

Water Column Trend Assessment via Semi Permeable Membrane Devices (SPMDs) Low and Moderate Flow Regimes: 2022-2023

TTWG Meeting


May 31, 2023



Background

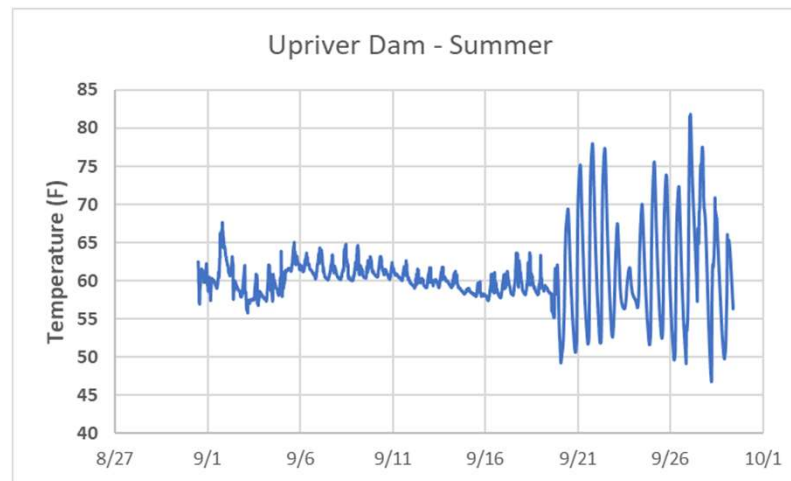
- SPMDs used to monitor water column PCBs for trend assessment
- First round of Task Force monitoring in 2020-2021
 - 3 rounds of sampling at four locations to capture seasonal flow regimes
 - Summer (low flow)
 - Winter (moderate flow)
 - Spring (high flow)
- Laboratory data from summer and winter SPMD deployments has been received and analyzed
 - Data have not been validated

Sampling Details

- Three one-month long SPMD deployments at five locations
 - Four primary trend stations, plus Mirabeau Point
 - Spring data has been collected but will not be analyzed by the Task Force due to timing of Task Force sunseting
 - Grab sampling occurred at the date of deployment, midway through the deployment, and the date of retrieval. Sampled for:
 - PCB
 - TOC/DOC
 - TSS
 - Summer grab sample results have been received and analyzed. Winter grab samples received 5/31 and will be incorporated into the draft report
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Sampling Details

- Temperature probes deployed to confirm that SPMDs remain submerged across deployment
 - All temperature probes showed malfunction
 - No visual indication of tampering, damage, or removal from water on the SPMDs



- Additional SPMD location added at Mirabeau Point during low flow
 - Prior grab sampling showed occasional high PCB concentrations at Mirabeau Point

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- This map illustrates the Spokane River area, highlighting the Washington-Idaho state line. Key features include:
- Dams:** Nine Mile Dam, Upriver Dam, and Mirabeau Point.
 - Geographic Features:** Lake Spokane, Lake Coeur d'Alene, and the Spokane River.
 - Urban Areas:** The city of Spokane is shown, with labels for E. Trent Avenue and Post Falls.
 - Infrastructure:** The Washington-Idaho State Line is clearly marked.
- A north arrow is located in the top right corner of the map.

Data Processing

- SPMD PCB concentrations are processed to estimate water column PCB concentrations
- First, estimate water column freely dissolved PCBs from SPMD data
 - USGS spreadsheet model
- Then, estimate water column total PCBs from freely dissolved PCBs

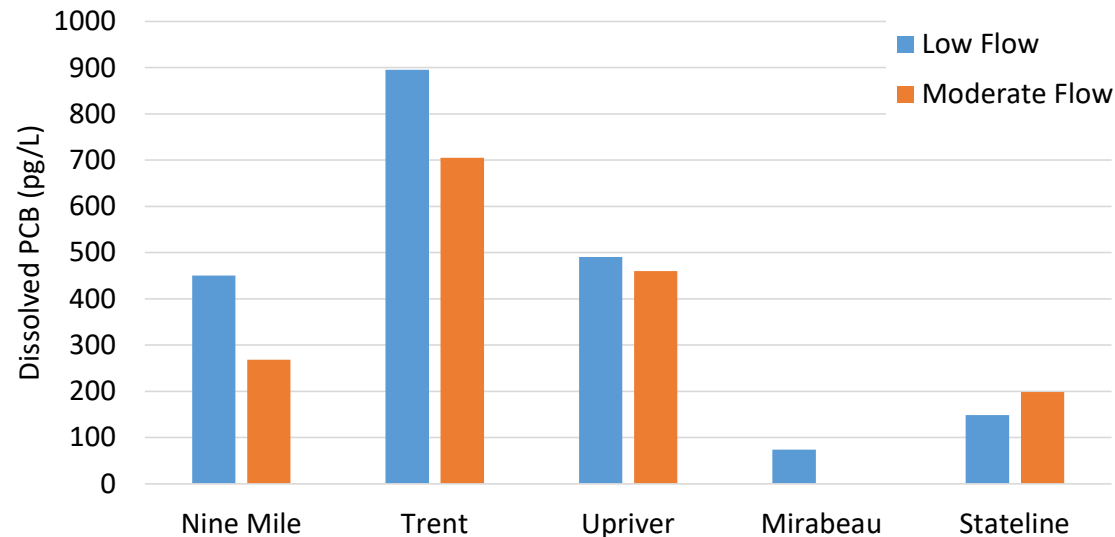
$$f_d = 1 / (1 + K_{oc,p}[POC] + K_{oc,d}[DOC]) \quad (1)$$

$$C_t = C_d / f_d \quad (2)$$

where:

- f_d = fraction of total PCB concentration in the freely dissolved phase
- $K_{oc,p}$ = organic carbon partition coefficient to particulate organic carbon (l/mg)
- $[POC]$ = particulate organic carbon concentration (mg/l)
- $K_{oc,d}$ = organic carbon partition coefficient to dissolved organic carbon (l/mg)
- $[DOC]$ = dissolved organic carbon concentration (mg/l)
- C_t = water column total PCB concentration
- C_d = water column dissolved phase PCB concentration

SPMD Measured Freely Dissolved PCB



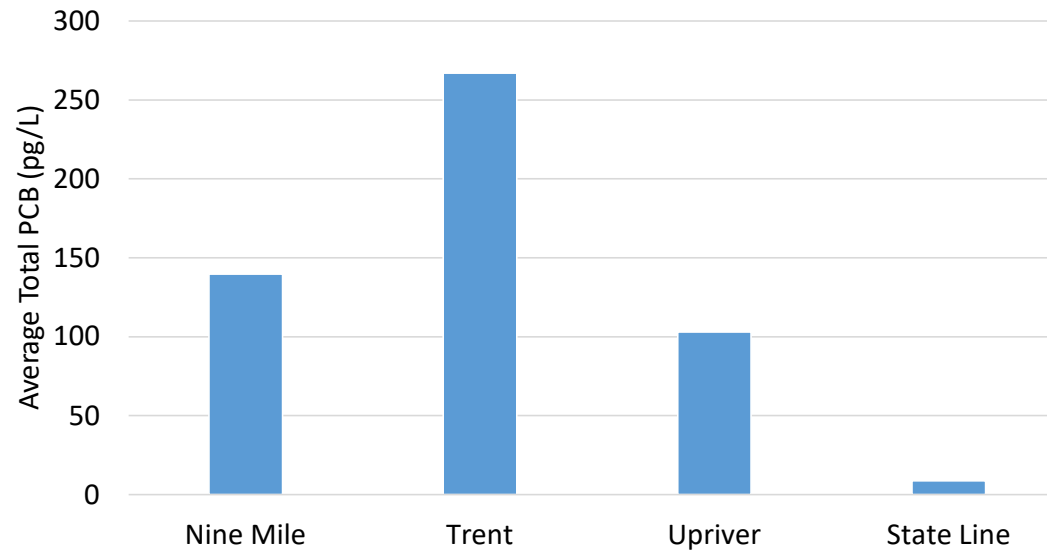
- PCB concentrations were greatest at Trent Ave in both Low and Moderate Flow conditions
- Concentrations at Mirabeau Point do not exceed Stateline concentrations
 - Indicates there is no significant unmonitored load entering between Mirabeau Point and Stateline

SPMD Measured Freely Dissolved vs Total PCBs

	Low Flow		Moderate Flow	
Location	Total	Dissolved	Total	Dissolved
Stateline	164	148.5	240.5	198.7
Mirabeau	92.9	74.2	NA	NA
Upriver	577.2	490.1	503.7	460
Trent	1047.6	895.4	790.8	704.7
Nine Mile	506	450.1	300.9	268.1

- PCBs were predominantly in the dissolved phase
 - Consistent with previous findings
- Dissolved PCBs used in trend assessment to reduce uncertainty
 - Uncertainty due to temporal variability in organic carbon concentrations
 - Uncertainty due to dissolved organic partitioning coefficients

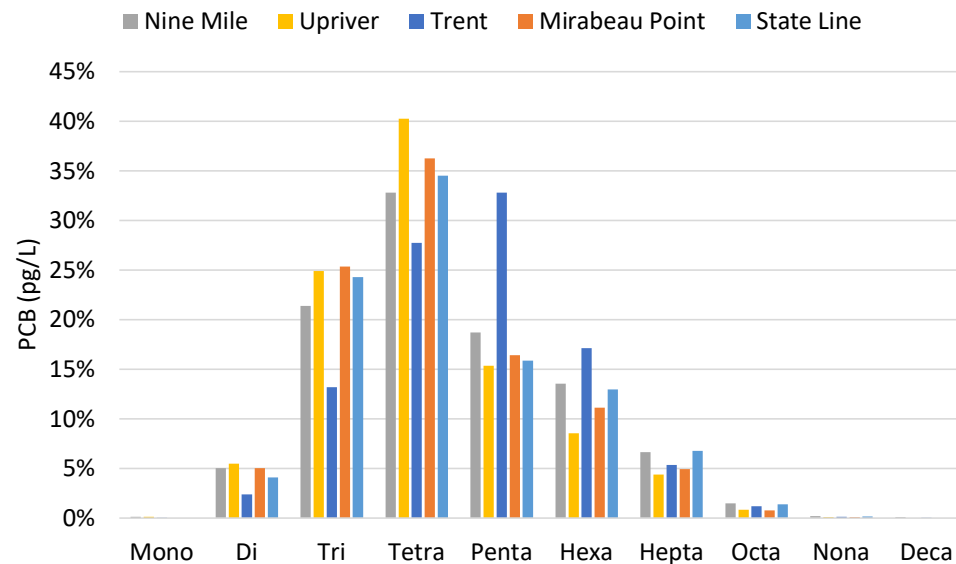
Grab Sample Measured PCBs



- Data shown are for low flow only. Moderate flow results received 5/31 and will be incorporated into the draft report
- Greatest concentrations observed at Trent Ave.
- All stations showed lower grab sample concentrations than SPMD

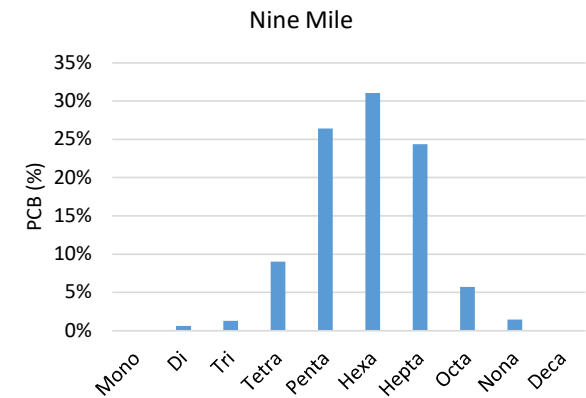
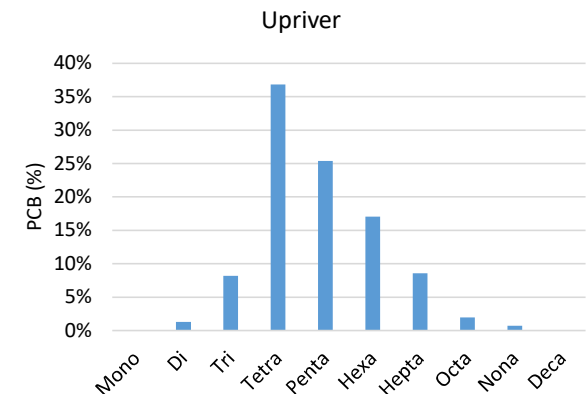
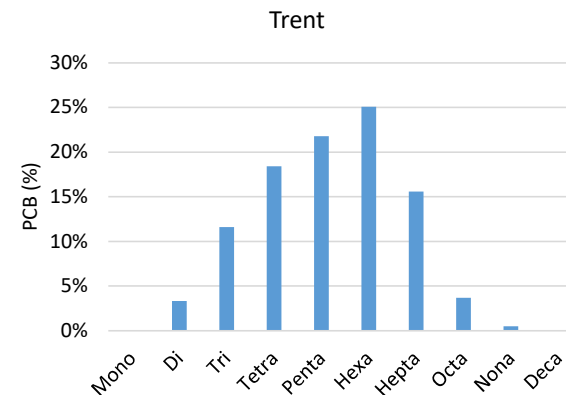
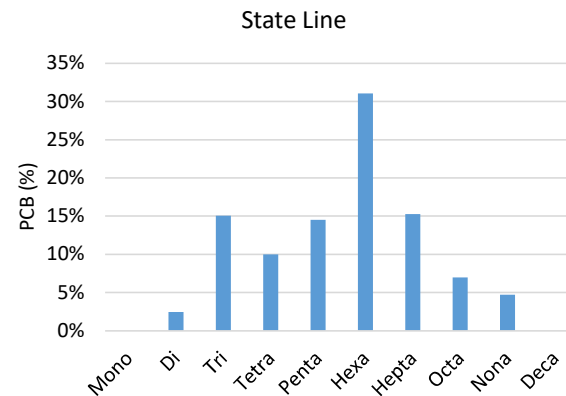
SPMD Measured Homolog Distribution

- Tetra-chloro homolog dominated all stations at both flows **except** Trent Ave. during low flow
 - Trent Ave (low flow) dominated by the penta-chloro homolog



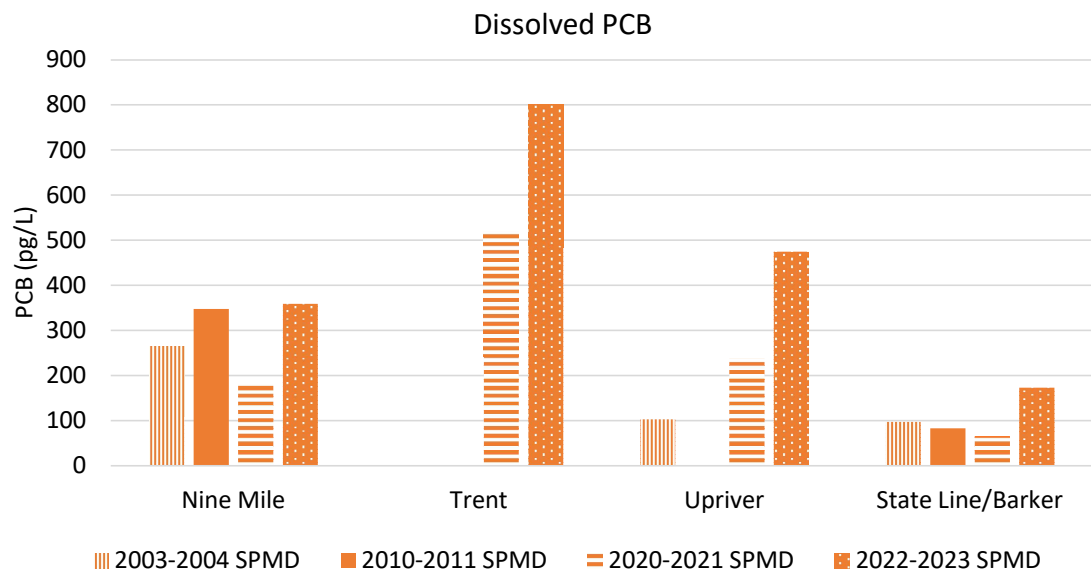
Grab Sample Homolog Distribution

- Higher concentration of heavier homologs than the SPMDs
- Stateline, Trent, and Nine Mile dominated by hexa-chloro homolog
- Upriver dominated by tetra-chloro homolog



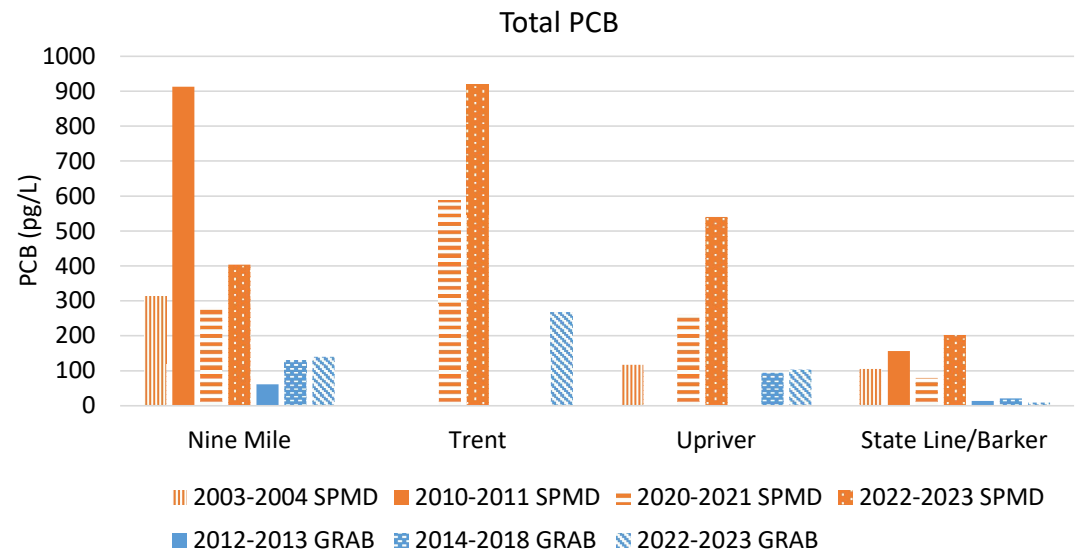
Comparison to Historic Data: Freely Dissolved

- Historic data includes:
 - SRRTTF: 2020-2021
 - Ecology: 2003-2004 and 2010-2011
- Too soon to evaluate trend
 - 2022-2023 data are missing high flow results, when concentrations are typically lowest




Comparison to Historic Data: Total PCB

- Grab sample concentrations always less than SPMD concentrations
- Too soon to evaluate trend
 - 2022-2023 data are missing high flow results, when concentrations are typically lowest



Key Findings

- PCB concentrations measured by SPMDs and grab samples were highest at East Trent Ave. and lowest at State Line
 - SPMD measured concentrations are higher than those measured via grab samples which agrees with historic data
 - SPMD results suggest that no significant unmonitored load is entering the river between State Line and Mirabeau Point
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Next Steps

- Near Term
 - Laboratory analysis of spring high flow SPMDs
 - Calculate water column PCB concentration for high flow at each trend station
 - Calculate annual average concentration at each trend station
- Longer term
 - Continue to sample at the four primary locations every two years during three flow regimes to inform trend assessment
 - Maintain the parallel collection of grab samples