

Project Title

***2003 NPDES monitoring report
for the Washington State Department of Fish and Wildlife
South Sound Salmon Net-pen Complex located on Peale Passage
NPDES Permit Number (WA 004087-8)***

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Appendices – All appendices are included on the attached CD.

1. SGS and TOC data encoded on DOE SEDQUAL Templates.
2. Results of the analysis of Sediment Grain Size
3. Results of the analysis of Total Organic Carbon

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Introduction. The National Pollutant Discharge Elimination System Waste Discharge Permit issued to this facility (WA 004087-8) required the Permittee to collect three replicate Petite Ponar, van Veen grab, box corer, or diver corer samples at those stations defined in Figure (1) during 2002. The top two centimeters of each sample were analyzed for sediment grain size (SGS), copper, zinc and total organic carbon (TOC). No exceedance of Washington State's Sediment Quality Criteria were observed for copper or zinc. Sediment percent fines (silt and clay with particle sizes $\leq 63 \mu\text{m}$) at all South Sound 100' SIZ stations fell within a range of 86.3 to 90.2 % with a corresponding TOC Trigger (Table 1) of 2.6%. The offshore Northeast and Southwest 100' SIZ stations significantly exceeded this trigger in 2002 using a one tailed *t*-test (with $\alpha = 0.05$) and required re-evaluation in 2003. Brooks (2003), approved by the Department of Ecology, provided a Sediment Sampling and Analysis Plan for conducting this work.

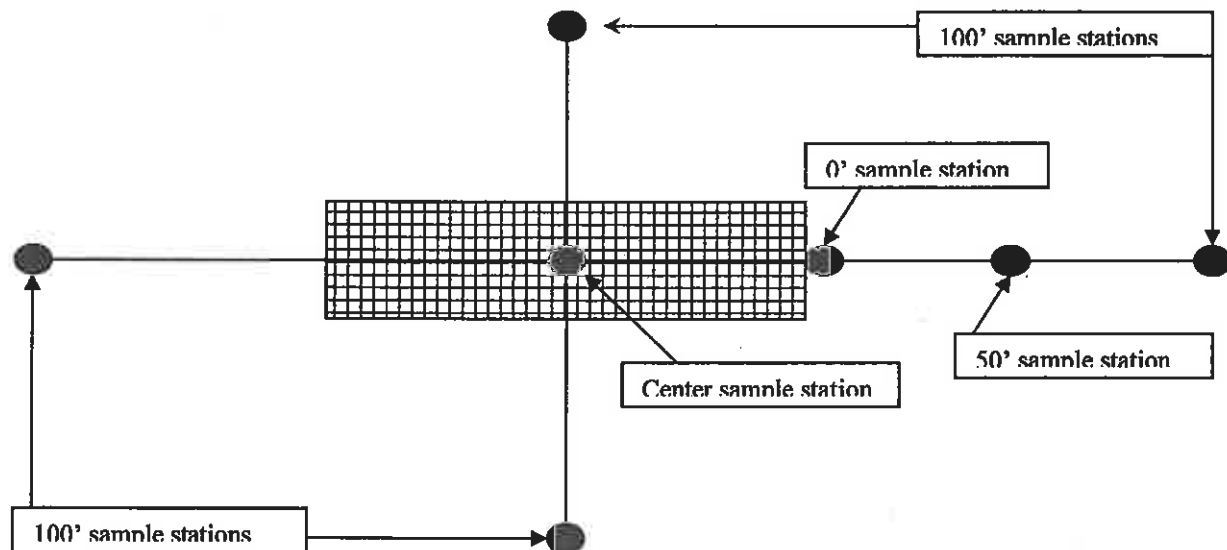


Figure 1. Sediment sampling stations defined in NPDES permit for Washington State marine netpen facilities.

Table 1. Total organic carbon triggers. The trigger values are keyed to the percent silt and clay ($\leq 63 \mu\text{m}$ diameter) observed in dry sediment samples.

Percent (dry weight) silt and clay	Percent (dry weight) total organic carbon
0 – 20	0.5
20 – 50	1.7
50 – 80	3.2
80 – 100	2.6

The Middle Complex, subject of this permit (Figure 3) is made up of 22 pens that are 20 x 40 feet in size and five pens measuring 40 x 40 feet. Minimum depth at the site is 17.5' MLLW

and the maximum depth is 18' MLLW. The minimum distance between the bottom of the net-pens and the sea floor is 4.5'. Dominant currents are north to south with an average speed estimated at 6 to 7 cm/sec. Maximum current speed is approximately 21.5 cm/sec-measured midway between the bottom of the net-pen and the sea floor. Coho salmon are introduced in January of each year at 25 fish per pound (72,000 pounds aggregate weight) and released in May or June at a target release size of 10 fish per pound (1,800,000 fish with an aggregate weight of 180,000 pounds). Net production on this site is 108,000 pounds during the six-month holding time. Containment nets are removed when fish are not present.

Figure (2) depicts the location of the South Sound Complex, which is at 47° 12.038' N latitude and 122° 54.263' W longitude in approximately 18' (MLLW) of water. The location of the reference station used in this evaluation is also provided. The layout of the net-pen complex, locations of the stations requiring examination, and the prevailing currents at this site are provided in Figure 3.

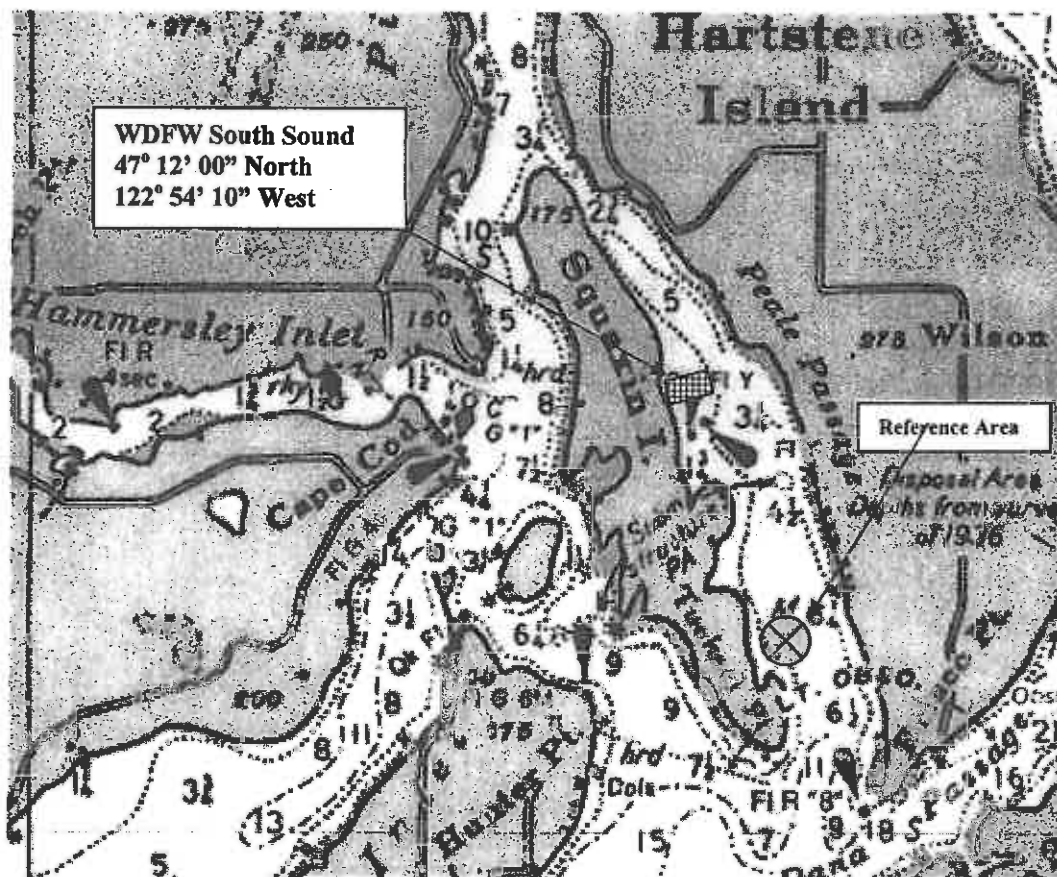


Figure 2. Location and orientation of the WDFW South Sound Netpen Complex in Peale Passage adjacent to Squaxin Island. The reference location is also identified.

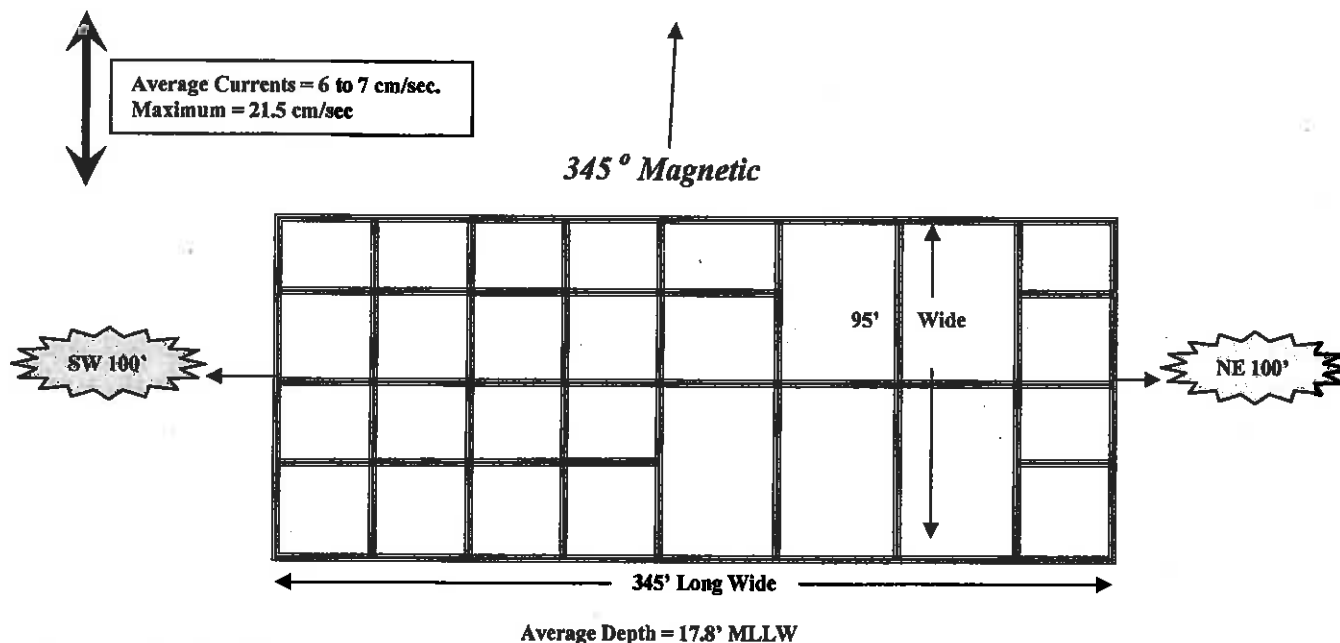


Figure 3. Configuration of the Washington Department of Fish and Wildlife South Sound Middle Complex in 2003. The Northwest and Southwest 100' stations, requiring examination in 2003, are marked.

Materials and methods. The Puget Sound Estuary Protocols (1996) and the NPDES Permit define protocols for this monitoring. No significant deviations were made from those protocols. Suitable grab samples met the requirements of the Puget Sound Protocols (PSEP 1996). The top two centimeters of each sample was removed, mixed in a stainless steel bowl and subsampled for total organic carbon and sediment grain size. This required < 5% of the surface area of the 0.1 m² van Veen grab. The remainder of the sample was used for macrofaunal analysis at stations where the TOC exceedance observed in 2002 was confirmed.

Sediment Sampling. Five replicate sediment samples were collected at the NW and SE 100' SIZ boundaries and at a local reference station using a 0.1 m² modified van Veen grab on September 22, 2003.

Station Positioning. A 12.5 mm diameter polypropylene transect line was marked at distances such that the boat's davit was located 100' from the perimeter of the net-pen complex. One end of the line was attached to the centerline of the complex and the other end was adjusted using the vessel's anchor windlass. The vessel was then maneuvered to place the grab over an extension of the centerline of the complex with the transect line held tight. An orthogonal bearing was assured by sighting down walkways on the farm.

The position of the sample was recorded using a Magellan™ DLX-10 GPS unit interfaced with a DBR-2 Precision Differential Beacon Receiver. The unit has a manufacturer's stated 95% RMS error of ± 3.0 meters in three dimensions. The error is less in two dimensions. The location of each sample was reported in latitude and longitude to the nearest one-thousandth of a second. However, given the \pm meter accuracy of the DGPS equipment, reporting positions to with 0.3 meters gives an incorrect perception of the actual accuracy. The location of each sample is provided electronically (3.5" floppy) on Department of Ecology SEDQUAL Templates in Appendix (1).

the 2.6% trigger for sediments containing >80% fines (Table 1). The TOC values were transformed using the $\arcsin(\sqrt{\text{TOC}\%/100})$ prior to analysis and the critical value of t is 2.132 for $N = 5$ (four degrees of freedom). The low t -values in both analyses are the result of the higher intra-station variability observed in 2003. Neither of these WDFW SS stations was significantly elevated above the trigger in 2003 and macrofaunal analysis is not required.

Table 3. Results of t -tests to assess the significance of increases in mean TOC values observed at the NE 100' SIZ and the SW 100' SIZ above the Washington State TOC trigger value of 2.6% for sediments containing >80% silt and clay.

NE 100' SIZ station

T-tests; Grouping: Station (WDFW SS 2003 Data Analysis) Group 1: SSNE100 Group 2: Trigger											
	Mean	Mean	t-value	df	P	Valid N	Valid N	Std.Dev.	Std.Dev.	F-ratio	P
ArcSin(sqrt(TOC %))	0.171804	0.161952	0.402978	4	0.707574	5	1	0.022319	0.00	0.00	1.000000

SW 100' SIZ Station

T-tests; Grouping: Station (WDFW SS 2003 Data Analysis) Group 1: SSSW100 Group 2: Trigger											
	Mean	Mean	t-value	df	P	Valid N	Valid N	Std.Dev.	Std.Dev.	F-ratio	P
ArcSin(sqrt(TOC %))	0.154738	0.161952	-0.841887	4	0.447242	5	1	0.007822	0.00	0.00	1.000000

A one-way ANOVA with $\arcsin(\sqrt{\text{TOC}\%/100})$ as the dependent variable and station as the single factor indicated that differences between the treatment stations, local reference station, and the Trigger value were not significant at $\alpha = 0.05$ but were significant at $\alpha = 0.10$ ($F = 3.09$; $p = 0.07$). Post hoc testing using Duncan's test with multiple ranges was not necessary but summarizes the results presented above nicely in Table 4. At $\alpha = 0.10$, TOC at the NE100' SIZ station was significantly different from TOC at the reference location but not from the trigger. The significance probabilities (p) given in Table 4 are the probabilities of obtaining a value of the test statistic as extreme as, or more extreme than the value computed from the actual data. The null hypothesis (farm station \leq reference or trigger value) is rejected when p is \leq the chosen value of α (0.05 in this case)

Table 4. Results of post hoc testing using Duncan's test with multiple ranges to examine the potential significance of differences in sediment TOC as a function of station and the Washington State TOC trigger of 2.6% TOC for sediments containing >80% silt and clay.

Duncan test; variable ArcSin(sqrt(TOC) (WDFW SS 2003 Data Analysis) Approximate Probabilities for Post Hoc Tests Error: Between MS = .00025, df = 11.000					
	Station	{1}	{2}	{3}	{4}
1	SSNE100		0.29	0.06	0.51
2	SSSW100	0.29		0.32	0.63
3	SSC1	0.06	0.32		0.17
4	Trigger	0.51	0.63	0.17e	

References.

- Brooks, K.M. 2003. Summer 2003 Sediment Sampling and Analysis Plan for the Washington Department of Fish and Wildlife, South Sound Net Pen Facility (NPDES Permit WA-004087-8). Prepared for Mr. Rich Eltrich, South Sound Net-Pen Complex Manager, Washington State Department of Fish & Wildlife, 7723 Phillips Road Southwest, Tacoma, WA 98498. 14 pp.
- Brooks, K.M. 2003. 2002 Report of Sediment Silt-Clay/Total Organic Carbon analyses for the Washington State Department of Fish and Wildlife South Sound Net-Pen Complex located on Peale Passage in Mason County, Washington. NPDES Permit Number (WA 004087-8). Prepared for Mr. Rich Eltrich, South Sound Net-Pen Complex Manager, Washington State Department of Fish and Wildlife, 7723 Phillips Road SW, Tacoma, Washington 98498. 12 pp., plus appendices.
- Puget Sound Estuary Program (PSEP). 1986 revised in 1996. Puget Sound Protocols. Prepared for the U.S. Environmental Protection Agency, Region 10, 1200 Sixth Avenue, Seattle, WA.
- Zar, J. H. 1984. Biostatistical Analysis, 2nd edition, Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632, 718 pp.

Quality assurance results. Quality assurance tests for the TOC analyses at Analytical Resources Incorporated were all within the data qualification limits. TOC was not detected in the method blank (<0.01 U) and 98.8% of the Standard Reference Material was recovered. The RSD (silt and clay) for the triplicate SGS analyses completed at AES was 0.67%.

Summary. The area within 100' of the WDFW South Sound netpen complex in Peale Passage had higher arithmetic mean TOC concentrations than the local reference station and mean concentrations at the NE 100' SIZ station were arithmetically higher than the Washington State TOC trigger. However, none of these differences were significant at $\alpha = 0.05$ and only the difference between the NE 100' SIZ station and the local reference station were significant at $\alpha = 0.10$. In 2003 the NE and SW 100' SIZ stations were in compliance with the facilities NPDES Permit and macrofaunal evaluation is not required. No further monitoring is required at this location during this permit cycle. Having said that, the area within 100' of the netpen's perimeter is slightly enriched. The slight but detectable concentration of hydrogen sulfide at the NE 100' station supports this assertion. Good management in the past has kept the lease in compliance with its permit and careful management will be required in the future to insure continued compliance.

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