Summary of Past Studies

SRRTTF Data Synthesis Workshop
May 30 - 31, Spokane WA
Objective

• Summarize what has been learned from past studies
  – How do they inform our assessment of management objectives?
    • Characterize sources
    • Identify and implement controls
    • Make progress toward achieving water quality standards

• Review each study individually this morning
  – Afternoon session will take a more holistic look

• What have we learned?
  – What are key information gaps?
Studies Considered

- **Groundwater**
  - Spokane County/Ecology, 2015-2016
  - Ecology, 2016
  - Kaiser, 2007-2017
  - Ecology, 2013

- **Water Column and Discharges**
  - Spokane County, 2016

- **Atmospheric Deposition**
  - Ecology, 2016-2017

- **Sediments**
  - Ecology, 2004, 2013, 2018

- **Biofilm, Macroinvertebrates**
  - Ecology, 2018

- **Fish**
  - Ecology, 2005 and 2012
Groundwater Studies

• Spokane County/Ecology, 2015-2016
• Kaiser, 2007-2017
• Ecology, 2013
Groundwater: Spokane County/Ecology, 2015-2016

• Seven locations
  – Four groundwater monitoring wells
  – Three surface springs
  – Locations chosen to represent groundwater flowing into the Spokane River or Little Spokane River
Groundwater: Spokane County/Ecology, 2015-2016

• Sample timing
  – Sampling events were planned to capture a range of flow conditions in the river
  – Sample Event #1
    • 8/24/2015
    • 9/14/2015
  – Sample Event #2
    • 2/16/2016
    • 2/17/2016
  – Sample Event #3
    • 5/17/2016
Groundwater: Spokane County/Ecology, 2015-2016

- Concentrations are low
  - Majority are <5 pg/l
- Two observations above 30 pg/l
  - Average of all blank samples was 76.0 pg/L
- Conclusion
  - Results did not indicate a significant source of PCB contamination in groundwater
Kaiser Groundwater

• 174 samples from 25 wells collected between 2007-2017
• Wells represent four distinct areas
  – Up-gradient
    • Located on the eastern side of the Kaiser facility
  – Kaiser Plume:
    • Down-gradient leading edge of PCB impacted groundwater from on-site sources at the Kaiser facility
  – West Discharge Ravine
  – River Boundary
    • Located on the western (groundwater downgradient) side of the Kaiser facility near the property boundary
Kaiser Groundwater
### Kaiser Groundwater

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean PCB sum (pg/L)</th>
<th>Median PCB sum (pg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plume</td>
<td>8,910</td>
<td>4,800</td>
</tr>
<tr>
<td>Upgradient</td>
<td>206</td>
<td>67.9</td>
</tr>
</tbody>
</table>

- Elevated concentrations in plume
- Up-gradient concentrations higher than observed in Ecology/County wells
  - Occasional spikes, potentially decreasing over time
Urban Waters Groundwater Seeps - 2013

- Two stations downriver of Upriver Dam
  - Concentrations < 100 pg/l
General Electric Spokane Site Groundwater, 2016

- National Priorities List site undergoing cleanup
- Ecology collected groundwater PCB data in October 2016
  - Eight wells sampled
- Total PCB concentrations ranged from 100-100,000 pg/l
Groundwater: What Has Been Learned

- Groundwater PCBs at most locations are lower than concentrations in the river itself
- Elevated PCB concentrations at known contaminated sites
  - Kaiser
  - General Electric
- Some evidence of contamination up-gradient of Kaiser
  - Sporadic spikes, unclear the extent to which they still exist
Atmospheric Deposition: Ecology, 2016-2017

- Quarterly seasonal bulk deposition samples
- Three sites representing different land uses
  - Turnbull National Wildlife Refuge: regional background
  - Monroe Street: urban-residential
  - Augusta Avenue: urban-commercial
Atmospheric Deposition Results

• Positive correlation between urbanization and atmospheric deposition
  – Results generally consistent with those seen in King County

• Differences in congener patterns seen between all three sites

• Significant level of variability seen in side-by-side replicates
Water Column and Discharge Studies

- Spokane County, 2016
- SRRTTF, 2014, 2015, 2016a, 2016b, 2019

  - Gather representative data to quantify PCB contamination in Washington reaches of the Spokane River
  - Analyzed PCBs in river water, wastewater effluents, stormwater, suspended particulate matter, bottom sediments, sediment cores, and fish tissue.

- Study area covered the Spokane River from the Idaho border to the mouth at the Columbia River.
  - We will focus on data from Nine Mile Dam and upstream

- Water column sampling
  - Sampling conducted using semipermeable membrane devices (SPMDs)
    - Passive samplers which consist of polyethylene membranes filled with a synthetic lipid that mimics biological uptake of dissolved PCBs
  - Five locations in SRRTTF study area

<table>
<thead>
<tr>
<th>Location</th>
<th>Station</th>
<th>RM</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>State line</td>
<td>Stateline</td>
<td>96.1</td>
<td>10/1 - 10/29/2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1/28 - 2/24/2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4/14/04 - 5/12/2004</td>
</tr>
<tr>
<td>Behind Upriver Dam at mid-depth</td>
<td>Upriver Dam</td>
<td>80.3</td>
<td>10/1 - 10/29/2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1/28 - 2/25/2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4/14 - 5/12/2004</td>
</tr>
<tr>
<td>Behind Upriver Dam near bottom</td>
<td>UPRIVER BOT</td>
<td>80.3</td>
<td>10/1 - 10/29/2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1/28 - 2/25/2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4/14 - 5/12/2004</td>
</tr>
<tr>
<td>Behind Monroe St./Upper Falls Dam</td>
<td>Monroe St</td>
<td>74.8</td>
<td>10/2 - 10/29/2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1/28 - 2/25/2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4/14 - 5/12/2004</td>
</tr>
<tr>
<td>Ninemile Dam Pool upstream of Plese Flats</td>
<td>Ninemile1</td>
<td>63.6</td>
<td>10/1 - 10/29/2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1/28 - 2/24/2004*</td>
</tr>
<tr>
<td>Ninemile Dam Pool near Sevenmile Bridge</td>
<td>Ninemile2</td>
<td>62.4</td>
<td>4/14 - 5/12/2004</td>
</tr>
</tbody>
</table>

- Water column sampling
  - SPMD measures dissolved PCBs
  - Results converted to total PCB

<table>
<thead>
<tr>
<th>Location</th>
<th>RM</th>
<th>Harmonic Mean Flow (L/sec)</th>
<th>Mean Total PCB Cd (pg/l)</th>
<th>Fraction C4</th>
<th>Mean Total PCB Cw (pg/l)</th>
<th>Total PCB Load (mg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stateline</td>
<td>96.1</td>
<td>52,151&lt;sup&gt;a&lt;/sup&gt;</td>
<td>97</td>
<td>0.92</td>
<td>106</td>
<td>477</td>
</tr>
<tr>
<td>Upriver Dam</td>
<td>80.3</td>
<td>53,081&lt;sup&gt;b&lt;/sup&gt;</td>
<td>68</td>
<td>0.88</td>
<td>77</td>
<td>354</td>
</tr>
<tr>
<td>Upriver Dam (bottom)</td>
<td>80.3</td>
<td>53,081&lt;sup&gt;b&lt;/sup&gt;</td>
<td>138</td>
<td>0.88</td>
<td>157</td>
<td>721</td>
</tr>
<tr>
<td>Monroe St.</td>
<td>74.8</td>
<td>82,239&lt;sup&gt;c&lt;/sup&gt;</td>
<td>179</td>
<td>0.90</td>
<td>199</td>
<td>1,413</td>
</tr>
<tr>
<td>Ninemile</td>
<td>63.6</td>
<td>82,758&lt;sup&gt;d&lt;/sup&gt;</td>
<td>265</td>
<td>0.85</td>
<td>311</td>
<td>2,281</td>
</tr>
</tbody>
</table>

- Wastewater effluent
  - Sampling conducted at four facilities in SRRTTF study area

<table>
<thead>
<tr>
<th>Facility</th>
<th>Station</th>
<th>RM</th>
<th>Dates</th>
</tr>
</thead>
</table>

- Wastewater effluent
  - PCB concentrations ranged from 1000 to 2500 pg/l
  - PCB loads ranged from 3 to 190 pg/l

<table>
<thead>
<tr>
<th>Facility</th>
<th>RM</th>
<th>Total PCB (pg/l)</th>
<th>Discharge (ML/day)</th>
<th>Total PCB Load (mg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liberty Lake WWTP</td>
<td>92.7</td>
<td>1,121</td>
<td>2.5</td>
<td>2.9</td>
</tr>
<tr>
<td>Kaiser Trentwood</td>
<td>86.0</td>
<td>1,080</td>
<td>60</td>
<td>65</td>
</tr>
<tr>
<td>Inland Empire Paper</td>
<td>82.5</td>
<td>2,544</td>
<td>18</td>
<td>45</td>
</tr>
<tr>
<td>Spokane WWTP</td>
<td>67.4</td>
<td>1,364</td>
<td>143</td>
<td>194</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>307</strong></td>
</tr>
</tbody>
</table>

ML/day = megaliters/day [0.264 MGD (million gallons per day)].

• Urban stormwater
  – Three storm drains and one CSO were sampled during June 2004
    • Sampling conducted by City of Spokane personnel during a runoff event produced by approximately 0.5 inches of rain in a 24-hour period.
  – Parsons/TerraGraphics collected stormwater samples at 14 stations during three storm events in May and June of 2007.
    • Event rainfall measured ranged from 0.29 to 0.86 inches
**Water Column and Discharges: Ecology, 2003-2007**

- **Urban wet weather loads (storm and combined sewer)**
  - Stormwater discharge volume was not monitored during sampling
  - Loads were estimated using calculations based on rainfall
  - Total wet weather load estimated as 691 mg/day

- **Updated stormwater loads calculated by Ecology in 2015**
  - Considered additional data collection from 2012-2013

**Conclusions**

- Wet weather loads are a significant fraction of PCB in the river during storm events
- Biggest gap in estimating wet weather PCB loads is understanding runoff volume
- Runoff volumes used in the previous assessment were likely an over-estimate

- Overall loading analysis
  - Mass balance assessment conducted to evaluate external loads and in-river load
- Results used to generate loading summary
Water Column and Discharges: Ecology, 2012-3

- Surface water grabs and Continuous Low-Level Aqueous Monitoring (CLAM) devices
- Four stations in Study Area

<table>
<thead>
<tr>
<th>Location</th>
<th>Season</th>
<th>Fall Dates</th>
<th>Spring Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stateline</td>
<td></td>
<td>10/23/12 - 10/24/12</td>
<td>5/23/13 - 5/24/13</td>
</tr>
<tr>
<td>Upriver Dam</td>
<td>-</td>
<td>10/24/12 - 10/25/12</td>
<td>X</td>
</tr>
<tr>
<td>Above Latah</td>
<td>-</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ninemile Dam</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

- Also deployed sediment traps at Ninemile and Upriver Dam
Water Column and Discharges: Ecology, 2012-3

• Observed concentrations
Water Column and Discharges: Spokane County, 2016; SRRTTF, 2019

• Source Assessment
  – Spokane County wastewater influent (Spokane County, 2016)
  – Spokane River (SRRTTF, 2019)

• What are the ultimate sources of PCBs?
  – Aroclors?
  – PCB-11?
  – Titanium tetrachloride?
We want to determine the main sources of PCBs to the Spokane River
Blank contamination is a significant problem
How to handle blank correction when performing source apportionment via factor analysis programs such as Positive Matrix Factorization?
  – Which measurements designated as ND?
  – Subtract or censor?
  – Which blanks to use?
Results of blank study

- All model runs gave the same five basic factors that are clearly present in the samples (i.e. they are not due to blank contamination)

- Blanks contain an additional two factors related to silicone
Conclusions of blank study

• Some kind of blank correction is necessary
• Blank correction at 3x blank levels results in no data!
• Blank subtraction generates phantom factors that have no meaning, so avoid this
• Batch-specific blank censoring works best
• Analyzing the uncorrected data and the blank data is helpful
Blank study results

August 2014 (low flow)

All y-axes max at 400 pg/L
Blank spaces mean no data
All flows are from the Spokane gage.

Source of A1248 just above SR7?
Spring 2016 (high flow – snow melt?)

3/24/2016 Flow = 15400 cfs

4/19/2016 Flow = 15000 cfs

5/24/2016 Flow = 8180 cfs

6/16/2016 Flow = 2360 cfs
Fall 2016 (medium flow – stormwater?)

The Oct/Dec 2016 samples have almost no A1242. Did someone clean up a mess in summer of 2016?
Fingerprinting of PCBs in SCRWRF influent/effluent

- Influent+effluent Factor 1 looks like A1242 but is also probably the dissolved phase.
- It remains in the effluent after PCBs on solids are stripped out.
- PCBs in the effluent strongly resemble Aroclors.
- No obvious correlations between PCBs and things like flow, total P, ammonia, and total chlorine.
Water Column and Discharges: SRRTTF, 2014

• Synoptic survey intended to support dry weather mass balance assessment
  – Identify unknown/unmonitored sources

• Survey details
  – Conducted August 12-24, 2014
  – Seven Spokane River stations, plus Hangman Creek
    • Each sampled seven times
  – Seven point source discharges
    • Sampled three times
Water Column and Discharges: SRRTTF, 2014

- Sampling locations
Water Column and Discharges: SRRTTF, 2014

- Identify unknown/unmonitored sources

Unknown source = Downstream load – Upstream load – Known Load
Water Column and Discharges: SRRTTF, 2014

- Observed river concentrations

![Graph showing observed river concentrations with points marked along the x-axis (locations) and y-axis (total PCB concentration). The x-axis includes locations such as Nine Mile, Spokane Gage, Greene St., Trent Ave., Barker Rd., Port Falls, and Lake CDA. The y-axis represents total PCB concentration in pg/l.}
Water Column and Discharges: SRRTTF, 2014

• Observed effluent concentrations

<table>
<thead>
<tr>
<th></th>
<th>Total PCB (pg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8/13</td>
</tr>
<tr>
<td>City of Spokane</td>
<td>771/955</td>
</tr>
<tr>
<td>Spokane County</td>
<td>490</td>
</tr>
<tr>
<td>Inland Empire Paper</td>
<td>3627</td>
</tr>
<tr>
<td>Kaiser Aluminum</td>
<td>3276</td>
</tr>
<tr>
<td>Liberty Lake</td>
<td>200</td>
</tr>
<tr>
<td>Post Falls</td>
<td>221</td>
</tr>
<tr>
<td>Coeur d’Alene</td>
<td>1227</td>
</tr>
</tbody>
</table>
Water Column and Discharges: SRRTTF, 2014

- Estimate of unknown/unmonitored load
Water Column and Discharges: SRRTTF, 2015

• Objective
  – Conduct repeat of 2014 mass balance assessment
  – Focus study area on locations where 2014 study indicated loads may be present

• Survey details
  – August 18-22, 2015
  – Five Spokane River stations
    • Sampled five times
  – Three point source discharges
    • Sampled three times
Water Column and Discharges: SRRTTF, 2015

- Sampling locations
Water Column and Discharges: SRRTTF, 2015

- River concentrations

Flow

[Graph showing river concentrations]
Water Column and Discharges: SRRTTF, 2015

- Estimate of unknown/unmonitored load
Water Column and Discharges: SRRTTF, 2016a

- Monthly instream monitoring

- Objective
  - Determine seasonal variability in river PCB concentrations
    • Collect data at higher flows than synoptic surveys
  - Informal objective to opportunistically assess concentrations during wet weather
  - Monitoring conducted Mar-Jun, Oct, and Nov
    • One day of sampling each month
    • Wet weather conditions occurred in October
Water Column and Discharges: SRRTTF, 2016a

• Sampling locations
Water Column and Discharges: SRRTTF, 2016a

- Observed concentrations
Findings

– Concentrations generally low leaving Lake Coeur d’Alene during all periods
– Some variance in homolog distributions by month
  • Difficult to draw strong conclusions from single sample at each station
Water Column and Discharges: SRRTTF, 2016b

- Comprehensive Plan
- Compiled and analyzed existing data on PCB sources and delivery mechanisms
Water Column and Discharges: SRRTTF, 2016b

• PCB source areas
• Majority of mass exists in three categories
  – Non-fixed building sources
  – Fixed building sources
  – Watershed soils
• Large uncertainty bands
Water Column and Discharges: SRRTTF, 2016b

- PCB delivery mechanisms
- Assess wastewater treatment plant loads
  - Considered discharger self-monitoring data in conjunction with Task Force data
- New estimate of wet weather load
  - Based on calculations from City of Spokane

<table>
<thead>
<tr>
<th>Delivery Mechanism</th>
<th>PCB Loading Rate (mg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upstream sources (Lake Coeur d’Alene)</td>
<td>33 - 444</td>
</tr>
<tr>
<td>Groundwater loading</td>
<td>60 - 300</td>
</tr>
<tr>
<td>Tributaries</td>
<td></td>
</tr>
<tr>
<td>Latah Creek</td>
<td>~0 - 215</td>
</tr>
<tr>
<td>Little Spokane River</td>
<td>15-200</td>
</tr>
<tr>
<td>WWTPs¹</td>
<td></td>
</tr>
<tr>
<td>Total Industrial</td>
<td>126 - 165</td>
</tr>
<tr>
<td>Total Municipal</td>
<td>51 - 125</td>
</tr>
<tr>
<td>Idaho</td>
<td>4-10</td>
</tr>
<tr>
<td>Washington</td>
<td>47-115</td>
</tr>
<tr>
<td>MS4 stormwater/CSOs</td>
<td>15 - 94</td>
</tr>
<tr>
<td>Bottom sediments</td>
<td>0.2 - 20</td>
</tr>
<tr>
<td>Fish hatcheries</td>
<td>Unknown</td>
</tr>
<tr>
<td>Atmospheric deposition to surface water</td>
<td>&lt;0</td>
</tr>
</tbody>
</table>
Water Column and Discharges: SRRTTF, 2018

• Objective
  – Address questions identified from 2014 and 2015 sampling results
    • Potential for groundwater loading sources between the Spokane USGS gage and Nine Mile Dam
    • Specific nature of groundwater loading sources suspected between Plante’s Ferry and Greene Street
    • Potential for groundwater loading sources between Barker Road and Mirabeau Point

• Survey details
  – August 4-8, 2015
  – Seven Spokane River stations
    • Sampled five times
  – Three point source discharges
    • Sampled three times
Water Column and Discharges: SRRTTF, 2018

- Sampling locations
Water Column and Discharges: SRRTTF, 2018

- Observed concentrations
Water Column and Discharges: SRRTTF, 2018

- Observed effluent concentrations

<table>
<thead>
<tr>
<th></th>
<th>8/4</th>
<th>8/6</th>
<th>8/8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inland Empire Paper</td>
<td>1937</td>
<td>1691</td>
<td>1122</td>
</tr>
<tr>
<td>Spokane County</td>
<td>234.5</td>
<td>240.9</td>
<td>221.6</td>
</tr>
<tr>
<td>City of Spokane</td>
<td>644.5</td>
<td>521.8</td>
<td>439.2</td>
</tr>
<tr>
<td>Kaiser</td>
<td></td>
<td></td>
<td>1537</td>
</tr>
</tbody>
</table>
Water Column and Discharges: SRRTTF, 2018

- Estimate of unknown/unmonitored load
  - No appreciable load above Mirabeau
  - Load above Trent consistent with other years
  - Loss of PCBs between Trent and Upriver Dam
  - Potentially loading between
    - Greene St. and USGS gage
    - USGS gage and Nine Mile
Water Column and Discharges: SRRTTF, 2018

• Homolog-specific mass balances
  – Extend prior mass balances (total PCB) to consider individual homologs

• Consistent pattern seen between Barker and Trent
  – Correlation analyses show this pattern is similar to that observed in Kaiser groundwater
  – Smaller contribution from sources up-gradient from Kaiser
Water Column and Discharges: SRRTTF, 2018

• Homolog-specific mass balances
• Consistent pattern seen between Trent and Greene St.
  – Loss of di- through tetra- homologs
  – Gain of penta- through hepta- homologs
Water Column and Discharges: SRRTTF, 2018

- Homolog-specific mass balances
- Less consistent patterns seen from Greene St. to Nine Mile
  - Gain of penta-chloro homolog between Greene and USGS Gage
  - Only one year of data for USGS Gage to Nine Mile
Water Column and Discharges: Ecology, 2016

• Evaluation of Fish Hatcheries as Sources of PCBs

• Screening-level study to:
  – Characterize PCB concentrations in hatchery discharges and hatchery-raised rainbow trout
  – Estimate PCB loads from hatchery operations to the Spokane River
Water Column and Discharges: Ecology, 2016

• Findings
  – PCB concentrations in hatchery discharges ranged from 147–219 pg/L
  – PCB concentrations in feed samples, ranged from 3.9–31.5 ug/kg.
  – PCB concentrations in fish caught from Lake Spokane four months after their release were higher than in pre-released fish
    • Suggesting that most of the PCB body burden in post-released fish was accumulated after being released.
  – The mean PCB load from hatchery operations was estimated to be 7.8 mg/day.
Water Column and Discharges: Summary

- Characterize sources
  - PCBs originate from Aroclors and PCB-11
  - Reasonable understanding of wastewater loads
  - Coarser understanding of stormwater loads
  - Coarse understanding of some groundwater loads

- Make progress
  - “Snapshots” of river concentrations at selected times
    - < 50 pg/l coming into Spokane; 50-150 pg/l in Spokane area
Sediments

- Ecology, 2003-2004
- Ecology, 2013
- Ecology, 2018

- One sediment station in SRRTTF study area, Monroe St. in 2004
  - Low in absolute concentration (total PCBs = 6.17 ng/g), but elevated when considered on an organic-carbon normalized basis
Sediments: Ecology, 2013

- Samples collected by Ecology Urban Waters Program at eight locations in late August 2013
Sediments: Ecology, 2013

• Concentrations generally low, higher at PostTerm2 station
Sediments: Ecology, 2018

- Measuring PCBs in Biofilm, Sediment, and Invertebrates in the Spokane River: Screening Study
  - Goal: Assess presence of previously unidentified sources of PCBs in the Spokane River
  - Measured PCBs in biofilm (19 sites), sediment (3 sites), and macroinvertebrates (2 sites)
• Biofilm Sites
• Synoptic Survey Sites
• Sediment Sites
• Macro-invertebrate Sites
Findings: Sediment
Biofilm:
Mirabeau (MBU) & Plantes Ferry (PF)
Biofilm: GE Mission (GEM-LB & GEM-RB)
Biofilm: SR3A (upstream of Trent Bridge)
Biofilm: Mission Bridge (MIB) & Spokane Gage (SG)
Macroinvertebrates

Spokane Gage (SG)
- *Hydropsychidae* and *Limnephilidae*
- Pupa

GE Mission (GEM-RB)
- *Hydropsychidae* and *Limnephilidae*
- Larvae
Sediments and Biofilm: Summary

- Much less data available than for water column or discharges
- Large degree of variability in concentrations observed
Fish

- Early Ecology studies
- Ecology, 2005
- Ecology, 2012
Fish: Early Ecology Studies

- Summarized in Serdar et al (2011)
- Date back to early 1990’s

<table>
<thead>
<tr>
<th>Location and Tissue Type</th>
<th>Total PCB Concentrations Measured by:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aroclor Analysis</td>
</tr>
<tr>
<td>Rainbow trout - fillet</td>
<td></td>
</tr>
<tr>
<td>State line</td>
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</tr>
<tr>
<td>Plante Ferry</td>
<td>918</td>
</tr>
<tr>
<td>Above Monroe Dam^a</td>
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</tr>
<tr>
<td>Ninemile</td>
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<tr>
<td>Mountain whitefish - fillet</td>
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<td>Above Monroe Dam</td>
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<tr>
<td>Ninemile</td>
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</tr>
<tr>
<td>Little Spokane</td>
<td>--</td>
</tr>
<tr>
<td>Upper Lake Spokane</td>
<td>--</td>
</tr>
<tr>
<td>Lower Lake Spokane</td>
<td>780</td>
</tr>
<tr>
<td>Large-scale suckers - whole</td>
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</tr>
<tr>
<td>State line</td>
<td>--</td>
</tr>
<tr>
<td>Plante Ferry</td>
<td>2,005</td>
</tr>
<tr>
<td>Above Monroe Dam</td>
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</tr>
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<td>Ninemile</td>
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</tr>
<tr>
<td>Little Spokane</td>
<td>--</td>
</tr>
<tr>
<td>Upper Lake Spokane</td>
<td>--</td>
</tr>
<tr>
<td>Lower Lake Spokane</td>
<td>410</td>
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</tbody>
</table>
Fish: Ecology, 2005

- Study details
  - August-November, 2005
  - Four fish species from six reaches along the Spokane River

<table>
<thead>
<tr>
<th>Reach</th>
<th>Approximate River Mile</th>
<th>Species</th>
</tr>
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<tbody>
<tr>
<td>Stateline</td>
<td>96.1-95.5</td>
<td>Largescale sucker</td>
</tr>
<tr>
<td>Plante Ferry</td>
<td>86.0-85.0</td>
<td>Rainbow trout Largescale sucker</td>
</tr>
<tr>
<td>Mission Park</td>
<td>78.5-74.5</td>
<td>Rainbow trout Mountain Whitefish Largescale sucker</td>
</tr>
<tr>
<td>Ninemile</td>
<td>64.5-63.5</td>
<td>Rainbow trout Mountain Whitefish Bridgelip sucker</td>
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<tr>
<td>Upper Long Lake</td>
<td>56.3-50.6</td>
<td>Mountain whitefish Smallmouth bass Brown trout Largescale sucker</td>
</tr>
<tr>
<td>Lower Long Lake</td>
<td>40.8-39.4</td>
<td>Mountain whitefish Smallmouth bass Largescale sucker</td>
</tr>
</tbody>
</table>

Figure 1. Approximate Location of Spokane River Fish Samples Collected in 2005
Fish: Ecology, 2005

- Results
  - Elevated concentrations at Mission Park
Fish: Ecology, 2005

• Conclusions
  – PCB concentrations in the 2005 Spokane River fillet samples are in the range of the statewide mean and median for fillets.
  – The whole fish results for Mission Park and Long Lake are at or above the upper end of the range of whole fish statewide values

<table>
<thead>
<tr>
<th></th>
<th>Spokane River 2005</th>
<th>Statewide*</th>
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<tbody>
<tr>
<td></td>
<td>Fillet</td>
<td>Whole Body</td>
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<tr>
<td>N =</td>
<td>24</td>
<td>24</td>
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<tr>
<td>Mean</td>
<td>104</td>
<td>442</td>
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<tr>
<td>Median</td>
<td>78</td>
<td>135</td>
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<tr>
<td>Minimum</td>
<td>36</td>
<td>16</td>
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<tr>
<td>Maximum</td>
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<tr>
<td>90th percentile</td>
<td>213</td>
<td>1,181</td>
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</table>
Fish: Ecology, 2012

• Study details
  – Four fish species from four locations in the Task Force study area
Fish: Ecology, 2012

• Study details
  – Four fish species from four locations in the Task Force study area

<table>
<thead>
<tr>
<th>Sample Location</th>
<th>LSS</th>
<th>RBT</th>
<th>MWF</th>
<th>NPM</th>
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<tbody>
<tr>
<td>Spokane River</td>
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<td></td>
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<tr>
<td>Stateline (1-SL)</td>
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<tr>
<td>Plante Ferry to Upriver Dam (2-PF)</td>
<td>7</td>
<td>3</td>
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<tr>
<td>Mission Park (3-MP)</td>
<td>7</td>
<td>3</td>
<td>5</td>
<td></td>
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<tr>
<td>Ninemile Dam, upstream (4-NM)</td>
<td>7</td>
<td>3</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

• LSS = Largescale sucker
• RBT = Rainbow trout
• MWF = Mountain whitefish
• NPM = Northern pikeminnow
Fish: Ecology, 2012

• Results
  – Similar order of magnitude as 2005, minus extremely high values at Mission Park
Fish: Ecology, 2012

- Conclusion
  - Concentrations generally much higher than in other waters of the State