

**2008-2009
Central Puget Sound
Marine Sediment
Monitoring**



**Sediment Quality Triad
Data Summary**

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Results

Sediment Triad Quality Index categories identified for stations in the 2008-2009 Central monitoring region.

Sample	Location	SCI Category	Toxicity Category	Benthos Hit	SQTI Category
2	Mid Elliott Bay	Low exposure	Low	Adversely affected	Possibly impacted
6	Commencement Bay, Outer	Minimum exposure	Low	Unaffected	Unimpacted
10	Dyes Inlet	Low exposure	Low	Adversely affected	Possibly impacted
18	West Elliott Bay	Minimum exposure	Low	Adversely affected	Inconclusive
26	Rich Passage	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
28	Dyes Inlet (S. of Windy Pt.)	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
31	NE of Meadow Point	Minimum exposure	Low	Adversely affected	Inconclusive
34	North of Blake Island	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
38	Commencement Bay, NE	Minimum exposure	Low	Unaffected	Unimpacted
40	Liberty Bay	Minimum exposure	High	Adversely affected	Likely impacted
47	Pt. Jefferson	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
50	Colvos Pass S. Anderson Pt.	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
58	Commencement Bay, SE	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
62	Commencement Bay, SE	Low exposure	Non-Toxic	Unaffected	Unimpacted
63	Mid Elliott Bay	Low exposure	Non-Toxic	Unaffected	Unimpacted
66	North Blake Island	Low exposure	Non-Toxic	Unaffected	Unimpacted
68	Colvos Pass S. Pt. Richmond	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
70	Commencement Bay, Outer	Minimum exposure	Low	Unaffected	Unimpacted
72	Port Madison (east entrance)	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
74	Sinclair Inlet	Low exposure	High	Adversely affected	Likely impacted
79	East of Rose Pt.	Moderate exposure	Non-Toxic	Unaffected	Unimpacted
82	Colvos Pass N. Pt. Richmond	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted

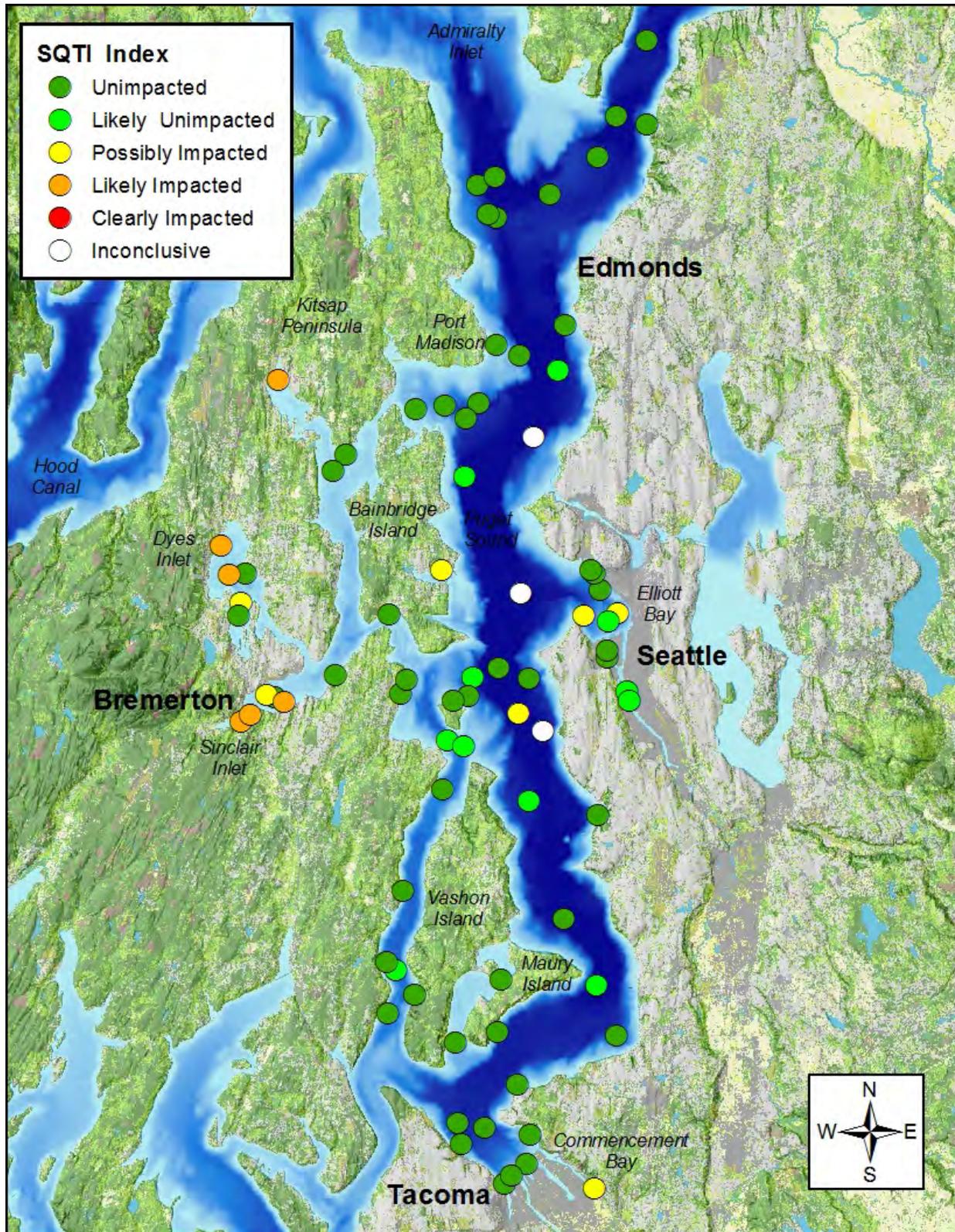
Sample	Location	SCI Category	Toxicity Category	Benthos Hit	SQTI Category
90	Quartermaster Harbor	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
94	Commencement Bay, SE	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
95	Mid Elliott Bay	Low exposure	Low	Adversely affected	Possibly impacted
98	E. Pt. Williams	Minimum exposure	Low	Adversely affected	Inconclusive
106	Sinclair Inlet	Low exposure	Low	Unaffected	Unimpacted
108	Dyes Inlet (North)	Low exposure	Moderate	Adversely affected	Likely impacted
111	South Pt. Wells	Low exposure	Non-Toxic	Unaffected	Unimpacted
114	South of Blake Island	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
122	East of Robinson Point	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
126	Commencement Bay, SE	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
127	Mid Elliott Bay	Low exposure	Non-Toxic	Adversely affected	Likely unimpacted
130	Eagle Harbor (northwest)	Low exposure	Low	Adversely affected	Possibly impacted
136	Port Madison (east)	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
138	Ostrich Bay (Dyes Inlet)	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
143	East of Possession Pt.	Minimum exposure	Low	Unaffected	Unimpacted
154	Seahurst	Minimum exposure	Moderate	Unaffected	Unimpacted
156	Dyes Inlet	Low exposure	Moderate	Adversely affected	Likely impacted
159	West Harbor Is.	Low exposure	Non-Toxic	Unaffected	Unimpacted
162	Central Sound N. Blake Island	Minimum exposure	Low	Unaffected	Unimpacted
168	Port Madison	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
170	Sinclair Inlet	Low exposure	Low	Adversely affected	Possibly impacted
175	South of Possession Pt.	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
178	Colvos Passage	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
186	Hylebos Waterway Head	Low exposure	Low	Adversely affected	Possibly impacted
191	Shoreline Elliott Bay	Low exposure	Non-Toxic	Unaffected	Unimpacted
194	Central Sound	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
202	Port Orchard E Sinclair Inlet	Minimum exposure	Non-Toxic	Unaffected	Unimpacted

Sample	Location	SCI Category	Toxicity Category	Benthos Hit	SQTI Category
207	Possession Sound	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
210	Colvos Passage Camp Stealth	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
218	East Passage Poverty Bay	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
226	Central Basin	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
232	North Port Orchard Pt. Bolin	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
234	Central Sound Manchester Fuel Dock	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
239	Central Basin	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
258	Duwamish Waterway	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
264	North Port Orchard	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
271	Possession Sound	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
274	Shoreline Elliott Bay	Minimum exposure	Low	Unaffected	Unimpacted
290	Central Basin	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
295	Possession Sound	Minimum exposure	Low	Unaffected	Unimpacted
298	East Passage	Low exposure	Low	Adversely affected	Possibly impacted
304	West Point	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
306	Port Orchard P. O Marina	Low exposure	High	Adversely affected	Likely impacted
316	East Passage Quartermaster Harbor	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
322	Port Orchard	Low exposure	High	Adversely affected	Likely impacted
327	Possession Sound	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
330	Colvos Passage Maplewood	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
346	Duwamish Waterway	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
370	Central Basin	Minimum exposure	Low	Unaffected	Unimpacted
375	West Harbor Is.	Low exposure	Non-Toxic	Unaffected	Unimpacted
426	Central Basin	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
439	Central Basin	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
446	East Passage Dash Point	Minimum exposure	Non-Toxic	Unaffected	Unimpacted

Sample	Location	SCI Category	Toxicity Category	Benthos Hit	SQTI Category
455	Possession Sound	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
458	East Passage	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
480	Central Basin	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
487	Possession Sound	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
498	East Passage Maury Island	Minimum exposure	Non-Toxic	Unaffected	Unimpacted

Spatial extent of Sediment Triad Quality Index categories for the 2008-2009 Central Puget Sound region survey.

SCI Category	STI Category	Interim SBI Category	SQTI Category	Spatial Extent (% of Area)
Minimum exposure	Non-Toxic	Unaffected	Unimpacted	53.6%
Minimum exposure	Low toxicity	Unaffected	Unimpacted	9.2%
Minimum exposure	Moderate toxicity	Unaffected	Unimpacted	2.3%
Low exposure	Non-Toxic	Unaffected	Unimpacted	4.4%
Low exposure	Low toxicity	Unaffected	Unimpacted	0.1%
Moderate exposure	Non-Toxic	Unaffected	Unimpacted	2.3%
Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted	14.9%
Low exposure	Non-Toxic	Adversely affected	Likely unimpacted	0.4%
Low exposure	Low toxicity	Adversely affected	Possibly impacted	4.0%
Minimum exposure	High toxicity	Adversely affected	Likely impacted	0.4%
Low exposure	Moderate toxicity	Adversely affected	Likely impacted	0.8%
Low exposure	High toxicity	Adversely affected	Likely impacted	0.4%
Minimum exposure	Low toxicity	Adversely affected	Inconclusive	7.0%



Spatial patterns of sediment condition in the 2008-2009 Central monitoring region.

Incidence and spatial extent of sediment condition in the 2008-2009 Central monitoring region.

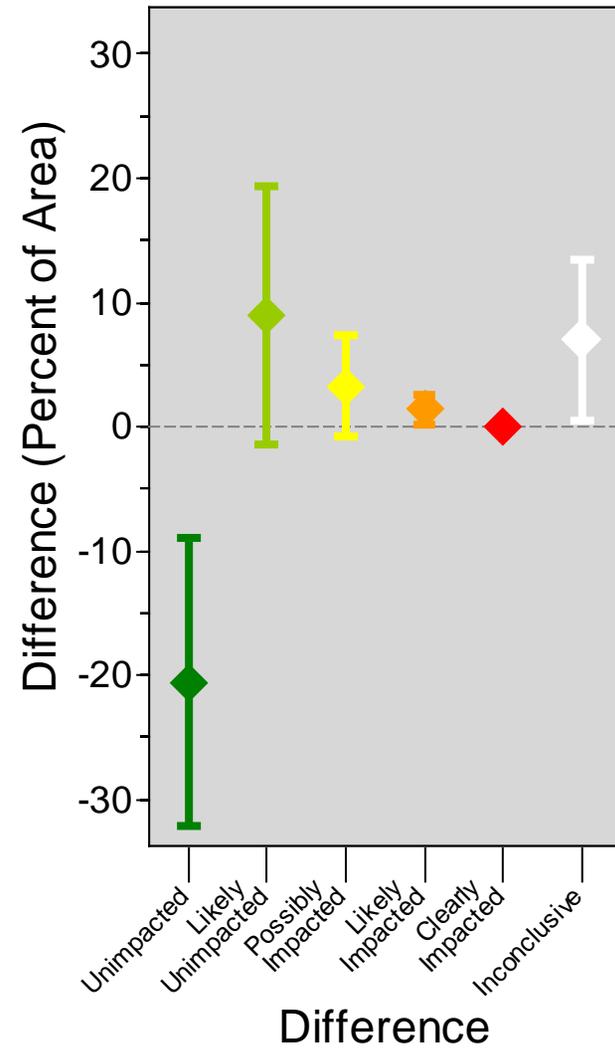
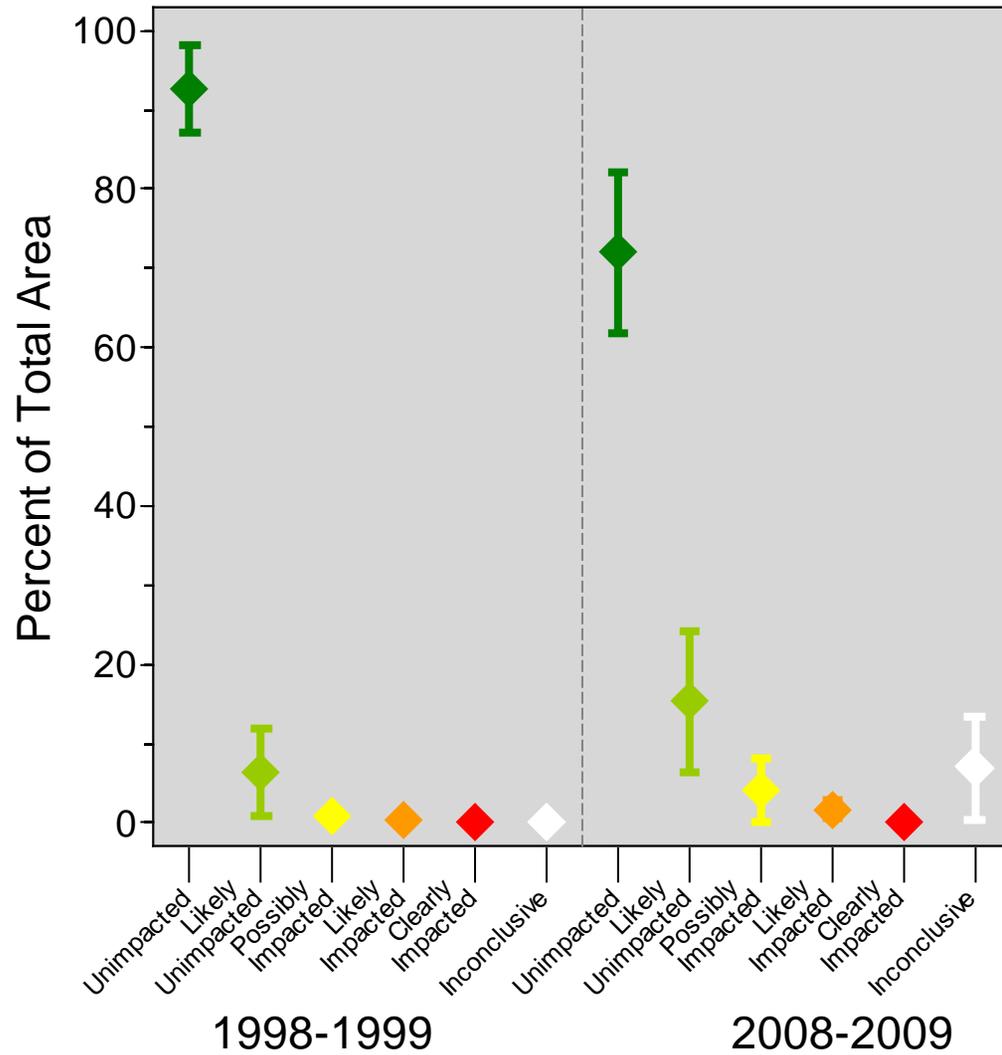
Sediment Triad Index Category	Stations		Area	
	No.	(%)	km ²	(%)
Strait of Georgia	80	(100.0)	667.5	(100.0)
Unimpacted	53	(66.3)	480.6	(72.0)
Likely unimpacted	11	(13.8)	102.1	(15.3)
Possibly impacted	7	(8.8)	26.8	(4.0)
Likely impacted	6	(7.5)	11.3	(1.7)
Clearly impacted	0	(0.0)	0.0	(0.0)
Inconclusive	3	(3.8)	46.7	(7.0)

Comparison of Sediment Quality Triad Index Categories by Year

Estimated spatial extent (percent of area) and 95% confidence intervals for each of the SQTI categories for the Central region in 2008-2009, compared to 1998-1999. The difference between the years for the unimpacted and likely impacted categories are statistically significant, as indicated by the difference confidence interval *not* containing the value zero. The differences for the other categories are not statistically significant.

Sediment Quality Triad Index Category	1998/1999			2008/2009			Difference (2008/9-1998/9)			* = significantly different (alpha=0.05)
	Estimate (% area)	Confidence Limit		Estimate (% area)	Confidence Limit		Estimate (% area)	Confidence Limit		
		Lower	Upper		Lower	Upper		Lower	Upper	
Unimpacted	92.60	87.14	98.07	72.01	61.79	82.23	-20.59	-32.18	-9.01	*
Likely unimpacted	6.35	0.88	11.82	15.29	6.43	24.16	8.94	-1.48	19.36	
Possibly impacted	0.74	0.26	1.22	4.02	0.00	8.05	3.28	-0.78	7.33	
Likely impacted	0.28	0.02	0.55	1.69	0.55	2.83	1.41	0.23	2.58	*
Clearly impacted	0.02	0.00	0.05	0.00	n.a.	n.a.	-0.02	n.a.	n.a.	
Inconclusive	0.00	n.a.	n.a.	6.99	0.47	13.51	6.99	n.a.	n.a.	

* Olsen et al. (in prep.), $\alpha = 0.05$



Comparisons with Other Regions

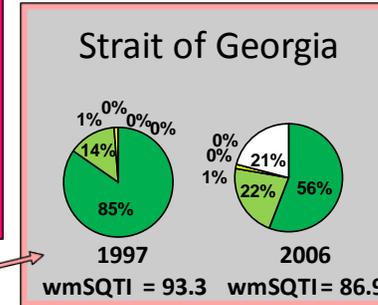
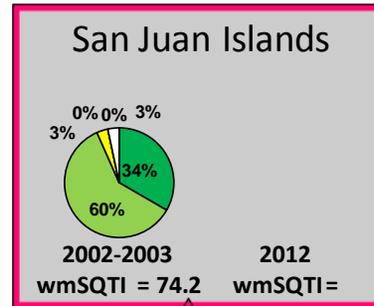
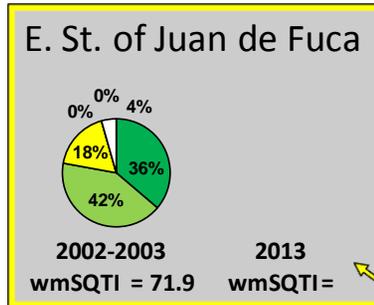
Incidence and spatial extent of sediment condition in eight sediment monitoring regions and all of Puget Sound.

Sediment Triad Index Category	Regional Baseline				Second Baseline			
	Stations		Area		Stations		Area	
	No.	(%)	km ²	(%)	No.	(%)	km ²	(%)
Central Sound	128	(100.0)	683.9	(100.0)	80	(100.0)	667.4	(100.0)
Unimpacted	76	(59.4)	633.3	(92.6)	53	(66.3)	480.6	(72.0)
Likely unimpacted	34	(26.6)	43.4	(6.4)	11	(13.8)	102.5	(15.4)
Possibly impacted	11	(8.6)	5.1	(0.7)	7	(8.8)	26.8	(4.0)
Likely impacted	6	(4.7)	1.9	(0.3)	6	(7.5)	11.3	(1.7)
Clearly impacted	1	(0.8)	0.1	(0.02)	0	(0.0)	0.0	(0.0)
Inconclusive	0	(0.0)	0.0	(0.0)	3	(3.8)	46.7	(7.0)
Strait of Georgia	61	(100.0)	386.9	(100.0)	40	(100.0)	360.6	(100.0)
Unimpacted	51	(83.6)	327.5	(84.6)	21	(52.5)	201.6	(55.9)
Likely unimpacted	7	(11.5)	54.6	(14.1)	8	(20.0)	78.8	(21.9)
Possibly impacted	3	(4.9)	4.81	(1.2)	3	(7.5)	4.6	(1.3)
Likely impacted	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
Clearly impacted	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
Inconclusive	0	(0.0)	0.0	(0.0)	8	(20.0)	75.6	(21.0)
Whidbey Basin	39	(100.0)	338.1	(100.0)	40	(100.0)	353.3	(100.0)
Unimpacted	10	(25.6)	104.8	(31.0)	20	(50.0)	167.7	(47.5)
Likely unimpacted	19	(48.7)	213.0	(63.0)	17	(42.5)	165.7	(46.9)
Possibly impacted	0	(0.0)	0.0	(0.0)	1	(2.5)	11.5	(3.3)
Likely impacted	8	(20.5)	0.7	(0.2)	1	(2.5)	0.3	(0.1)
Clearly impacted	1	(2.6)	0.06	(0.0)	0	(0.0)	0.0	(0.0)
Inconclusive	1	(2.6)	19.6	(5.8)	1	(2.5)	8.2	(2.3)
South Sound	42	(100.0)	341.6	(100.0)	Results in Preparation			
Unimpacted	24	(57.1)	211.2	(61.8)				
Likely unimpacted	14	(33.3)	120.2	(35.2)				
Possibly impacted	2	(4.8)	9.8	(2.9)				
Likely impacted	2	(4.8)	0.5	(0.2)				
Clearly impacted	0	(0.0)	0.0	(0.0)				
Inconclusive	0	(0.0)	0.0	(0.0)				
Hood Canal	21	(100.0)	331.7	(100.0)	30	(100.0)	294.8	(100.0)
Unimpacted	7	(33.3)	106.2	(32.0)	7	(23.3)	64.6	(21.9)
Likely unimpacted	11	(52.4)	186.8	(56.3)	18	(60.0)	178.1	(60.4)
Possibly impacted	3	(14.3)	38.8	(11.7)	1	(3.3)	9.2	(3.1)

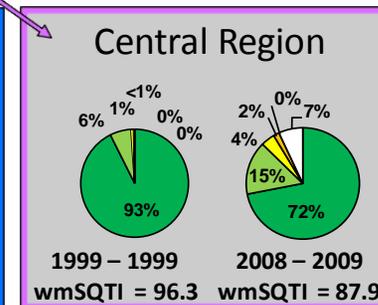
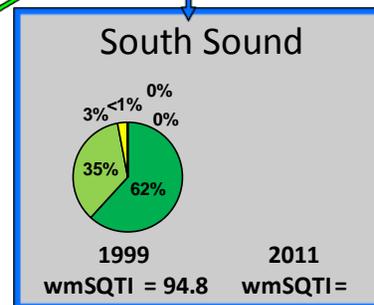
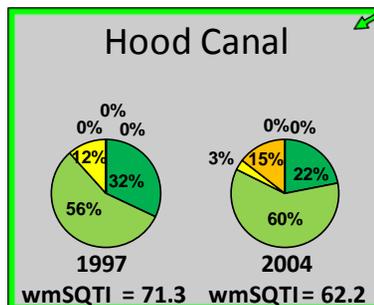
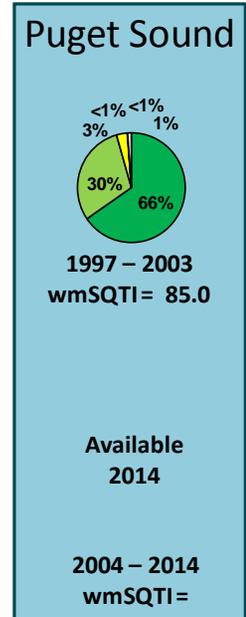
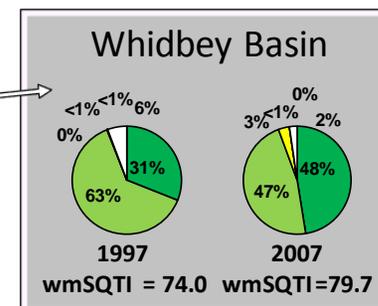
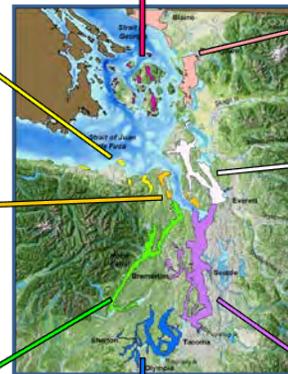
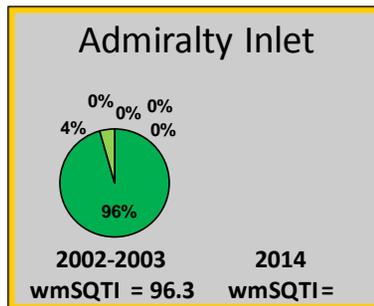
Sediment Triad Index Category	Regional Baseline				Second Baseline			
	Stations		Area		Stations		Area	
	No.	(%)	km ²	(%)	No.	(%)	km ²	(%)
Likely impacted	0	(0.0)	0.0	(0.0)	4	(13.3)	42.9	(14.5)
Clearly impacted	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
Inconclusive	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
San Juan Archipelago	30	(100.0)	80.7	(100.0)	Sampling in June 2012			
Unimpacted	10	(33.3)	26.91	(33.3)				
Likely unimpacted	18	(60.0)	48.44	(60.0)				
Possibly impacted	1	(3.3)	2.69	(3.3)				
Likely impacted	0	(0.0)	0.0	(0.0)				
Clearly impacted	0	(0.0)	0.0	(0.0)				
Inconclusive	1	(3.3)	2.7	(3.3)				
E. Strait of Juan de Fuca	30	(100.0)	61.8	(100.0)				
Unimpacted	15	(50.0)	22.4	(36.2)				
Likely unimpacted	10	(33.3)	25.76	(41.7)				
Possibly impacted	4	(13.3)	10.95	(17.7)				
Likely impacted	0	(0.0)	0.0	(0.0)				
Clearly impacted	0	(0.0)	0.0	(0.0)				
Inconclusive	1	(3.3)	2.7	(4.4)				
Admiralty Inlet	30	(100.0)	69.2	(100.0)	Available after 2014			
Unimpacted	28	(93.3)	66.1	(95.6)				
Likely unimpacted	2	(6.7)	3.1	(4.4)				
Possibly impacted	0	(0.0)	0.0	(0.0)				
Likely impacted	0	(0.0)	0.0	(0.0)				
Clearly impacted	0	(0.0)	0.0	(0.0)				
Inconclusive	0	(0.0)	0.0	(0.0)				
Total Study Area	381	(100.0)	2294.1	(100.0)	Available after 2014			
Unimpacted	221	(58.0)	1498.3	(65.3)				
Likely unimpacted	115	(30.2)	695.3	(30.3)				
Possibly impacted	24	(6.3)	72.15	(3.1)				
Likely impacted	16	(4.2)	3.15	(0.1)				
Clearly impacted	2	(0.5)	0.2	(0.0)				
Inconclusive	3	(0.8)	24.98	(1.1)				

Puget Sound Sediment Triad Index (SQTI)

Spatial and Temporal Trends



Pie charts depict percent of study area sediments in each Sediment Triad Index Category.



Sediment Quality Triad Index Category	Sediment Quality Triad Index Score
Unimpacted	>83-100
Likely unimpacted	>57-83
Possibly impacted	>35-57
Likely impacted	>5-35
Clearly impacted	0-5
Inconclusive	

Spatial patterns of sediment condition in eight sediment monitoring regions and all of Puget Sound.