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 sunsetting
• 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
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
Sampling Locations

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

1. WA/ID State Line
2. Mirabeau Point
3. Downstream of Upriver Dam
4. Upstream of E. Trent Avenue
5. Nine Mile Dam
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

\[
f_d = \frac{1}{1 + K_{OCp}[POC] + K_{OCd}[DOC]}
\]

\[
C_t = C_d / f_d
\]

where:

- \( f_d \) = fraction of total PCB concentration in the freely dissolved phase
- \( K_{OCp} \) = organic carbon partition coefficient to particulate organic carbon (l/mg)
- \([POC]\) = particulate organic carbon concentration (mg/l)
- \( K_{OCd} \) = 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

<table>
<thead>
<tr>
<th>Location</th>
<th>Low Flow</th>
<th>Moderate Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Dissolved</td>
</tr>
<tr>
<td>Stateline</td>
<td>164</td>
<td>148.5</td>
</tr>
<tr>
<td>Mirabeau</td>
<td>92.9</td>
<td>74.2</td>
</tr>
<tr>
<td>Upriver</td>
<td>577.2</td>
<td>490.1</td>
</tr>
<tr>
<td>Trent</td>
<td>1047.6</td>
<td>895.4</td>
</tr>
<tr>
<td>Nine Mile</td>
<td>506</td>
<td>450.1</td>
</tr>
</tbody>
</table>

- 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

• 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.
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