

Appendix J

Pre and Post-Remediation SWAC Calculations for the Remedial Reach

Table J-1
GIS-based method: Pre and Post-Remediation SWACs for Alternative S-3¹
Area 1, OU5 Kalamzoo River

Calculation ID	Description	Remedial Reach ²			
		Interval 1 (0-6 in)	Interval 2 (6-12 in)	Interval 3 (12-24 in)	All Intervals (0-24 in)
S-3A	Stream tube method, unmodified tubes, SWAC based only on transect data, excavated tubes replaced with a concentration of 1 mg/kg.				
	Pre-Remediation SWAC	1.44	2.44	11.24	4.37
	Post-Remediation SWAC	1.09	1.12	1.83	1.30
S-3B	Stream tubes extended or truncated to fit hot spot footprint ³ , SWAC based only on transect data, excavated footprint replaced with 1 mg/kg.				
	Pre-Remediation SWAC	1.16	1.37	2.45	1.57
	Post-Remediation SWAC	1.08	1.10	0.97	1.06
S-3C	Stream tubes extended or truncated to fit hot spot footprint ³ , average IPWCs inside hot spot footprint include both transect and non-transect data (pre-excavation), excavated footprint replaced with 1 mg/kg.				
	Pre-Remediation SWAC	1.76	2.35	2.66	2.21
	Post-Remediation SWAC	1.09	1.12	1.00	1.07

Notes:

- Alternative S-3 (Hot Spot Removal) includes excavation of KPT-19, KPT-20, KRT-4, KRT-5, and S-IM1.
- The Remedial Reach extends approximately 3 miles, from RM72.4 (upstream of KPT 19) to RM69.4 (downstream of S-IM1).
- For S-3B and S-3C, a value of 1 mg/kg was applied to truncated stream tubes outside of the remediation footprint in both pre- and post-remediation SWAC calculations.

RM = River Mile

IPWC = Interval Participation Weighted Concentration

SWAC = Surface-area Weighted Average Concentration

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Table J-2
Arithmetic Method: Pre- and Post-Remediation SWAC and Bounds in Remedial Reach for Remedial Alternative S-3
Area 1, OU5 Kalamzoo River

	SWAC (mg/kg)											
	Lower Confidence Limit			Average			Upper Confidence Limit			Combined Intervals		
	Interval 1	Interval 2	Interval 3	Interval 1	Interval 2	Interval 3	Interval 1	Interval 2	Interval 3	LCL	Average	UCL
Pre Remediation	0.49	0.20	0.18	1.41	2.46	1.55	2.33	4.73	2.91	0.87	1.92	2.96
Post Remediation	0.35	0.06	0.00	0.71	1.57	0.56	1.06	3.07	1.27	0.39	1.06	1.73

Notes:

LCL - lower confidence limit

UCL - upper confidence limit

SWAC - Surface area weighted average concentration

IPWCs - Interval participation weighted concentrations

1. Arithmetic Method- IPWCs for all data (transect and non-transect) were grouped into two categories: 1) those in the hot spot area to be removed and 2) those in the remainder of the remedial reach. See below for SWAC equation.

2. Pre SWAC equation:
$$\frac{C_{\text{hotspot}} * A_{\text{hot spot}} + C_{\text{reach}} * A_{\text{reach}}}{A_{\text{total}}}$$

Where C_{hotspot} = Average concentration in hot spots
 C_{reach} = Average concentration in the remainder of the remedial reach
 A_{hotspot} = Area of the hot spots
 A_{reach} = Area of the remainder of the remedial reach
 A_{total} = Total area of the remedial reach

3. Post SWAC equation: Used Pre SWAC equation where C_{hotspot} was replaced with 1 mg/kg.

4. The Remedial Reach extends approximately 3 miles, from RM72.4 (upstream of KPT 19) to RM69.4 (downstream of S-IM1) and includes hot spots KPT-19, KPT-20, KRT-4, KRT-5, and S-IM1.

Interval 1 = 0" to 6"
 Interval 2 = 6" to 12"
 Interval 3 = 12" to 24"

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Table J-3
GIS-based method: Pre and Post-Remediation SWACs for Alternative S-4¹
Area 1, OU5 Kalamazoo River

Calculation ID	Description	Remedial Reach ²				
		Interval 1 (0-6 in)	Interval 2 (6-12 in)	Interval 3 (12-24 in)	All Intervals (0-24 in)	
S-4A	Stream tube method, unmodified tubes, SWAC based only on transect data, excavated tubes (whole) containing hot spots or with any part within 30 ft of the bank in Section 3 replaced with a concentration of 1 mg/kg.	Pre-Remediation SWAC	1.44	2.44	11.24	4.37
		Post-Remediation SWAC	0.55	0.42	0.38	0.46
S-4B	Stream tubes extended or truncated to fit hot spot footprint ² , SWAC based only on transect data, excavated hot spot footprint and whole edge tubes with any part within 30 ft of bank in Section 3 replaced with 1 mg/kg.	Pre-Remediation SWAC	1.16	1.37	2.45	1.57
		Post-Remediation SWAC	0.36	0.41	0.38	0.38
S-4C	Stream tubes extended or truncated to fit hot spot footprint ² , average IPWCs inside hot spot footprint include both transect and non-transect data (pre-excavation), excavated hot spot footprint and whole edge tubes with any part within 30 ft of bank in Section 3 replaced with 1 mg/kg.	Pre-Remediation SWAC	1.76	2.35	2.66	2.21
		Post-Remediation SWAC	0.37	0.43	0.41	0.40
S-4D	Same as S-4A, except edge tubes in Section 3 sliced so that edges include only portions of tubes within 30 ft of bank.	Pre-Remediation SWAC	1.44	2.44	11.24	4.37
		Post-Remediation SWAC	0.59	0.73	1.32	0.83
S-4E	Same as S-4B, except edge tubes in Section 3 sliced so that edges include only portions of tubes within 30 ft of bank.	Pre-Remediation SWAC	1.16	1.37	2.45	1.57
		Post-Remediation SWAC	0.36	0.41	0.38	0.38
S-4F	Same as S-4C, except edge tubes in Section 3 sliced so that edges include only portions of tubes within 30 ft of bank.	Pre-Remediation SWAC	1.76	2.35	2.66	2.21
		Post-Remediation SWAC	0.60	0.72	0.56	0.63

Notes:

- Alternative S-4 (Hot Spot and Edge Removal) includes excavation of hot spots KPT-19, KPT-20, KRT-4, KRT-5, and S-IM1 and river edges in Section 3 (30' on each bank).
- The Remedial Reach extends approximately 3 miles, from RM72.4 (upstream of KPT 19) to RM69.4 (downstream of S-IM1).
- For S-3B and S-3C, a value of 1 mg/kg was applied to truncated stream tubes outside of the remediation footprint in both pre- and post- remediation SWAC calculations.

RM = River Mile

IPWC = Interval Participation Weighted Concentration

SWAC = Surface-area Weighted Average Concentration

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Table J-4
Arithmetic Method: Pre- and Post-Remediation SWAC and Bounds in Remedial Reach for Remedial Alternative S-4
Area 1, OU5 Kalamazoo River

	SWAC (mg/kg)											
	Lower Confidence Limit			Average			Upper Confidence Limit			Combined Intervals		
	Interval 1	Interval 2	Interval 3	Interval 1	Interval 2	Interval 3	Interval 1	Interval 2	Interval 3	LCL	Average	UCL
	Pre Remediation	0.49	0.30	0.25	1.36	1.81	1.39	2.23	3.32	2.53	0.86	1.58
Post Remediation	0.34	0.43 ^a	0.00	0.62	0.61	0.36	0.90	0.79	0.81	0.50	0.60	0.71

Notes:

a - Post-remediation SWACs do not include sample variability from hotspots and edges. LCL and UCL values calculated solely on sample variability of the remaining reach concentrations. For interval 2, this results in a slightly higher post-remediation LCL than the pre-remediation LCL.

LCL - lower confidence limit (2.5%)

UCL - upper confidence limit (97.5%)

SWAC - Surface area weighted average concentration

IPWCs - Interval participation weighted concentrations

1. Arithmetic Method- IPWCs for all data (transect and non-transect) were grouped into two categories: 1) those in the hot spot area and Section 3 edges to be removed and 2) those in the remainder of the remedial reach. Edges defined as 30 feet from river shore in Section 3. See below for SWAC equation.

2. Pre SWAC equation:
$$\frac{C_{\text{hotspot\&edges}} \cdot A_{\text{hotspot\&edges}} + C_{\text{reach}} \cdot A_{\text{reach}}}{A_{\text{total}}}$$
 Where $C_{\text{hotspot\&edges}}$ = Average concentration in hot spots
 C_{reach} = Average concentration in the remainder of the remedial reach
 $A_{\text{hotspot\&edges}}$ = Area of the hot spots
 A_{reach} = Area of the remainder of the remedial reach
 A_{total} = Total area of the remedial reach

3. Post SWAC equation: Used Pre SWAC equation where $C_{\text{hotspot\&edges}}$ was replaced with 1 mg/kg.

4. The Remedial Reach extends approximately 3 miles, from RM72.4 (upstream of KPT 19) to RM69.4 (downstream of S-IM1) and includes hot spots KPT-19, KPT-20, KRT-4, KRT-5, and S-IM1.

Interval 1 = 0" to 6"

Interval 2 = 6" to 12"

Interval 3 = 12" to 24"

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Table J-5
Summary of SWAC bounds for Remedial Alternatives S-3 and S-4
Area 1, OU5 Kalamazoo River

Alternative S-3	Remedial Reach^a SWACs (mg/kg)											
	Interval 1			Interval 2			Interval 3			Combined Intervals		
	LCL	Best Est.(S-3C)	UCL	LCL	Best Est.(S-3C)	UCL	LCL	Best Est.(S-3C)	UCL	LCL	Best Est.(S-3C)	UCL
Pre Remediation	0.49	1.76	2.33	0.20	2.35	4.73	0.18	2.66	2.91	0.87	2.21	2.96
Post Remediation	0.35	1.09 ^d	1.06	0.06	1.12	3.07	0.00	1.00	1.27	0.39	1.07	1.73

Alternative S-4	Remedial Reach SWACs (mg/kg)											
	Interval 1			Interval 2			Interval 3			Combined Intervals		
	LCL	Best Est. (S-4F)	UCL	LCL	Best Est. (S-4F)	UCL	LCL	Best Est. (S-4F)	UCL	LCL	Best Est. (S-4F)	UCL
Pre Remediation	0.49	1.76	2.23	0.30	2.35	3.32	0.25	2.66 ^d	2.53	0.86	2.21	2.31
Post Remediation	0.34	0.60	0.90	0.43 ^c	0.72	0.79	0.00	0.56	0.81	0.50	0.63	0.71

Notes:

LCL - lower confidence limit

UCL - upper confidence limit

SWAC - Surface area weighted average concentration

IPWCs - Interval participation weighted concentrations

a. The Remedial Reach extends approximately 3 miles, from RM72.4 (upstream of KPT 19) to RM69.4 (downstream of S-IM1) and includes hot spots KPT-19, KPT-20, KRT-4, KRT-5, and S-IM1.

b. Best Estimate corresponds to calculation methods S-3C and S-4F, which are the most representative of site conditions based on the available data by limiting the post-remediation "credit" for removal to the actual footprint of excavation (rather than whole stream tubes), and consider all of the available sediment data within a hot spot area.

c. Post-remediation SWACs do not include sample variability from hotspots and edges. LCL and UCL values calculated solely on sample variability of the remaining reach concentrations. For interval 2, this results in a slightly higher post-remediation LCL than the pre-remediation LCL.

d. Best estimate in this scenario is slightly above the UCL calculated. The difference between these two methods is that one weights each hot spot area separately and the other weights the aggregate average hot spot concentration. The UCL is based on the latter, which has lower variability.

Interval 1 = 0" to 6"

Interval 2 = 6" to 12"

Interval 3 = 12" to 24"

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Table J-6
Individual Hot Spot Concentrations Used in GIS-Based Post-Remediation SWAC Estimate
Area 1, OU5 Kalamazoo River

Hot Spot ID	Depth Interval	Average PCB IPWC ^a (mg/kg)	Number of Observations	Minimum IPWC (mg/kg)	Maximum IPWC (mg/kg)
KPT19	1	1.38	21	0.115	8.9
	2	1.54	20	0.0670	19.7
	3	6.60	15	0.0575	45.8
KPT20	1	32.7	3	1.88	72.2
	2	12.6	4	0.0530	39.0
	3	39.2	1	39.2	39.2
KRT4	1	13.9	4	0.124	54.1
	2	36.3	4	0.168	142
	3	36.0	4	0.145	122
KRT5	1	14.7	8	0.112	113
	2	41.7	8	0.151	290
	3	36.3	7	0.0750	181
S-IM1	1	59.2	7	0.533	178
	2	47.9	7	0.425	142
	3	34.6	7	0.0133	97.5

Notes:

a. Average interval IPWC for all sample cores within hotspot.

IPWC = Interval participation weighted concentration

SWAC - Surface-area weighted average concentration

mg/kg = milligrams per kilograms

Interval 1 = 0" to 6"

Interval 2 = 6" to 12"

Interval 3 = 12" to 24"

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Table J-7
Inputs for S-3 Arithmetic Method Calculations for Hot Spot Concentrations in the Remedial Reach
Area 1, OU5 Kalamzaoo River

Depth Interval	Area (ft ²)	Number of Samples	Average PCB Concentration ^a	Concentration LCL	Concentration UCL	Post-Remediation Concentration
Combined Hot Spot Areas						
Interval 1	119,790	43	16.6	4.12	29.1	1
Interval 2	119,790	43	20.8	3.94	37.7	1
Interval 3	119,790	34	22.9	8.43	37.4	1
Combined Intervals	119,790	120	19.9	11.6	28.2	1
Mid-River Area (remainder of river excluding hot spots)						
Interval 1	2,532,578	31	0.692	0.323	1.06	na
Interval 2	2,532,578	32	1.59	0.0190	3.17	na
Interval 3	2,532,578	10	0.535	0.000	1.28	na
Combined Intervals	2,532,578	73	1.07	0.366	1.76	na

Notes:

a. average concentration of all individual samples within each area and interval.

all concentrations reported in mg/kg

LCL - lower confidence limit

UCL - upper confidence limit

SWAC - Surface-area weighted average concentration

mg/kg = milligrams per kilograms

ft² = Square feet

Interval 1 = 0" to 6"

Interval 2 = 6" to 12"

Interval 3 = 12" to 24"

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Table J-8
Inputs for S-4 Arithmetic Method Calculations for Hot Spot and 30-foot Edge Concentrations in the Remedial Reach
Area 1, OU5 Kalamazoo River

Depth Interval	Area (ft ²)	Number of Samples	Average PCB Concentration ^a	Concentration LCL	Concentration UCL	Post-Remediation Concentration
River Edges (extend 30 feet from each bank)						
Interval 1	523,347	20	0.77	0.19	1.3	1
Interval 2	523,347	20	2.3	0	4.8	1
Interval 3	523,347	6	0.76	0	2.2	1
Combined Hot Spot Areas						
Interval 1	119,790	43	16.6	4.1	29.1	1
Interval 2	119,790	43	20.8	3.9	37.7	1
Interval 3	119,790	34	22.9	8.4	37.4	1
Mid-River Area (remainder of river excluding hot spots)						
Interval 1	1,889,441	11	0.56	0.35	0.77	na
Interval 2	1,889,441	12	0.48	0.23	0.72	na
Interval 3	1,889,441	4	0.20	0	0.43	na

Notes:

a. average concentration of all individual samples within each area and interval.

all concentrations reported in mg/kg

LCL - lower confidence limit

UCL - upper confidence limit

SWAC - Surface-area weighted average concentration

mg/kg = milligrams per kilograms

ft² = Square feet

Interval 1 = 0" to 6"

Interval 2 = 6" to 12"

Interval 3 = 12" to 24"

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