06 March 2013

Memorandum

To: The Lower Willamette Group

From: Kennedy/Jenks Consultants

Subject: Statistical Comparison of Historical and 2012 Smallmouth Bass Data

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Smallmouth bass were collected from Portland Harbor and analyzed for total PCB congeners during three sampling events, including samples collected in 2002 and 2007 for the Remedial Investigation and Risk Assessments and samples collected in 2012 for the purposes of supporting the Feasibility Study. Smallmouth bass were collected and analyzed by EPA in 2011; however, these data were not available for the entire Study Area, and therefore, were not included in this evaluation. Kennedy/Jenks performed statistical analyses to compare the historical (2002 and 2007) and 2012 total PCB congener datasets for smallmouth bass tissue.

Methods

Statistical analyses and calculations were performed using Microsoft Excel and the U.S. Environmental Protection Agency's ProUCL Statistical Package, version 4.1.

Analyses were performed on both a Study Area-wide and individual river mile (RM) basis, and include: a direct comparison of summary statistics without statistical tests; production of box and whisker plots to visualize concentration ranges and compare historical and 2012 data; and two-sample hypothesis tests to determine whether differences in historical and 2012 datasets are statistically significant. For the purposes of this evaluation, the Study Area includes tissue samples collected between RM 1.9 and RM 11.8, inclusive. The RM classifications presented herein are designated as follows: RM 1.5 up to RM 2.5 = "RM 2", RM 2.5 up to RM 3.5="RM 3", etc. Samples collected from RM 10.5 through RM 12.0 were designated as "RM 11".

The 2012 smallmouth bass samples were discrete samples analyzed only as whole body tissue. The 2002 samples were composite samples that included individual fish collected on both sides of the river over approximately 1-mile stretches, and were analyzed as whole body tissue. The 2007 samples were composite samples that included individual fish collected on the east or west side of the river over approximately 1-mile stretches, and were analyzed as fillet tissue and rest of body tissue. Whole body concentrations were calculated from laboratory analytical results for those samples. The differences in the sampling and analysis schemes are not addressed in this evaluation and should be considered in reviewing the results of the data comparisons.

Because the 2002 and 2007 datasets consisted of composite samples only and the sample size was small compared to 2012, the effect of compositing was a loss in information concerning variance. As a result, the magnitude of the change in difference of the observed means would need to be quite large in order to be statistically significant.

Total PCB congener (vs. PCB Aroclor) data were used for consistency between data sets. For all datasets, the RM classifications, the rules for data reduction, and the rules for summing individual congener concentrations to calculate total PCB congener concentrations followed those used in the Baseline Risk Assessments. These rules are described in the following documents:

GSI Water Solutions 2011. Sampling and Analysis Plan: Portland Harbor 2011 Baseline Smallmouth Bass Tissue Study, GSI Water Solutions, Inc. Portland, Oregon, 2011.

Kennedy/Jenks Consultants 2004. Portland Harbor RI/FS Technical Memorandum: Guidelines for Data Averaging and Treatment of Non-detected Values for the Round 1 Database, Kennedy/Jenks Consultants. Portland, Oregon, 2013.

The 2012 total PCB congener concentrations, lipid percentages, and river mile designations for these data evaluations are presented in Table 1. For the purposes of comparison, 2002 and 2007 data were combined into a single historical dataset and compared to the 2012 data. In addition, 2002 and 2007 datasets were compared individually against the 2012 data, with an emphasis on comparing 2007 data against 2012 data, since those datasets are the most recent and represent composites collected over smaller spatial scales on separate sides of the river. It should be noted that in 2007, Swan Island Lagoon (SIL) was not sampled for smallmouth bass, and upriver samples were not collected. In 2002, smallmouth bass samples were not collected from RM 2, RM 10, or RM 11.

Results

A direct comparison of means, maximum and minimum detected concentrations, and number of samples per RM are provided in Table 2. The comparison of concentrations in Table 2 is not based on statistical tests. Complete summary statistics are provided in Table 3.

A direct comparison of summary statistics shows that the mean of the 2012 PCB concentrations per RM and Study Area-wide are lower than the combined historical data mean concentrations, with the exception of RM 10 (see Table 2). Compared to only the 2007 mean concentrations, the 2012 means are lower for all exposure areas with data except RM 3 and RM 10. For SIL, the 2012 mean concentration is lower than that of 2002. The dataset is not large enough to determine statistical significance on a RM scale.

The 2012 upriver mean concentrations are higher than historical upriver mean concentrations, but historical upriver samples were collected at RM 20 and RM 28, whereas the 2012 upriver samples were taken near Ross Island, between RM 15 and RM 17, inclusive. A visual representation of mean concentrations per exposure area is provided in Figure 1.

Although the historical data are from composite samples and essentially represent average concentrations, minimum and maximum concentrations of historical data were compared

against 2012 data as an additional evaluation of the datasets. Minimum PCB concentrations per RM and Study Area-wide are lower in 2012 than in the historical datasets for all exposure areas (Table 2). Maximum PCB concentrations per RM are lower in 2012 than in 2007 for 6 of the10 RM exposure areas with 2007 data. In addition, the maximum total PCB congener concentration of 2012 smallmouth bass was less than average total PCB congener concentrations of 2007 smallmouth bass in 5 of 10 RMs.

Figures 2 and 3 present box plots of RM and Study Area-wide concentrations, respectively. These figures present the ranges of concentrations detected in each RM. The 2012 dataset consists of 83 discrete samples for the Study Area, and the historical dataset consists of 32 composite samples for the Study Area (14 in 2002 and 18 in 2007). More outliers would be expected in the 2012 dataset due to the discrete samples than in the historical dataset consisting of composite samples, which represent average concentrations. Figure 4 shows a comparison of the number of sample results in each dataset.

Hypothesis testing was also performed on historical versus 2012 Study Area-wide datasets to provide a statistical evaluation. Due to the limited number of samples on a RM basis, hypothesis testing was only performed for the Study Area-wide datasets.

Both the 2012 and combined historical Study Area-wide datasets follow nonparametric distributions, so a two-sample Wilcoxon-Mann-Whitney test was performed. The test was performed to a 95% (α =0.05) confidence limit. The null hypothesis (H_0) was that the mean of the combined historical data is equal to or less than the mean of the 2012 data.In other words, the difference between the means of the two datasets is either unchanged or has become greater with the passage of time. The alternative hypothesis (H_1) was that the 2012 mean is less than the combined historical data mean. The results were statistically significant (p<0.05), and H_0 is rejected, indicating that the 2012 mean PCB congener concentration is less than that of the combined historical data.

The same test was performed on the 2012 data against the 2007 data with and without the 2002 data for Swan Island Lagoon. The results were also statistically significant (p<0.05), and H_0 is rejected, indicating that the 2012 mean concentration is less than the 2007 mean concentration on a Study Area-wide scaleThe outputs of the analyses are provided in Tables 4, 5, and 6.

The same statistically significant (p<0.05) results were obtained when the hypothesis tests were performed on lipid normalized data, indicating that the observed decrease in concentrations in the 2012 dataset is not attributable to a difference in lipid content between sampling events. The outputs of the Wilcoxon-Mann-Whitney tests on Study Area-Wide lipid-normalized data from 2012 versus the combined historical dataset and versus the 2007 dataset are provided in Tables 7 and 8, respectively.

Conclusion

On a Study Area-wide scale, total PCB congener concentrations in whole body smallmouth bass tissue show a statistically significant (p<0.05) decrease from combined 2002 and 2007 historical data and from 2007 data alone. On a RM scale, datasets are not large enough to show statistically meaningful comparisons, but means, maximums, and minimum total PCB congener concentrations are generally lower in 2012 smallmouth bass than in previously

collected samples. Although 2012 discrete samples were being compared to historical composite samples, it appears likely from the data that maximum concentrations decreased between 2012 and prior years in most locations. Overall, it is likely that total PCB concentrations in whole body smallmouth bass are decreasing in the Portland Harbor.

Figure 1. Comparison of Mean PCB Congener Concentrations for Historical and 2012 Data

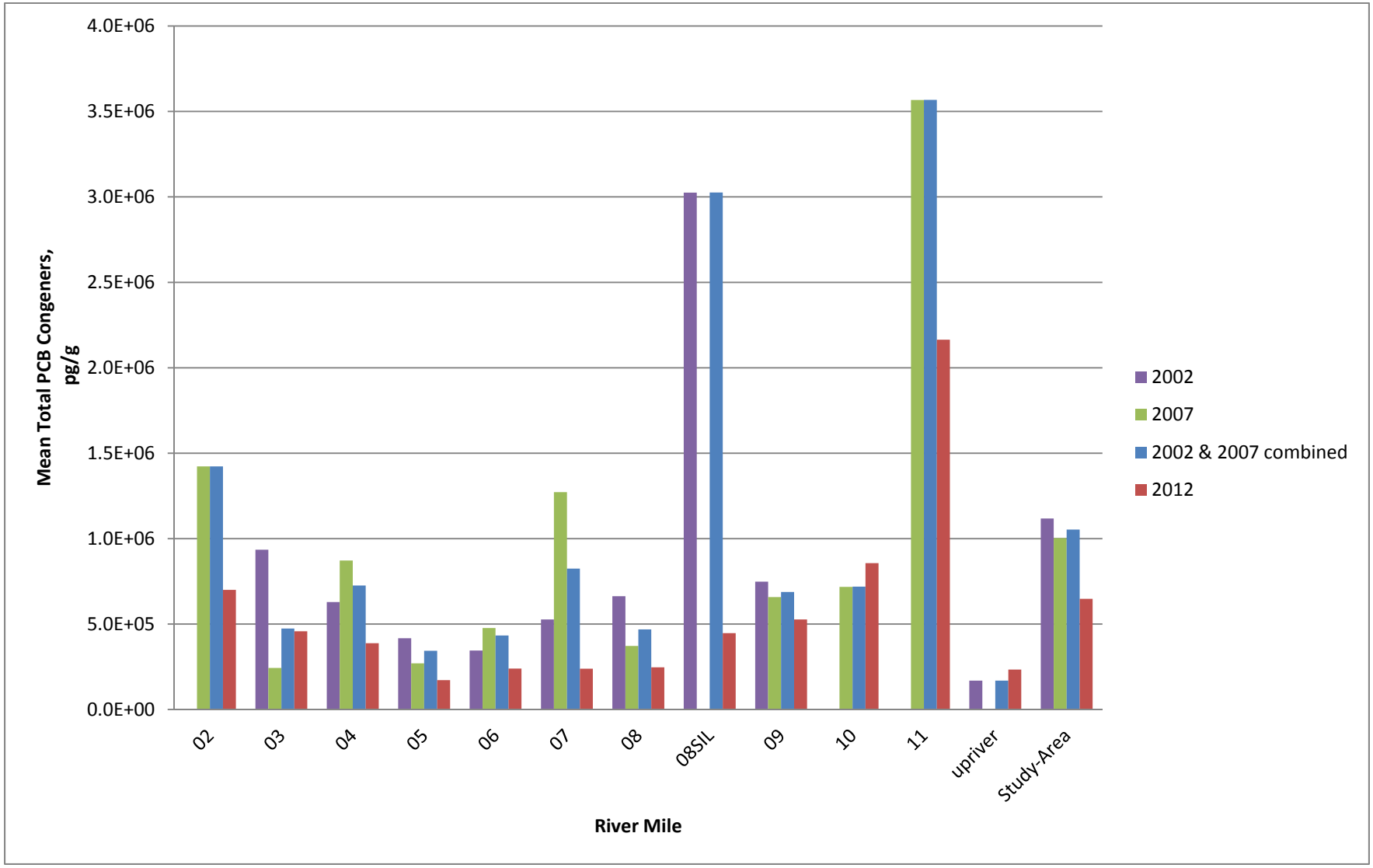
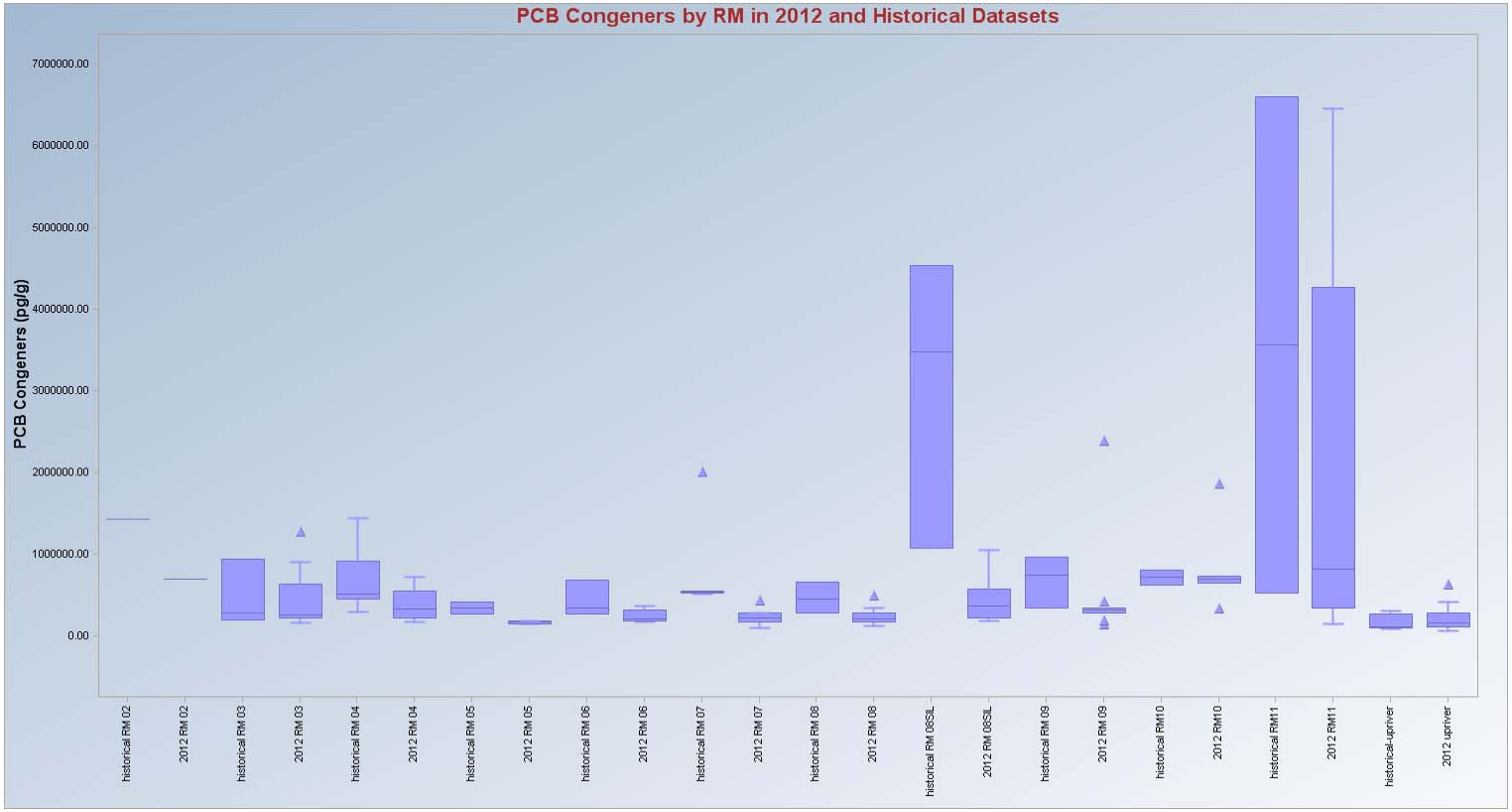
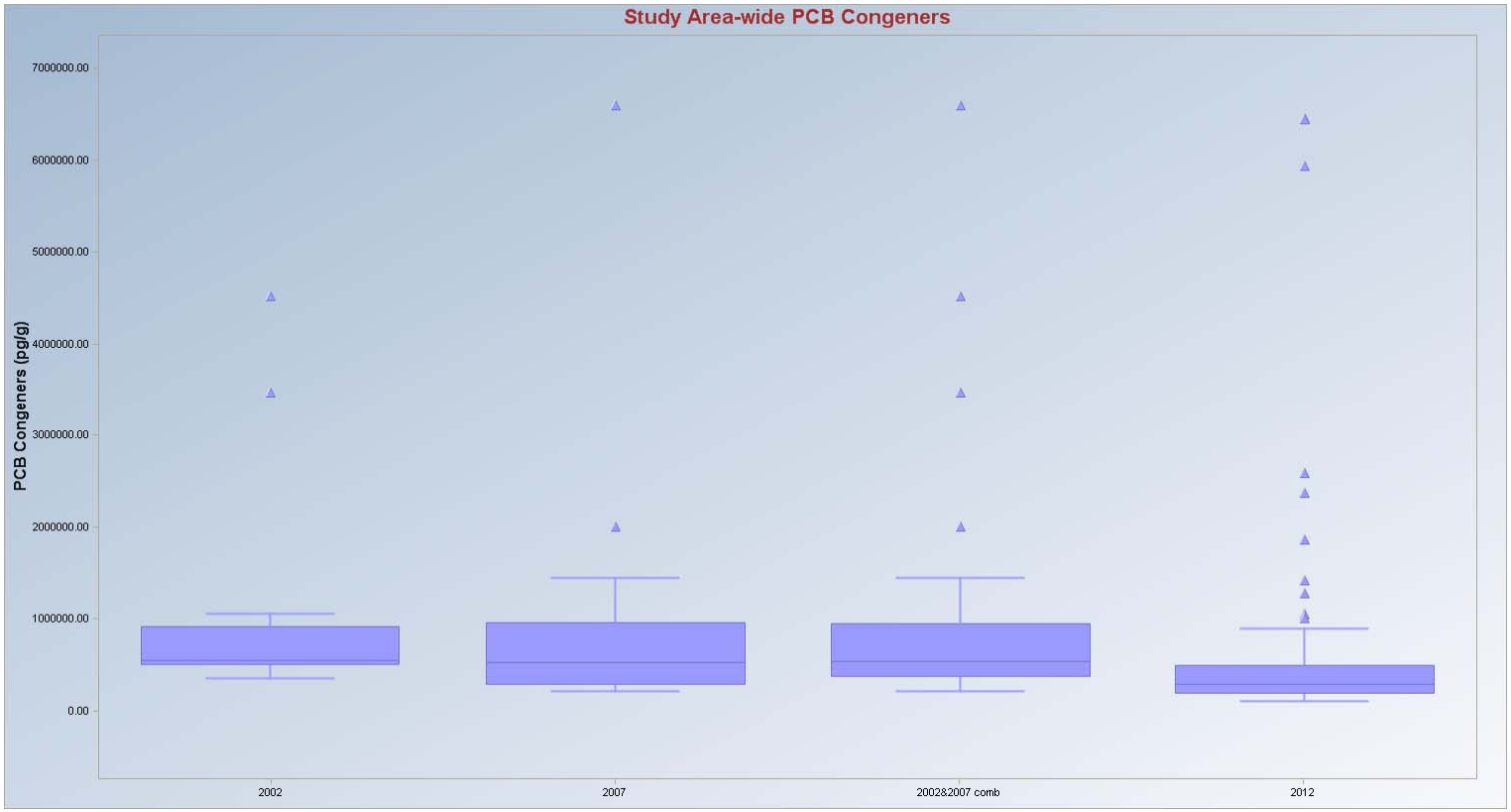


Figure 2. Box Plots of Smallmouth Bass Data, by River Mile
(Historical Dataset includes combined 2002 and 2007 data)



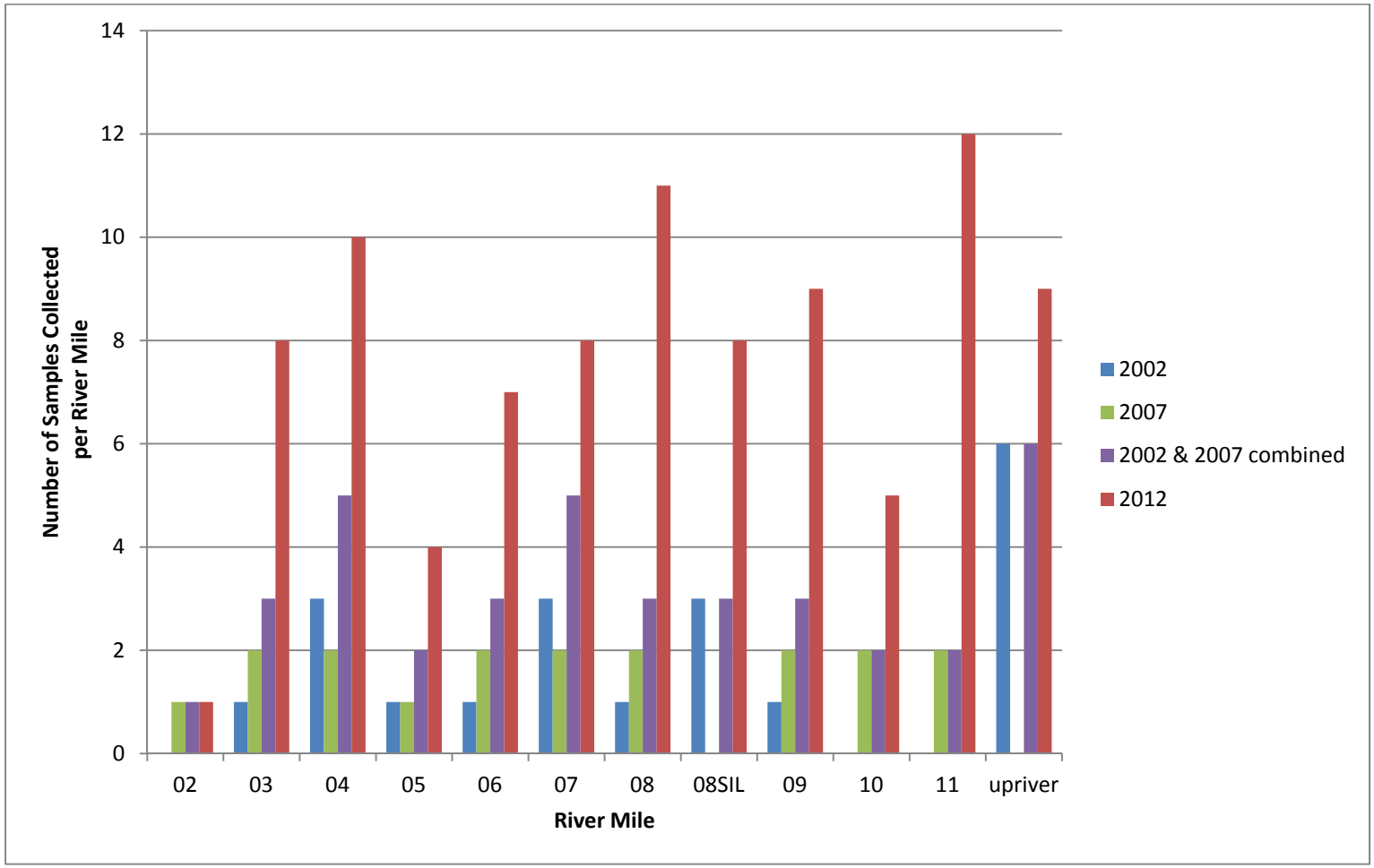
Legend:
The top and bottom of the box are the 75th and 25th percentiles, and the horizontal line represents the median.
The whiskers are 1.5 times the interquartile range added to the 75th percentile and subtracted from the 25th percentile.
Triangles represent potential outliers in the dataset.

Figure 3. Box Plots of Study Area-wide Smallmouth Bass Data



Legend:
The top and bottom of the box are the 75th and 25th percentiles, and the horizontal line represents the median.
The whiskers are 1.5 times the interquartile range added to the 75th percentile and subtracted from the 25th percentile.
Triangles represent potential outliers in the dataset.
The 2002 dataset did not include samples from RM 11, which has the highest detected PCB concentrations in the Study Area shown in the 2007 and 2012 datasets.

Figure 4. Number of Samples Collected Per River Mile in Historical and 2012 Datasets



Note: For the 2002 and 2007 datasets, the number of samples represents the number of composite samples, which generally included five individual fish (in three of the 2002 composite samples, the number of individual fish was less than the targeted five).

Table 1. Summary of 2012 Sampling Locations and Analytical Results

River Mile Designation For Comparison to Historical Data[a]	Sample ID	Collection Date	Total PCB Congeners[b] (pg/g)	Qualifier	Lipids (percent)
02	LW4-SB-02E-02	8/29/2012	7.00E+05	TJ	6.24
03	LW4-SB-02E-01	8/29/2012	1.28E+06	TJ	7.45
03	LW4-SB-02E-03	9/4/2012	2.45E+05	TJ	5.18
03	LW4-SB-02E-04	9/4/2012	2.71E+05	TJ	8.43
03	LW4-SB-02W-01	8/29/2012	2.50E+05	TJ	5.54
03	LW4-SB-02W-02	8/29/2012	1.48E+05	TJ	6.28
03	LW4-SB-03E-02	9/4/2012	9.13E+05	TJ	9.95
03	LW4-SB-03W-01	8/29/2012	3.61E+05	TJ	7.05
03	LW4-SB-03W-02	8/29/2012	1.95E+05	TJ	6.76
04	LW4-SB-03E-01	9/4/2012	6.13E+05	TJ	6.55
04	LW4-SB-03E-03	9/7/2012	2.47E+05	TJ	6.66
04	LW4-SB-03E-04	9/7/2012	5.54E+05	TJ	6.77
04	LW4-SB-03E-05	9/7/2012	3.30E+05	TJ	8.00
04	LW4-SB-03E-06	9/11/2012	2.16E+05	TJ	6.20
04	LW4-SB-03E-07	9/13/2012	7.33E+05	TJ	7.05
04	LW4-SB-03E-08	9/13/2012	4.78E+05	TJ	7.86
04	LW4-SB-03E-09	9/13/2012	3.26E+05	TJ	9.14
04	LW4-SB-04E-01	9/13/2012	2.26E+05	TJ	7.55
04	LW4-SB-04W-01	9/1/2012	1.60E+05	TJ	6.22
05	LW4-SB-05E-02	8/27/2012	1.67E+05	TJ	5.81
05	LW4-SB-05W-01	8/30/2012	2.04E+05	TJ	6.76
05	LW4-SB-05W-03	9/3/2012	1.82E+05	TJ	6.33
05	LW4-SB-05W-04	9/3/2012	1.34E+05	TJ	4.99
06	LW4-SB-05E-01	8/27/2012	3.22E+05	TJ	6.96
06	LW4-SB-05E-03	9/10/2012	2.09E+05	TJ	6.25
06	LW4-SB-05W-02	9/3/2012	1.63E+05	TJ	4.75
06	LW4-SB-06E-02	8/27/2012	1.89E+05	TJ	6.26
06	LW4-SB-06E-03	8/30/2012	2.01E+05	TJ	4.99
06	LW4-SB-06W-01	8/27/2012	3.80E+05	TJ	6.00
06	LW4-SB-06W-02	9/6/2012	2.16E+05	TJ	7.67
07	LW4-SB-06E-01	8/27/2012	4.40E+05	TJ	5.78
07	LW4-SB-06E-04	9/4/2012	2.67E+05	TJ	5.07
07	LW4-SB-06E-05	9/5/2012	1.75E+05	TJ	4.59
07	LW4-SB-06W-03	9/9/2012	1.85E+05	TJ	5.81
07	LW4-SB-06W-04	9/9/2012	2.70E+05	TJ	6.55
07	LW4-SB-06W-05	9/8/2012	1.85E+05	TJ	6.86
07	LW4-SB-06W-06	9/25/2012	2.93E+05	TJ	6.94

River Mile Designation For Comparison to Historical Data[a]	Sample ID	Collection Date	Total PCB Congeners[b] (pg/g)	Qualifier	Lipids (percent)
07	LW4-SB-07E-01	8/27/2012	9.23E+04	TJ	4.25
08	LW4-SB-07E-02	8/29/2012	2.59E+05	TJ	6.51
08	LW4-SB-07E-03	9/2/2012	1.86E+05	TJ	3.74
08	LW4-SB-07E-04	9/2/2012	1.18E+05	TJ	7.12
08	LW4-SB-07E-05	9/12/2012	2.88E+05	TJ	5.27
08	LW4-SB-07W-04	9/12/2012	2.18E+05	TJ	5.99
08	LW4-SB-07W-01	8/31/2012	1.76E+05	TJ	7.23
08	LW4-SB-07W-02	9/7/2012	1.70E+05	TJ	5.95
08	LW4-SB-07W-03	9/10/2012	2.02E+05	TJ	5.54
08	LW4-SB-07W-05	9/25/2012	3.59E+05	TJ	6.93

River Mile Designation For Comparison to Historical Data[a]	Sample ID	Collection Date	Total PCB Congeners[b] (pg/g)	Qualifier	Lipids (percent)
08	LW4-SB-08W-03	8/31/2012	2.44E+05	TJ	4.92
08	LW4-SB-08W-05	9/9/2012	5.00E+05	TJ	7.36
08SIL	LW4-SB-08E-02	8/29/2012	3.60E+05	TJ	7.05
08SIL	LW4-SB-08E-03	8/31/2012	6.53E+05	TJ	7.68
08SIL	LW4-SB-08E-04	8/31/2012	1.06E+06	TJ	4.88
08SIL	LW4-SB-08E-05	9/5/2012	2.74E+05	TJ	7.35
08SIL	LW4-SB-08E-07	9/12/2012	1.84E+05	TJ	5.55
08SIL	LW4-SB-08E-08	9/13/2012	4.89E+05	TJ	5.9
08SIL	LW4-SB-08E-09	9/24/2012	1.72E+05	TJ	6.36
08SIL	LW4-SB-09E-06	9/25/2012	3.84E+05	TJ	6.44
09	LW4-SB-08E-01	8/28/2012	3.01E+05	TJ	3.95
09	LW4-SB-08E-06	9/9/2012	3.40E+05	TJ	7.45
09	LW4-SB-08W-01	8/31/2012	4.31E+05	TJ	6.86
09	LW4-SB-08W-02	8/31/2012	3.41E+05	TJ	7.46
09	LW4-SB-08W-04	9/8/2012	2.90E+05	TJ	6.61
09	LW4-SB-09E-01	8/28/2012	1.98E+05	TJ	6.51
09	LW4-SB-09E-02	9/2/2012	3.18E+05	TJ	4.71
09	LW4-SB-09E-03	9/6/2012	1.48E+05	TJ	5.28
09	LW4-SB-09W-02	9/25/2012	2.38E+06	TJ	5.96
10	LW4-SB-09E-04	9/6/2012	6.92E+05	TJ	5.05
10	LW4-SB-09E-05	9/6/2012	6.53E+05	TJ	7.91
10	LW4-SB-09W-01	9/8/2012	1.87E+06	TJ	3.09
10	LW4-SB-10E-02	8/27/2012	3.44E+05	TJ	6.43
10	LW4-SB-10E-03	9/5/2012	7.28E+05	TJ	4.08
11	LW4-SB-10E-01	8/27/2012	2.28E+05	TJ	5.49
11	LW4-SB-10W-01	8/27/2012	4.17E+05	TJ	4.46
11	LW4-SB-11E-01	8/27/2012	1.43E+06	TJ	4.86
11	LW4-SB-11E-02	8/27/2012	5.95E+06	TJ	6.52
11	LW4-SB-11E-03	8/27/2012	6.46E+06	TJ	5.2
11	LW4-SB-11E-04	8/27/2012	1.34E+05	TJ	3.75
11	LW4-SB-11E-05	9/7/2012	2.59E+06	TJ	6.86
11	LW4-SB-11E-06	9/7/2012	6.45E+06	TJ	6.55
11	LW4-SB-11W-01	8/27/2012	3.70E+05	TJ	4.33
11	LW4-SB-11W-02	9/3/2012	1.01E+06	TJ	6.26
11	LW4-SB-11W-03	9/8/2012	3.12E+05	TJ	5.69
11	LW4-SB-11W-04	9/8/2012	6.15E+05	TJ	5.44
upriver	LW4-SB-15W-01	8/28/2012	1.37E+05	TJ	5.89
upriver	LW4-SB-15W-02	8/28/2012	1.97E+05	TJ	5.02

River Mile Designation For Comparison to Historical Data[a]	Sample ID	Collection Date	Total PCB Congeners[b] (pg/g)	Qualifier	Lipids (percent)
upriver	LW4-SB-16W-01	8/28/2012	4.28E+05	TJ	5.55
upriver	LW4-SB-16W-02	8/28/2012	6.33E+05	TJ	5.7
upriver	LW4-SB-16W-03	9/24/2012	1.58E+05	TJ	7.26
upriver	LW4-SB-16W-04	9/24/2012	2.80E+05	TJ	8.62
upriver	LW4-SB-17W-03	8/28/2012	1.09E+05	TJ	5
upriver	LW4-SB-17W-01	8/28/2012	5.06E+04	TJ	6.04
upriver	LW4-SB-17W-02	8/28/2012	1.10E+05	TJ	4.76

Abbreviations:

J Indicates at least one congener within the sum was J-flagged, meaning the analyte was positively identified, and the associated numerical value is the approximate concentraion of the analyte in the sample.

PCB Polychlorinated Biphenyls

pg/g picograms per gram

SIL Swan Island Lagoon

T Indicates the result is a calculated sum

Notes:

a Sample locations for the purposes of comparing results to historical data are based on half-river miles to be consistent with historical compositing schemes, such that samples collected from RM 6 .5 up to RM 7.5 are designated "RM 7". In contrast, River Mile designations indicated in the Sample ID are based on full river mile delineations, such that samples caught between RM 6.0 up to RM 7.0 are designated "RM 6", etc. Sample ID naming is consistent with the Sampling and Analysis Plan for the 2012 Smallmouth Bass Study (*Windward Environmental. 2012. Portland Harbor RI/FS: 2012 Modifications to the Field Sampling Plan for Bass Tissue Windward Environmental. Seattle, Washington, 2012).*

b Results rounded to three significant figures. Summation rules were the same as those used in the Portland Harbor Baseline Risk Assessments, such that nondetected congeners in a given sample were included at half their reporting detection limit, provided the congener was detected at least once in the data set.

Table 2. Comparison of Summary Statistics for Historic and 2012 Smallmouth Bass Total PCB Congener Concentrations [a].

Portland Harbor

River Mile[c]	# of Samples				Mean Concentration[b]					
	2002[d]	2007[d]	2002 & 2007 combined[d]	2012	2002	2007	2002 & 2007 combined	2012	**2012 < 2002?[e]**	**2012 < 2007?[e]**
02	0	1	1	1	--	1.4E+06	1.4E+06	7.0E+05	--	Y
03	1	2	3	8	9.4E+05	2.4E+05	4.7E+05	4.6E+05	Y	N
04	3	2	5	10	6.3E+05	8.7E+05	7.3E+05	3.9E+05	Y	Y
05	1	1	2	4	4.2E+05	2.7E+05	3.4E+05	1.7E+05	Y	Y
06	1	2	3	7	3.5E+05	4.8E+05	4.3E+05	2.4E+05	Y	Y
07	3	2	5	8	5.3E+05	1.3E+06	8.3E+05	2.4E+05	Y	Y
08	1	2	3	11	6.6E+05	3.7E+05	4.7E+05	2.5E+05	Y	Y
08SIL	3	0	3	8	3.0E+06	--	3.0E+06	4.5E+05	Y	--
09	1	2	3	9	7.5E+05	6.6E+05	6.9E+05	5.3E+05	Y	Y
10	0	2	2	5	--	7.2E+05	7.2E+05	8.6E+05	--	N
11	0	2	2	12	--	3.6E+06	3.6E+06	2.2E+06	--	Y
upriver[f]	6	0	6	9	1.7E+05	--	1.7E+05	2.3E+05	N	--
Study-Area	14	18	32	83	1.1E+06	1.0E+06	1.1E+06	6.5E+05	Y	Y

River Mile[c]	Maximum Concentration[b]						Minimum Concentration[b]					
	2002	2007	2002 & 2007 combined	2012	**2012 < 2002?[e]**	**2012 < 2007?[e]**	2002	2007	2002 & 2007 combined	2012	**2012 < 2002?[e]**	**2012 < 2007?[e]**
02	--	1.4E+06	1.4E+06	7.0E+05	--	Y	--	1.4E+06	1.4E+06	7.0E+05	--	Y
03	9.4E+05	2.8E+05	9.4E+05	1.3E+06	N	N	9.4E+05	2.1E+05	2.1E+05	1.5E+05	Y	Y
04	9.2E+05	1.5E+06	1.5E+06	7.3E+05	Y	Y	4.6E+05	2.9E+05	2.9E+05	1.6E+05	Y	Y
05	4.2E+05	2.7E+05	4.2E+05	2.0E+05	Y	Y	4.2E+05	2.7E+05	2.7E+05	1.3E+05	Y	Y
06	3.5E+05	6.8E+05	6.8E+05	3.8E+05	N	Y	3.5E+05	2.8E+05	2.8E+05	1.6E+05	Y	Y
07	5.5E+05	2.0E+06	2.0E+06	4.4E+05	Y	Y	5.1E+05	5.4E+05	5.1E+05	9.2E+04	Y	Y
08	6.6E+05	4.6E+05	6.6E+05	5.0E+05	Y	N	6.6E+05	2.9E+05	2.9E+05	1.2E+05	Y	Y
08SIL	4.5E+06	--	4.5E+06	1.1E+06	Y	--	1.1E+06	--	1.1E+06	1.7E+05	Y	--
09	7.5E+05	9.7E+05	9.7E+05	2.4E+06	N	N	7.5E+05	3.5E+05	3.5E+05	1.5E+05	Y	Y
10	--	8.1E+05	8.1E+05	1.9E+06	--	N	--	6.3E+05	6.3E+05	3.4E+05	--	Y
11	--	6.6E+06	6.6E+06	6.5E+06	--	Y	--	5.3E+05	5.3E+05	1.3E+05	--	Y
upriver[f]	3.2E+05	--	3.2E+05	6.3E+05	N	--	7.8E+04	--	7.8E+04	5.1E+04	Y	--
Study-Area	4.5E+06	6.6E+06	6.6E+06	6.5E+06	N	Y	3.5E+05	2.1E+05	2.1E+05	9.2E+04	Y	Y

Notes:

a Table presents a direct comparison of the summary statistics shown above. Statistical tests are not presented here and were not peformed on a river mile-basis.

b Concentrations are shown in pg/g.

c RM designations are as follows: RM 1.5-2.5 = "RM 2", RM 2.5 - 3.5="RM 3", etc. Samples collected from RM 10.5-12.0 were designated as "RM 11".

d Historical data include all whole body smallmouth bass concentrations evaluated in the Baseline Human Health Risk Assessment.

e "Y" or "N" indicator is based on a direct comparison of summary statistics (Mean, Max, Min) for 2012 and the prior year indicated. "Y"/"N" does not indicate statistically significant differences in the data sets.

f Upriver samples from the historic data set were collected from river miles 20 and 28; upriver samples from the 2012 data set were collected from river miles 15-17 inclusive.

Abbreviations

N = No

SIL = Swan Island Lagoon

Y = Yes

Table 3. Summary Statistics for Smallmouth Bass PCB Total Congener Data, by Year and Exposure Area

Variable	NumObs	Minimum	Maximum	Mean	Median	Variance	SD	MAD/0.675	Skewness	Kurtosis	CV
VALUE (2002, rm 3)	1	934995	934995	934995	934995	N/A	N/A	0	N/A	N/A	N/A
VALUE (2002, rm 4)	3	456748	918415	629025	511911	6.36E+10	252133	81784	1.639	N/A	0.401
VALUE (2002, rm 5)	1	417007	417007	417007	417007	N/A	N/A	0	N/A	N/A	N/A
VALUE (2002, rm 6)	1	344519	344519	344519	344519	N/A	N/A	0	N/A	N/A	N/A
VALUE (2002, rm 7)	3	505446	548559	527366	528093	4.65E+08	21566	30343	-0.152	N/A	0.0409
VALUE (2002, rm 8)	1	662690	662690	662690	662690	N/A	N/A	0	N/A	N/A	N/A
VALUE (2002, rm 8sil)	3	1072177	4528587	3025466	3475634	3.14E+12	1771632	1561086	-1.07	N/A	0.586
VALUE (2002, rm 9)	1	748164	748164	748164	748164	N/A	N/A	0	N/A	N/A	N/A
VALUE (2002, rm upriver)	6	78129	316984	168599	116842	1.01E+10	100626	35346	0.947	-1.411	0.597
VALUE (2002, Study Area-Wide)	14	344519	4528587	1118068	605624	1.58E+12	1257341	250181	2.288	4.363	1.125
VALUE (2007, rm 10)	2	624518	812057	718288	718288	1.76E+10	132610	139021	N/A	N/A	0.185
VALUE (2007, rm 11)	2	531518	6603200	3567359	3567359	1.84E+13	4293328	4500877	N/A	N/A	1.204
VALUE (2007, rm 2)	1	1422864	1422864	1422864	1422864	N/A	N/A	0	N/A	N/A	N/A
VALUE (2007, rm 3)	2	205341	281128	243235	243235	2.87E+09	53590	56180	N/A	N/A	0.22
VALUE (2007, rm 4)	2	287614	1456025	871820	871820	6.83E+11	826191	866131	N/A	N/A	0.948
VALUE (2007, rm 5)	1	270141	270141	270141	270141	N/A	N/A	0	N/A	N/A	N/A
VALUE (2007, rm 6)	2	274912	679712	477312	477312	8.19E+10	286236	300074	N/A	N/A	0.6
VALUE (2007, rm 7)	2	535659	2007991	1271825	1271825	1.08E+12	1041096	1091425	N/A	N/A	0.819
VALUE (2007, rm 8)	2	289415	454512	371964	371964	1.36E+10	116742	122385	N/A	N/A	0.314
VALUE (2007, rm 9)	2	348688	967239	657963	657963	1.91E+11	437382	458526	N/A	N/A	0.665
VALUE (2007, Study Area-Wide)	18	205341	6603200	1002919	533588	2.20E+12	1484319	378900	3.515	13.43	1.48
VALUE (2012, rm 02)	1	700300	700300	700300	700300	N/A	N/A	0	N/A	N/A	N/A
VALUE (2012, rm 03)	8	148300	1281200	458000	260550	1.69E+11	411026	122980	1.585	1.361	0.897
VALUE (2012, rm 04)	10	160100	733400	387830	328050	3.76E+10	194000	193921	0.633	-0.913	0.5
VALUE (2012, rm 05)	4	134000	203700	171700	174550	8.58E+08	29283	27131	-0.526	0.464	0.171
VALUE (2012, rm 06)	7	163200	379800	239871	208900	6.30E+09	79362	29800	1.212	0.161	0.331
VALUE (2012, rm 07)	8	92300	440400	238313	226000	1.09E+10	104510	68421	0.802	1.321	0.439
VALUE (2012, rm 08)	11	118400	499900	247409	217600	1.12E+10	105978	61972	1.462	2.487	0.428
VALUE (2012, rm 08sil)	8	171800	1057800	446675	371800	8.63E+10	293722	226168	1.445	2.136	0.658
VALUE (2012, rm 09)	9	148500	2379200	527322	318200	4.89E+11	699319	41957	2.919	8.648	1.326
VALUE (2012, rm 10)	5	343600	1868400	857280	692700	3.43E+11	585569	58710	1.833	3.882	0.683
VALUE (2012, rm 11)	12	133800	6465300	2163242	814550	6.66E+12	2580578	890067	1.104	-0.636	1.193
VALUE (2012, upriver)	9	50700	634200	233956	157600	3.52E+10	187673	72202	1.462	1.654	0.802
VALUE (2012, Study Area-Wide)	83	92300	6465300	648206	293400	1.41E+12	1185621	160563	4.138	17.44	1.829

Notes:

all units are in pg/g

Abbreviations:

CV = coefficient of variation

MAD/0.675 = median absolute deviations

rm = river mile

SD = standard deviation

sil = Swan Island Lagoon

Table 4. ProUCL Output for Wilcoxon-Mann-Whitney Test For 2012 vs Combined Historical Study Area-Wide Data Comparison

All Units are pg/g

Wilcoxon-Mann-Whitney 2012 Data vs Combined Historic Data Comparison Test for Full Data Sets without NDs

User Selected Options

From File	PCBs -noUpriver.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Combined Historical Data Mean/Median Less Than or Equal to 2012 Data Mean/Median (Form 1)
Alternative Hypothesis	Combined Historical Data Mean/Median Greater Than 2012 Mean/Median

Area of Concern Data: Combined Historical Data (2002 and 2007)

2012 Data: 2012

Raw Statistics

	Combined Historic Data	2012
Number of Valid Observations	32	83
Number of Distinct Observations	32	83
Minimum	205341	92300
Maximum	6603200	6465300
Mean	1053296	648206
Median	542109	293400
SD	1369138	1185621
SE of Mean	242032	130139

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Combined Historical Data <= Mean/Median of 2012

Combined Historic Data Rank Sum W-Stat	2518
WMW Test U-Stat	4.128
WMW Critical Value (0.050)	1.645
P-Value	0.000018268

Conclusion with Alpha = 0.05

Reject H0, Conclude Combined Historical Data > 2012

P-Value >= alpha (0.05)

Table 5. ProUCL Output for Wilcoxon-Mann-Whitney Test For 2012 vs 2007 Study Area-Wide Data Comparison
All Units are pg/g

Wilcoxon-Mann-Whitney 2007 vs 2012 Comparison Test for Full Data Sets without NDs

User Selected Options	
From File	PCBs -noUpriver.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	2007 Mean/Median Less Than or Equal to 2012 Mean/Median (Form 1)
Alternative Hypothesis	2007 Mean/Median Greater Than 2012 Mean/Median

Area of Concern Data: 2007 data
2012 Data: 2012 data

Raw Statistics

	2007	2012
Number of Valid Observations	18	83
Number of Distinct Observations	18	83
Minimum	205341	92300
Maximum	6603200	6465300
Mean	1002919	648206
Median	533588	293400
SD	1484319	1185621
SE of Mean	349857	130139

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of 2007 <= Mean/Median of 2012

2007 Rank Sum W-Stat	1219
WMW Test U-Stat	2.667
WMW Critical Value (0.050)	1.645
P-Value	0.00383

Conclusion with Alpha = 0.05
Reject H0, Conclude 2007 > 2012
P-Value < alpha (0.05)

Table 6. ProUCL Output for Wilcoxon-Mann-Whitney Test For '2012' vs '2007 plus 2002 Swan Island Lagoon' Study Area-Wide Data Comparison
All Units are pg/g

Wilcoxon-Mann-Whitney 2007+SIL vs 2012 Comparison Test for Full Data Sets without NDs

User Selected Options	
From File	PCBs -noUpriver.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	2007+SIL Mean/Median Less Than or Equal to 2012 Mean/Median (Form 1)
Alternative Hypothesis	2007+SIL Mean/Median Greater Than 2012 Mean/Median

Area of Concern Data: 2007 data plus Swan Island Lagoon data from 2002
2012 Data: 2012 data

Raw Statistics

	2007+SIL	2012
Number of Valid Observations	21	83
Number of Distinct Observations	21	83
Minimum	205341	92300
Maximum	6603200	6465300
Mean	1291854	648206
Median	624518	293400
SD	1646979	1185621
SE of Mean	359400	130139

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of 2007+SIL <= Mean/Median of 2012

2007+SIL Rank Sum W-Stat	1514
WMW Test U-Stat	3.328
WMW Critical Value (0.050)	1.65E+00
P-Value	0.000437

Conclusion with Alpha = 0.05
Reject H0, Conclude 2007+SIL > 2012
P-Value < alpha (0.05)

Table 7. ProUCL Output for Wilcoxon-Mann-Whitney Test For 2012 vs Combined Historical Study Area-Wide Lipid-Normalized Data Comparison
All Units are pg/g

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options	
From File	LipidNormalizedPCB-noUpriver.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Lipid-Normalized Historical Mean/Median Less Than or Equal to Lipid-Normalized 2012 Mean/Median (Form 1)
Alternative Hypothesis	Lipid-Normalized Historical Mean/Median Greater Than Lipid-Normalized 2012 Mean/Median

Area of Concern Data: Lipid-normalized Historical Data (2002 and 2007 combined)
Lipid-Normalized 2012 Data: Lipid-Normalized 2012 Data

Raw Statistics

	Lipid-Normalized Historical	Lipid-Normalized 2012
Number of Valid Observations	32	83
Number of Distinct Observations	32	83
Minimum	38026	16629
Maximum	1241203	1243327
Mean	203910	110515
Median	119460	46193
SD	261345	205145
SE of Mean	46200	22518

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Lipid-Normalized Historical <= Mean/Median of Lipid-Normalized 2012

Lipid-Normalized Historical Rank Sum W-Stat	2622
WMW Test U-Stat	4.777
WMW Critical Value (0.050)	1.645
P-Value	8.8782E-07

Conclusion with Alpha = 0.05
Reject H0, Conclude Lipid-Normalized Historical > Lipid-Normalized 2012
P-Value < alpha (0.05)

Table 8. ProUCL Output for Wilcoxon-Mann-Whitney Test For 2012 vs 2007 Study Area-Wide Lipid-Normalized Data Comparison
All Units are pg/g

Wilcoxon-Mann-Whitney Lipid-Normalized 2007 vs Lipid-Normalized 2012 Comparison Test for Full Data Sets without NDs

User Selected Options	
From File	LipidNormalizedPCB-noUpriver.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Lipid-Normalized 2007 Mean/Median Less Than or Equal to Lipid-Normalized 2012 Mean/Median (Form 1)
Alternative Hypothesis	Lipid-Normalized 2007 Mean/Median Greater Than Lipid-Normalized 2012 Mean/Median

Area of Concern Data: Lipid-Normalized 2007 Data
Lipid-Normalized 2012 Data: Lipid-Normalized 2012 Data

Raw Statistics

	Lipid-Normalized 2007	rmalized 2012
Number of Valid Observations	18	83
Number of Distinct Observations	18	83
Minimum	38026	16629
Maximum	1241203	1243327
Mean	187627	110515
Median	115500	46193
SD	277805	205145
SE of Mean	65479	22518

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Lipid-Normalized 2007 <= Mean/Median of Lipid-Normalized 2012

Lipid-Normalized 2007 Rank Sum W-Stat	1295
WMW Test U-Stat	3.341
WMW Critical Value (0.050)	1.65E+00
P-Value	0.000417

Conclusion with Alpha = 0.05
Reject H0, Conclude Lipid-Normalized 2007 > Lipid-Normalized 2012
P-Value < alpha (0.05)