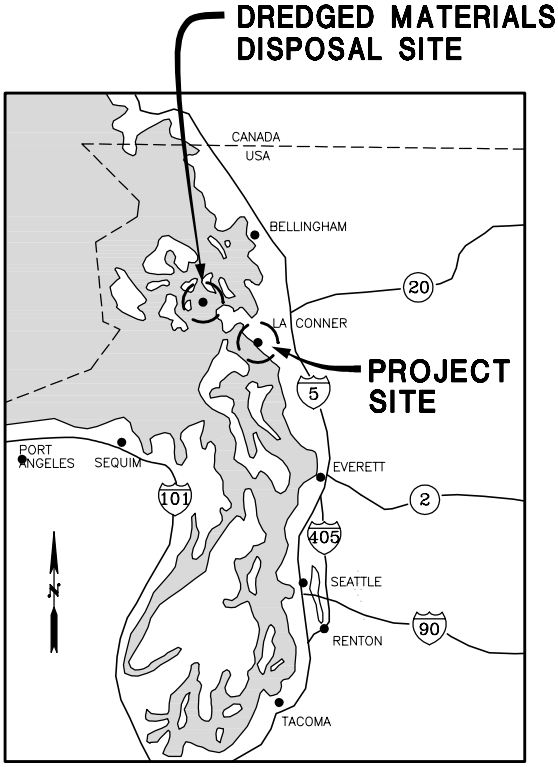
Table 6. Chemical results compared to marine SMS regulatory guidelines.

CHEMICAL	Marine SMS Guidelines		DMMU 1		DMMU 2		DMMU 3		DMMU 4	
	SQS	CSL	conc	LQ	conc	LQ	conc	LQ	conc	LQ
Total Organic Carbon, %			0.937	J	1.02	J	1.14	J	1.4	J
METALS (mg/kg dry)										
Arsenic	57	93	10		15		9		15	
Cadmium	5.1	6.7	0.6		0.8		0.5		0.7	
Chromium	260	270	61.4		86.6		54.2		75.2	
Copper	390	390	46.5		63.5		38.1		60.1	
Lead	450	530	8		12		7		10	
Mercury	0.41	0.59	0.07	J	0.11	J	0.06	J	0.11	J
Silver	6.1	6.1	0.5	U	0.5	U	0.4	U	0.5	U
Zinc	410	960	84		109		70		98	
PAHs (mg/kg OC)										
Total LPAH	370	780	2.03	UJ	3.22	J	6.40	J	1.57	J
Naphthalene	99	170	2.03	UJ	1.96	UJ	1.23	J	1.43	UJ
Acenaphthylene	66	66	2.03	UJ	1.96	UJ	1.75	UJ	1.43	UJ
Acenaphthene	16	57	2.03	UJ	1.96	UJ	1.75	UJ	1.43	UJ
Fluorene	23	79	2.03	UJ	0.96	J	1.14	J	1.43	UJ
Phenanthrene	100	480	2.03	UJ	2.25	J	2.98	J	1.57	J
Anthracene	220	1200	2.03	UJ	1.96	UJ	1.05	J	1.43	UJ
2-Methylnaphthalene	38	64	2.03	UJ	1.96	UJ	1.05	J	1.43	UJ
Total HPAH	960	5300	17.08	J	27.75	J	25.53	J	22.29	J
Fluoranthene	160	1200	6.83	J	7.94	J	7.28	J	6.57	J
Pyrene	1000	1400	4.48	J	8.92	J	8.25	J	5.93	J
Benzo(a)anthracene	110	270	1.28	J	1.67	J	1.49	J	1.29	J
Chrysene	110	460	2.35	J	2.65	J	3.16	J	3.21	J
Benzofluoranthenes	230	450	2.13	J	5.49	J	4.21	J	4.14	J
Benzo(a)pyrene	99	210	2.03	UJ	1.08	J	1.14	J	1.14	J
Indeno(1,2,3-c,d)pyrene	34	88	2.03	UJ	1.96	UJ	1.75	UJ	1.43	UJ
Dibenzo(a,h)anthracene	12	33	2.03	UJ	1.96	UJ	1.75	UJ	1.43	UJ
Benzo(g,h,i)perylene	34	88	2.03	UJ	1.96	UJ	1.75	UJ	1.43	UJ
CHLORINATED BENZENES (mg/kg OC)										
1,2-Dichlorobenzene	2.3	2.3	2.03	UJ	1.96	UJ	1.75	UJ	1.43	UJ
1,4-Dichlorobenzene	3.1	9	2.03	UJ	1.96	UJ	1.75	UJ	1.43	UJ
1,2,4-Trichlorobenzene	0.81	1.8	2.03	UJ	1.96	UJ	1.75	UJ	1.43	UJ
Hexachlorobenzene	0.38	2.3	2.03	UJ	1.96	UJ	1.75	UJ	1.43	UJ
PHTHALATE ESTERS (mg/kg OC)										
Dimethyl phthalate	53	53	2.03	U	1.86	U	1.67	U	1.43	U
Diethyl phthalate	61	110	2.03	U	1.96	U	1.75	U	1.43	U
Di-n-butyl phthalate	220	1700	2.03	U	1.96	U	1.75	U	1.43	U
Butyl benzyl phthalate	4.9	64	2.03	U	1.96	U	1.75	U	1.43	U
Bis(2-ethylhexyl)phthalate	47	78	5.12	U	4.80	U	4.30	U	3.57	U
Di-n-octyl phthalate	58	4500	2.03	U	1.96	U	1.75	U	1.43	U

	Marine SMS Guidelines		DMMU 1		DMMU 2		DMMU 3		DMMU 4	
PHENOLS (ug/kg dry)										
Phenol	420	1200	79	J	96	U	31	J	50	J
2 Methylphenol	63	63	19	UJ	20	UJ	20	UJ	20	UJ
4 Methylphenol	670	670	23	J	17	U	20	UJ	19	J
2,4-Dimethylphenol	29	29	24	UJ	25	UJ	25	UJ	25	UJ
Pentachlorophenol	360	690	97	UJ	98	UJ	99	UJ	100	UJ
MISCELLANEOUS EXTRACTABLES (mg/kg OC)										
Dibenzofuran	15	58	2.03	J	1.96	J	1.75	UJ	1.43	UJ
Hexachlorobutadiene	3.9	6.2	0.10	J	0.10	J	0.08	J	0.07	J
N-Nitrosodiphenylamine	11	11	2.03	UJ	1.96	UJ	1.75	UJ	1.43	UJ
PCBs (mg/kg OC)										
Total PCBs (mg/kg carbon)	12	65	1.92	U	2.25	U	0.87	U	1.07	U
MISCELLANEOUS EXTRACTABLES (ug/kg dry)										
Benzyl alcohol	57	73	81	J	39	J	19	J	30	J
Benzoic acid	650	650	240	J	65	J	200	UJ	200	UJ

U = undetected
QL = laboratory qualifier
OC = organic carbon
SMS = Sediment Management Standards
SQS = sediment quality standard
CSL = cleanup screening level
above SQS

SHELTER BAY MAINTENANCE DREDGING

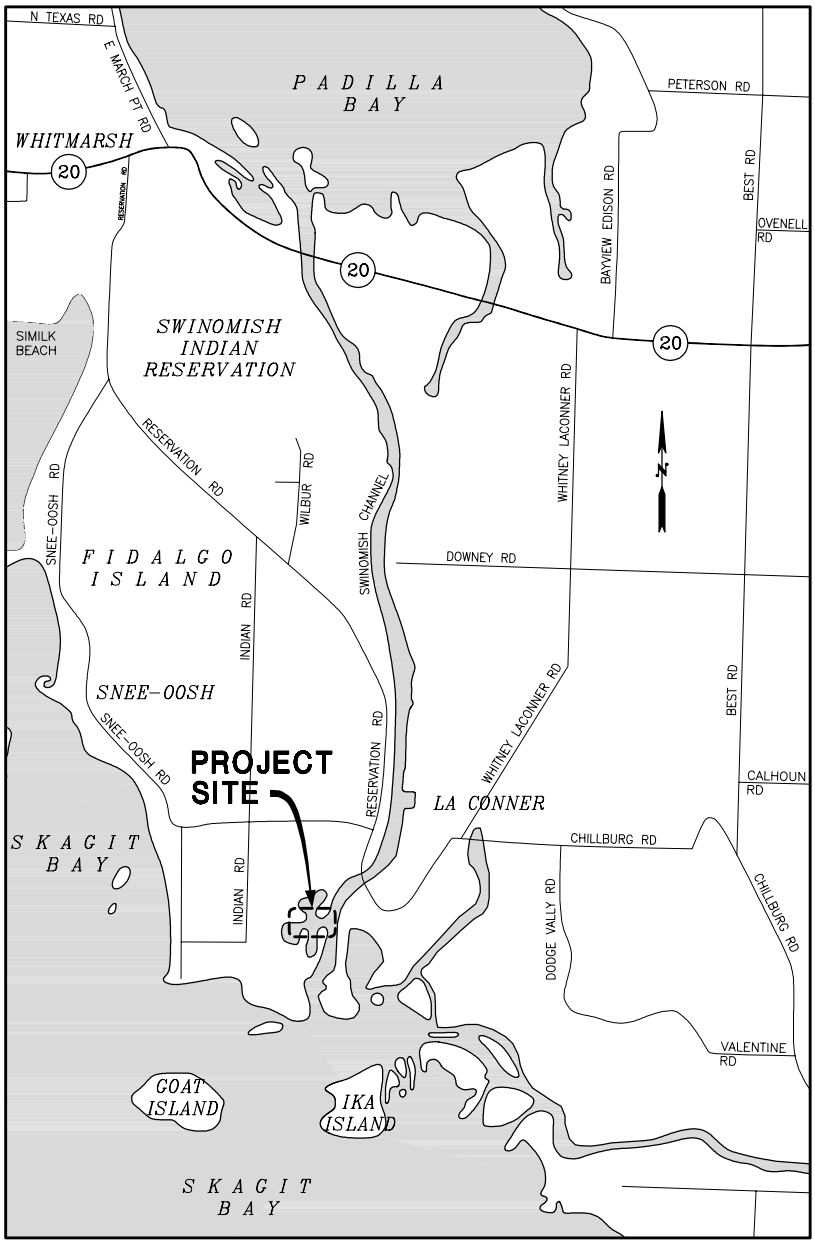


VICINITY MAP
NOT TO SCALE

OWNER
SHELTER BAY COMPANY
ADDRESS: 1000 SHOSHONE DRIVE
LA CONNER, WA 98257
CONTACT: DEBBIE BYRD
PHONE: 360-466-3805

PROJECT SITE ADDRESS
SHELTER BAY MARINA
SWINOMISH DRIVE, LA CONNER, WA
NORTHWEST QUARTER OF SECTION 1, TOWNSHIP 33 NORTH, RANGE 2 EAST, W. M.
LATITUDE: 48° 23' 03"
LONGITUDE: 122° 30' 37"

DREDGED MATERIALS DISPOSAL SITE
ROSARIO STRAIT
LATITUDE: 48° 30.87'
LONGITUDE: 122° 43.56'



LOCATION MAP
NOT TO SCALE

PURPOSE: MAINTENANCE DREDGING OF EXISTING MARINA

DATUM: MLLW 0.0'

SHELTER BAY MAINTENANCE DREDGING

VICINITY AND LOCATION MAPS

NAME: SHELTER BAY COMPANY
ADDRESS: 1000 SHOSHONE DRIVE
LA CONNER, WA 98257

Reid Middleton
728 134th Street SW · Suite 200
Everett, Washington 98204
Ph: 425 741-3800

IN: SHELTER BAY
AT: SHELTER BAY MARINA
COUNTY OF: SKAGIT
APPLICATION BY: SHELTER BAY COMPANY

FIGURE 1

DATE: AUGUST 2013

3C - ACTUAL SAMPLING LOCATION

3CS - PLANNED LOCATION PER SAP

BASE MAP PROVIDED BY: CIVIL 3D MAPS

HWA GEOSCIENCES INC.

15

SHELTER BAY MAINTENANCE DREDGING

SITE AND EXPLORATION PLAN

DRAWN BY	EFK
CHECK BY	AS
DATE:	10.13.14

Figure 2

PROJECT # 2014-002 TASK 0100

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