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SUBJECT: **Technical Memo: Spokane River Central Tendency for PCBs**

Background

This technical memo describes how the central tendency of total polychlorinated biphenyl (PCB) concentrations in the surface water of the Spokane River was developed. According to the schedule laid out by the U.S. Environmental Protection Agency (EPA) in response to court case 2:11-cv-01759-BJR, the instream concentration of total PCBs must be demonstrated to meet 200 pg/L, parts per quadrillion (ppq). This demonstration must occur by December 15, 2020 and should be "based on the annual central tendency of the preceding year." While 2019 is technically the *preceding year*, EPA stated that they support Ecology's use of surface water data collected in 2014, 2015, 2016, and 2018 by LimnoTech on behalf of the Spokane River Regional Toxics Task Force (SRRTTF) to determine the central tendency of total PCB concentrations (B. Nickel 2018, pers. comm.).

Methods

Six surface water monitoring locations were chosen to determine the central tendency of total PCBs in the Spokane River. The instream surface water monitoring locations are shown in Figure 1. Moving from upstream to downstream, the locations are:

- SR9 Barker Bridge
- SR8a Mirabeau Park
- SR7 Trent Ave./Plante's Ferry
- SR4 Greene St.
- SR3 Spokane Gage
- SR1 Below Nine Mile Dam

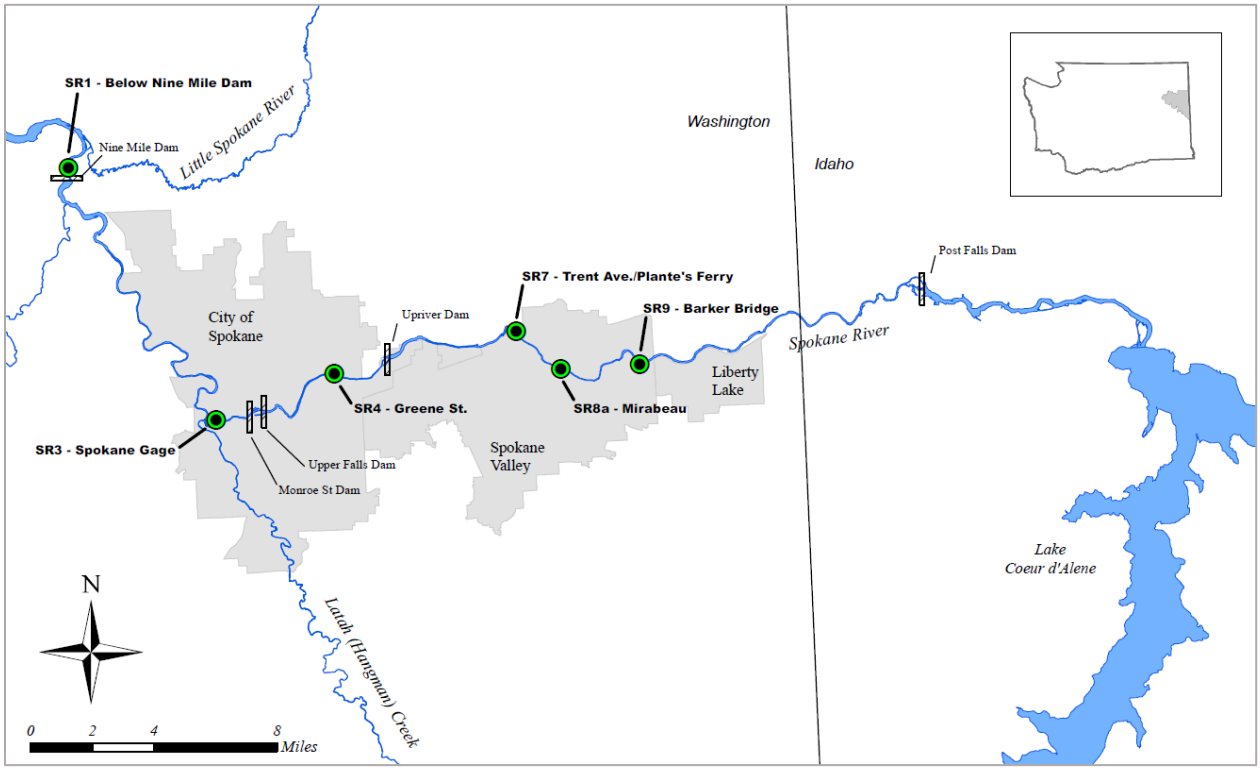

Figure 1. Instream Monitoring Locations on the Spokane River

These six surface water monitoring locations have been the most consistently sampled by LimnoTech over the monitoring period (2014 – 2018) and represent the lowest to highest concentrations of total PCBs measured, the exception being the lower total PCB concentrations found at the outlet of Lake Coeur d'Alene at Post Falls Dam in Idaho. Surface water data from 2014, 2015, and 2018 were collected synoptically and represent August low-flow conditions in the Spokane River. The 2016 surface water data were collected monthly and represent other seasonal and hydrological conditions.

The LimnoTech data used for the Spokane River PCB central tendency analysis were downloaded from the SRRTTF database on May 14, 2020. Instructions for how to use the database are included in the following link on the SRRTTF website: http://srrttf.org/wp-content/uploads/2019/02/SRRTTF-PCB-Database-Instructions-Feb-2019.pdf

The SRRTTF database is dynamic and includes multiple reporting options. For example, users can choose what laboratory method blank censoring level they want. For the central tendency analysis, we chose a censoring level of 5. The censoring level is a standard factor (usually 3, 5, or 10) that is (1) multiplied by the concentration of the chemical of interest detected in the laboratory method blank and (2) compared to the concentration of that chemical in the associated environmental sample. If the calculated method blank censor value is higher than the actual sample result value, then the sample result is considered to be a non-detect and given a value of zero for the purposes of summing total PCBs.

Different levels of method blank censoring are used for different situations. For example, Ecology's "Water Quality Program Permit Writer's Manual" recommends that a censoring level of 10 is appropriate for developing effluent limits (Ecology, 2018). A censoring level of 3 has been used in PCB source identification efforts in the Spokane River by SRRTTF, because it

allows for the inclusion of more congeners (Limnotech, 2016). A censoring level of 3 can produce more false positives, causing calculations of total PCBs to sometimes be biased high, whereas a censoring level of 10 can lead to more false negatives and results that are biased low. A censoring level of 5 generally produces a balance between this low and high bias (Era-Miller, 2020).

While the SRRTTF database has multiple options for reporting data, it automatically treats all tentatively identified (NJ-qualified) results as real values with no option for excluding them. Thus, NJ-qualified result values are included in the total PCB sums for the central tendency analysis. Including NJs has the potential effect of raising total PCB result values. In the case of calculating total PCBs for comparison to the 200 pg/L central tendency threshold, potentially biasing total PCBs higher will only produce a more protective outcome.

At the upstream monitoring locations (SR9 - Barker Bridge and SR8a - Mirabeau Park), more than half of the total PCB results were zero after method blank censoring. For the statistical analyses, half of the detection limit of 0.5 pg/L was used instead of zero.

Descriptive statistics including 95% confidence intervals (CI) around the sample mean were calculated using the data analysis tool pack in Microsoft Excel. CIs around the median were calculated by hand using 95% confidence with the following equation:

$$j = [0.50n - 0.980\sqrt{n}]$$
$$k = [0.50n + 1 + 0.980\sqrt{n}]$$

where

j = Sample rank integer representing the lower confidence interval
k = Sample rank integer representing the upper confidence interval
n = Number of samples
√ = Square root

Both the mean and median were chosen to describe the central tendency of the data because the data were found to be both normally and not-normally distributed depending on the monitoring location. A 95% confidence interval was used to determine both lower and upper bounds of the datasets, although the upper confidence interval is the most important statistic in determining if the central tendency meets the 200 pg/L threshold.

For example, if the sample mean was 175 pg/L ± 15 pg/L, the lower bound of the 95% CI would be 160 pg/L and the upper bound would be 190 pg/L. Therefore, we can be 95% sure that the population mean is between 160 – 190 pg/L, thus meeting the 200 pg/L threshold.

Results

Table 1 shows total PCB concentrations at the six previously discussed locations on the Spokane River from Barker Bridge moving downstream to below Nine Mile Dam (see Figure 1). The data are biased towards low-flow conditions, as the majority of the samples were collected during the August low-flow period. However, the majority of high total PCB concentrations in the dataset occurred during August low-flow compared to the 2016 monthly samples. This suggests that, even with a bias towards low flow, we are likely not missing enough potentially higher concentrations to drive the central tendency higher.

Table 1. Total PCB concentrations[1] in Spokane River surface water (pg/L, ppq).

Date	SR9 - Barker Bridge	SR8a - Mirabeau Park	SR7 - Trent Ave./ Plante's Ferry	SR4 - Greene St.	SR3 - Spokane Gage	SR1 - Below Nine Mile Dam
8/4/18	9	ND	50	27	46	20
8/5/18	ND	ND	56	41	24	25
8/6/18	ND	3	55	3	23	15
8/7/18	21	15	46	12	33	15
8/8/18	ND	ND	75	14	24	46
3/24/16	--	--	3	5	39	36
4/19/16	ND	--	--	17	31	4
5/24/16	--	--	10	ND	40	52
6/16/16	--	--	17	3	22	6
10/26/16	--	--	2	58	186	39
12/1/16	--	--	35	3	--	19
8/18/15	ND	156	159	113	164	--
8/19/15	ND	ND	97	77	87	--
8/20/15	8	ND	31	13	51	--
8/21/15	53	ND	68	25	53	--
8/22/15	ND	ND	108	12	70	--
8/12/14	2	--	115	109	170	137
8/14/14	ND	--	91	102	121	83
8/16/14	ND	--	122	58	324	96
8/18/14	14	--	362	20	194	142
8/20/14	ND	--	119	152	160	188
8/22/14	ND	--	24	11	322	35
8/24/14	ND	--	49	6	24	33

[1] Total PCBs were calculated using tentatively identified compounds (NJ-qualified) treated as detected values and a laboratory method blank censoring level of 5.

-- Missing data in the table indicates that samples were not collected for the specific dates and locations.

ND = PCBs were not detected above the detection limit. A value of ½ the detection limit of 0.5 pg/L was used for the statistical calculations.

Table 2 gives the summary statistics and 95% confidence intervals around both the mean and median for each of the six surface water monitoring locations. The upper bound of the CIs range from 8 – 164 pg/L total PCBs, well below the 200 pg/L threshold.

Table 2. Summary Statistics for Total PCBs (pg/L, ppq) in Spokane River Surface Water.

Statistic	SR9 - Barker Bridge	SR8a - Mirabeau Park	SR7 - Trent Ave./ Plante's Ferry	SR4 - Greene St.	SR3 - Spokane Gage	SR1 - Below Nine Mile Dam
Normal Distribution?	No	No	No	Yes	No	Yes
Mean	6.1	17.6	76.9	38.2	100.4	55.1
Standard Error	3.1	15.5	16.4	9.1	19.9	12.5
Median	0.25	0.25	55.7	16.8	52	35.5
Mode	0.25	0.25	N/A	11.92	24	N/A
Standard Deviation	13	49	77	44	93	53
Sample Variance	172	2402	5915	1898	8725	2804
Kurtosis	10	10	9	1	1	1
Skewness	3	3	3	1	1	1
Range	53	156	360	152	302	184
Minimum	0.25	0.25	1.6	0.25	22	3.8
Maximum	53	156	362	152	324	188
Sum	109	176	1692	879	2208	992
Sample Count	18	10	22	23	22	18
Mean CI (95%)	6.5	35.1	34.1	18.8	41.4	26.3
Mean Upper CI	13	53	111	57	142	81
Mean Lower CI	NM	NM	42.8	19.4	58.9	28.8
Median CI Rank (95%)	5,14	2,9	6,17	7,17	6,17	5,14
Median Upper CI	8	15	108	58	164	83
Median Lower CI	0.25	0.25	31	11	31	19

N/A = Not Applicable.
CI = Confidence Interval; Upper CIs are highlighted to show importance.
NM = Not Measurable as the lower confidence interval falls below zero.

Conclusion

Based on surface water data from 2014, 2015, 2016, and 2018, the central tendency of total PCBs in the Spokane River falls well below the 200 pg/L threshold defined by the schedule laid out by EPA in response to court case 2:11-cv-01759-BJR. This measure of central tendency is based on the upper 95% confidence intervals around the mean and median at each of six monitoring locations from Barker Bridge downstream to below Nine Mile Dam.

Note that LimnoTech conducted trend analysis on the 2014–2018 synoptic data for four of the six monitoring sites (SR9, SR7, SR3, SR1) using linear regression and Mann-Kendall non-parametric statistical tests. They found that total PCB concentrations appear to be largely decreasing in the Spokane River over that period (LimnoTech, 2019).

References

Ecology, 2018. Water Quality Program Permit Writer's Manual. Prepared by M. Eleanor Key, P.E. Washington State Department of Ecology, Water Quality Program. Publication 92-109. https://apps.ecology.wa.gov/publications/summarypages/92109.html

Era-Miller, B., 2020. Technical Memo: Polychlorinated Biphenyl (PCB) Groundwater Sampling Guidance for the Lower Duwamish River [*In Draft*]. Washington State Department of Ecology, Environmental Assessment Program.

LimnoTech, 2015. Spokane River Regional Toxics Task Force Phase 2 Technical Activities Report: Identification of Potential Unmonitored Dry Weather Sources of PCBs to the Spokane River. Prepared for the Spokane River Regional Toxics Task Force by LimnoTech, Ann Arbor, Michigan. April 12, 2015.

LimnoTech, 2016. Spokane River Regional Toxics Task Force 2015 Technical Activities Report: Continued Identification of Potential Unmonitored Dry Weather Sources of PCBs to the Spokane River. Prepared for the Spokane River Regional Toxics Task Force by LimnoTech, Ann Arbor, Michigan. November 16, 2016.

LimnoTech, 2017. Spokane River Regional Toxics Task Force 2016 Monthly Monitoring Report. Prepared for the Spokane River Regional Toxics Task Force by LimnoTech, Ann Arbor, Michigan. May 24, 2017.

LimnoTech, 2019. Water Column Status and Trend Analysis – presentation to the Spokane River Regional Toxics Task Force by Dave Dilks from LimnoTech, Ann Arbor, Michigan. May 30, 2019.