From What Pathway(s) Are Fish Receiving the Majority of Their PCBs?

SRRTTF-TTWG Data Synthesis Workshop

February 1, 2022

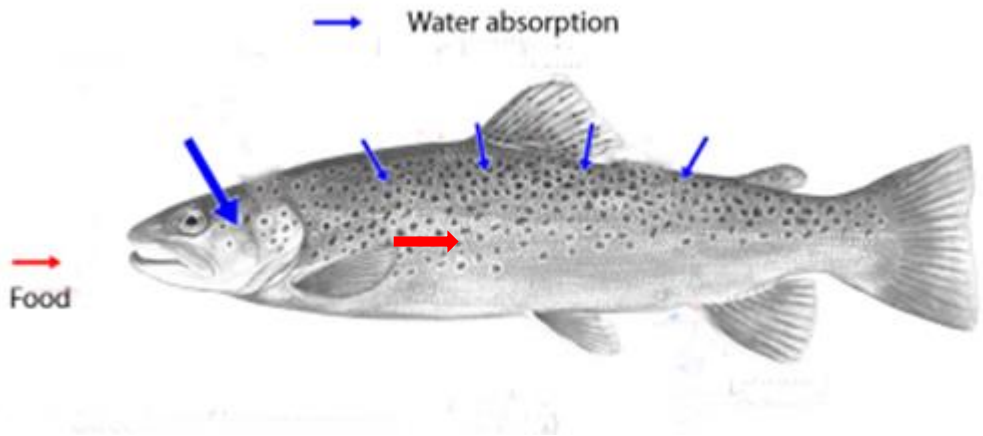
Background

- Spokane River has been placed on the impaired waters list due to elevated PCB concentrations in fish tissue
- Fish can receive their PCBs from different pathways
- Understanding these pathways can identify which sources of PCBs are most important to address

- TMDL will require compliance with water column water quality standard, regardless of fish tissue concentrations

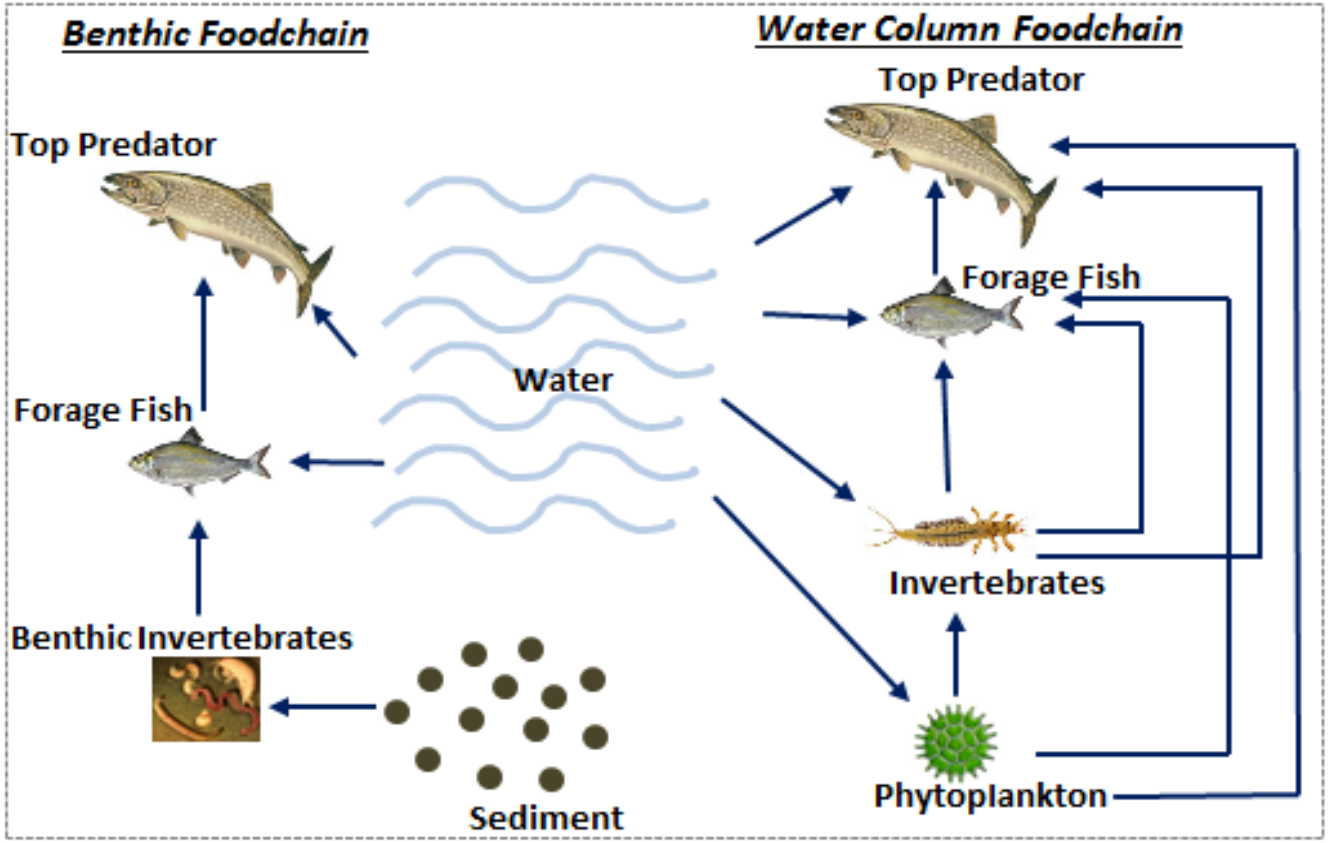
Principles of Bioaccumulation

- Fish obtain PCBs from water and food
  - Directly from the water column via gills and skin
  - From the food that they eat via the gut



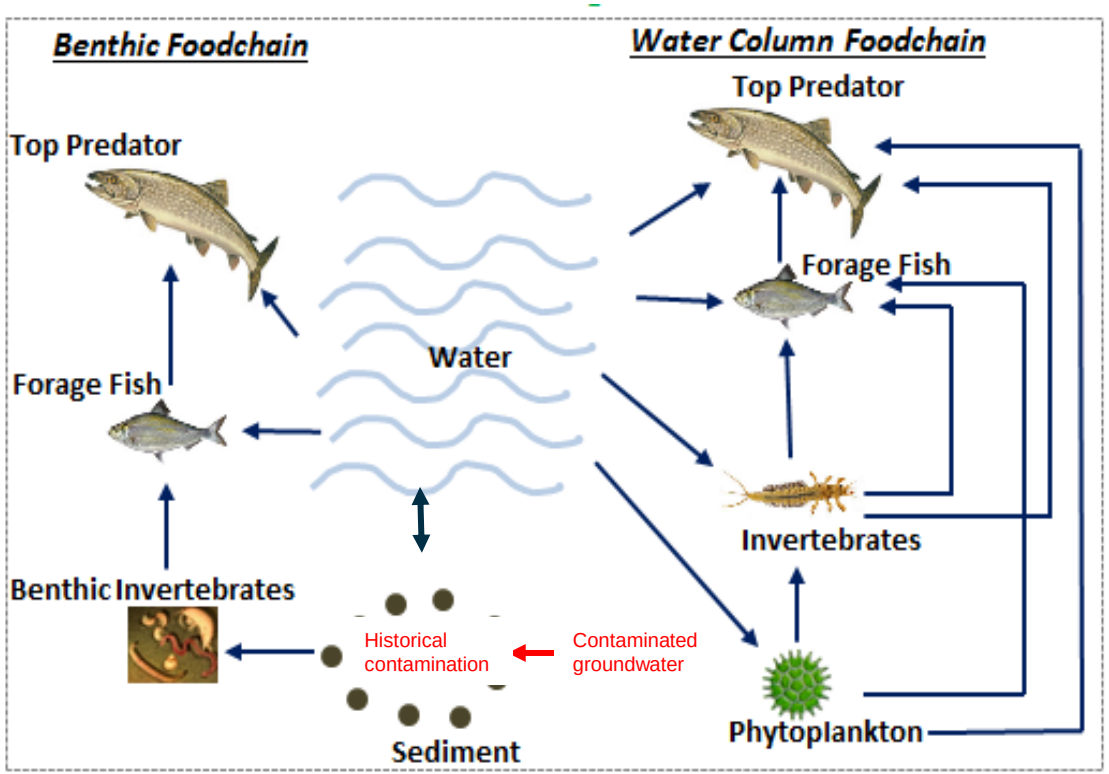
Principles of Bioaccumulation

- Food sources are part of a food web, and diets (and exposure pathways) vary across fish species



Why We Care about Bioaccumulation in Spokane

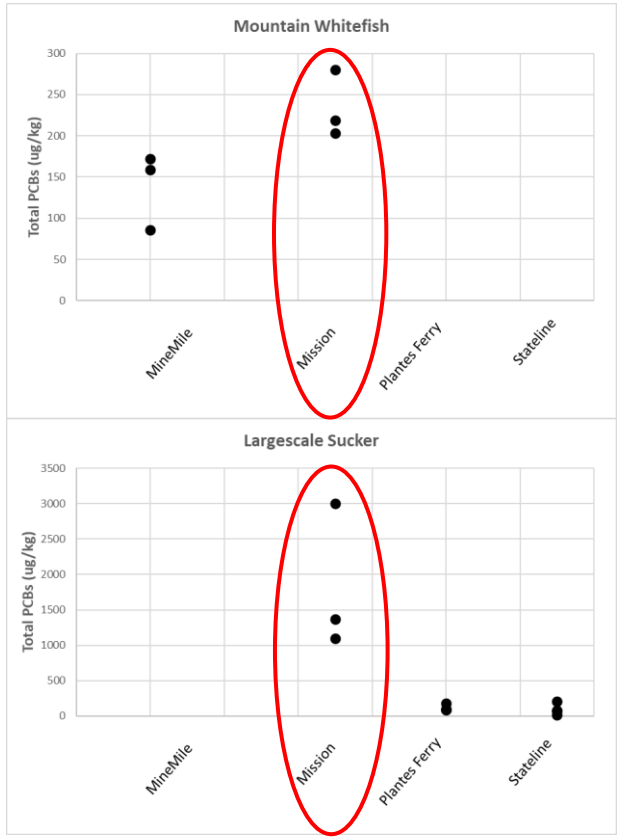
- An understanding of the pathways by which Spokane River fish obtain PCBs could help focus control efforts
  - If water column pathway dominates, fish will respond to control of PCB sources to the water column
  - If benthic pathway dominates, fish will respond to control of sediment PCB sources



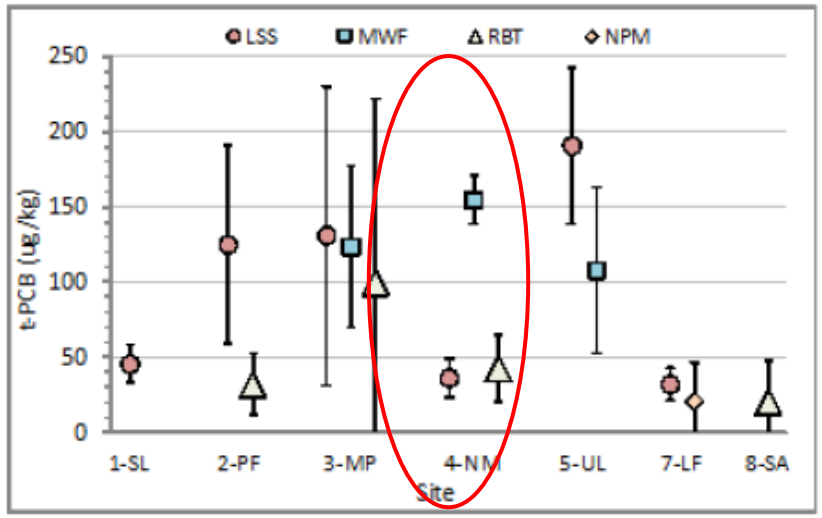
Data Suggest That A Benthic Pathway Is Important

- Mission Reach fish tissue PCB is consistently higher than at other sites

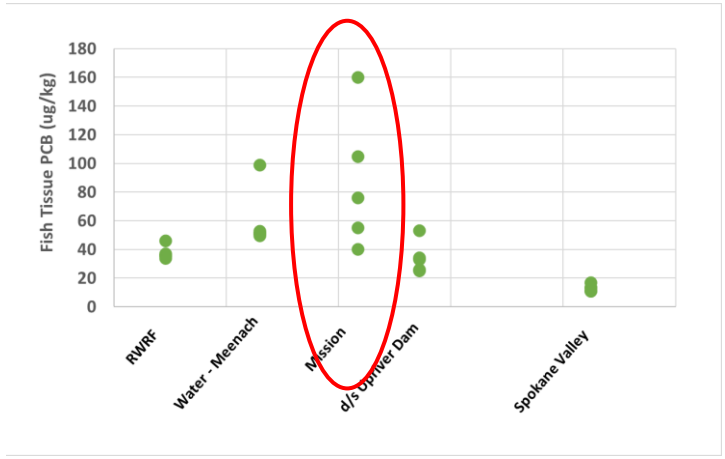
2005



2012

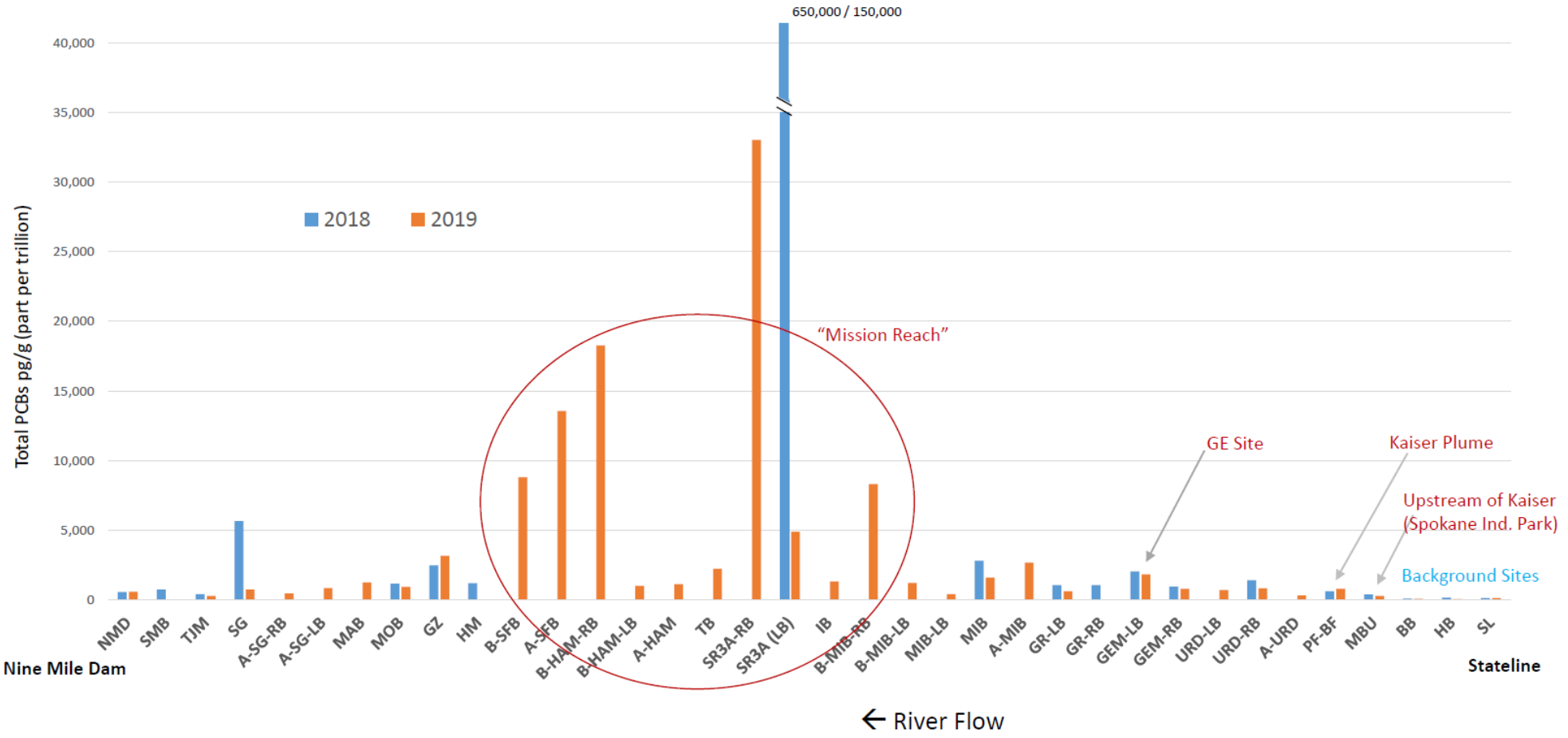


2020



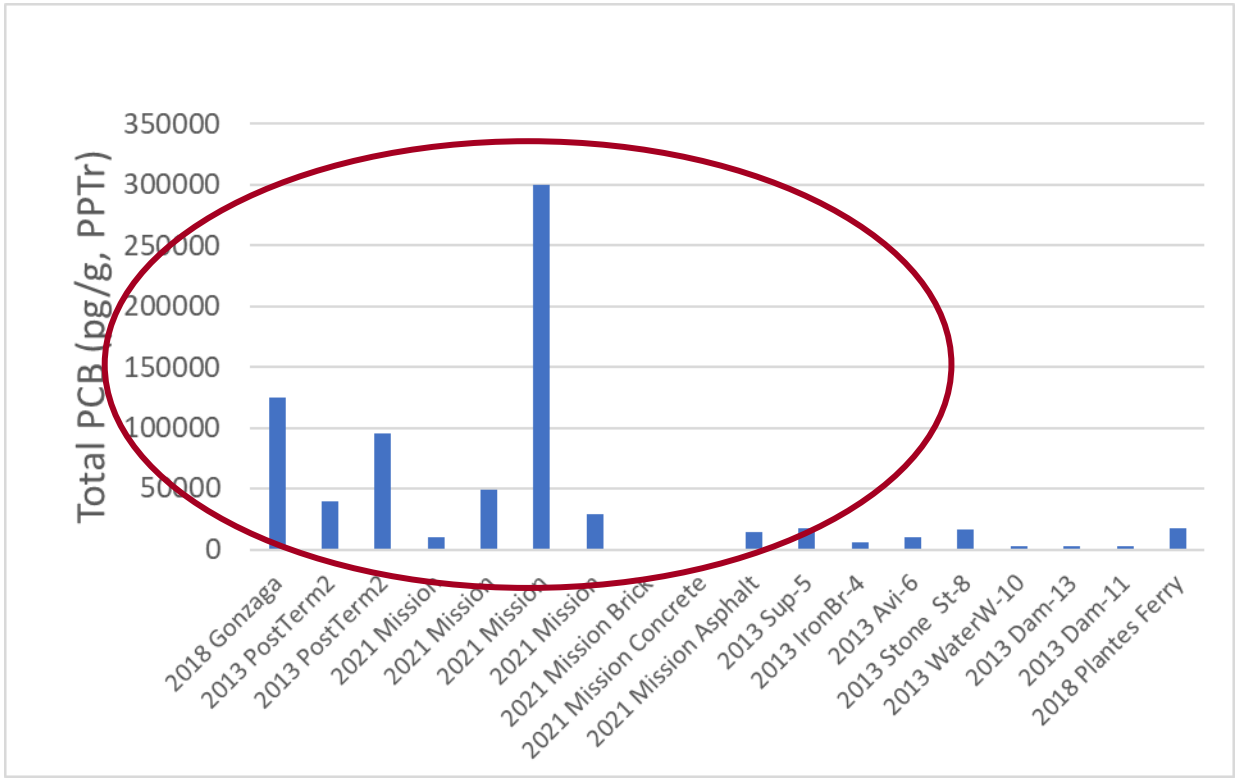
Data Suggests That A Sediment/Benthic Pathway Is Important

- Mission Reach biofilm PCB consistently higher than at other sites



Data Suggests That A Sediment/Benthic Pathway Is Important

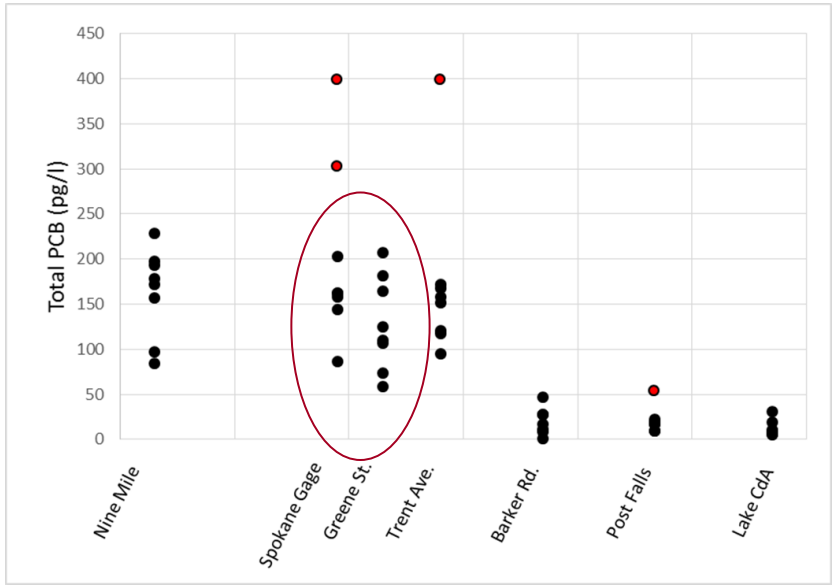
- Mission Reach sediment PCB consistently higher than at other sites



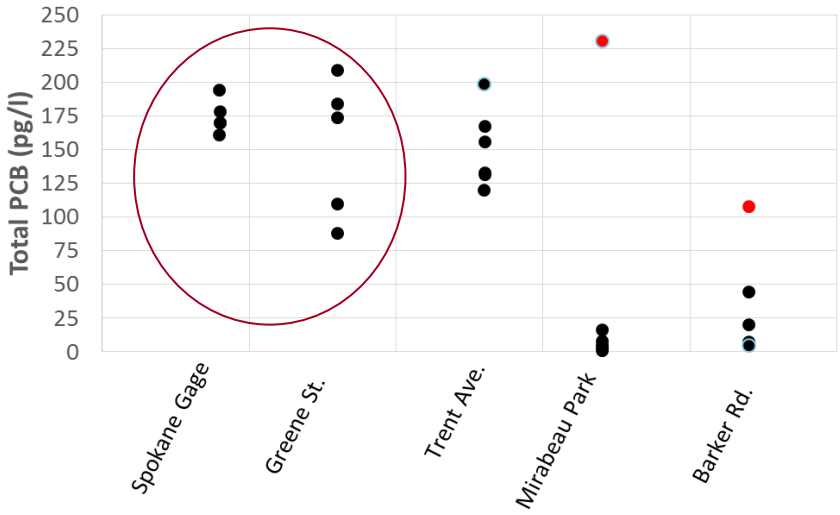
Data Suggests That A Sediment/Benthic Pathway Is Important

- Mission Reach water column concentrations downstream of Mission Reach not consistently higher than upstream

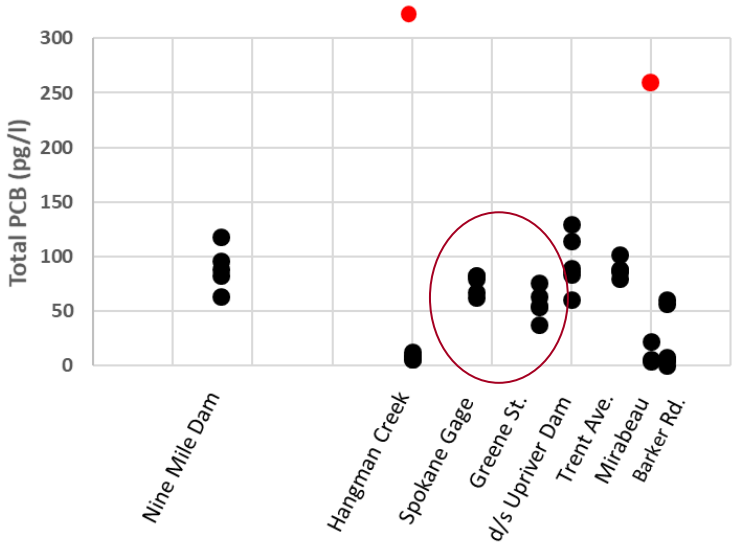
2014



2015

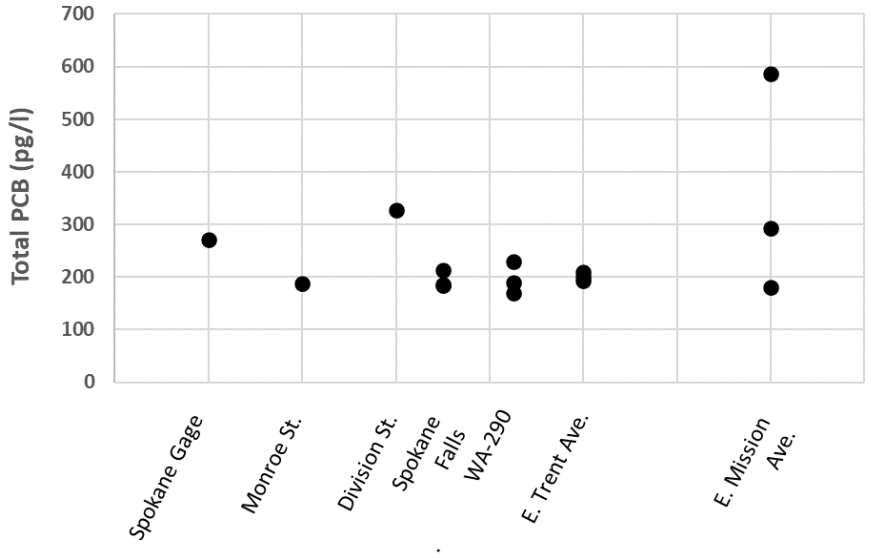


2018



Data Suggests That A Sediment/Benthic Pathway Is Important

- Water column PCB concentrations do not increase within Mission Reach



Initial Bioaccumulation Modeling Efforts in Spokane

- Serdar (2011) screening-level bioaccumulation model
  - Indicated that sediment pathway could be important in Spokane
  - Relied on a number ‘default’ values
- 2019 Data Synthesis workshop updated Serdar model to incorporate enhancements of Wenatchee River model of Hobbs and Friese (2016)
  - Included lower food web – periphyton
  - More accurate description of food web structure
- Sensitivity analyses conducted on above models indicated that data gaps were too large for credible predictions to be made

Information Needed to Support Bioaccumulation Model

- Water column
  - PCB and organic carbon concentration
- Bottom sediments
  - PCB and organic carbon concentration
- Biota
  - Fish PCB concentration and lipid content
    - For all species of interest
  - Macroinvertebrate PCB concentration and lipid content
  - Biofilm PCB concentration and lipid content
- Food web structure
  - Who eats what and when?
- Sediment source assessment/ PCB fate and transport model
  - If fish are getting the majority of PCBs from the sediment, what is causing the elevated concentration?

Data Gaps

- ~~Water column~~
  - ~~PCB and organic carbon concentration~~
- Bottom sediments
  - PCB and organic carbon concentration
- Biota
  - ~~Fish PCB concentration and lipid content~~
    - ~~For all species of interest~~
  - Macroinvertebrate PCB concentration and lipid content
  - ~~Biofilm PCB concentration and lipid content~~
- Food web structure
  - Who eats what and when?
- Sediment source assessment/ PCB fate and transport model
  - If fish are getting the majority of PCBs from the sediment, what is causing the elevated concentration?

Candidate Studies

- Sediment sampling
  - Mapping of presence of bedded sediments
  - PCB content of bedded sediments
- Macroinvertebrate sampling
- Food web study
  - Consultation with WDFW
- Sediment source assessment/PCB fate and transport model

Next Steps

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Next Steps

- Are we making progress?
  - Confirm future WDFW participation in fish sampling
  - Do we add a different species at State Line?
  - Do we modify and/or supplement SPMDs?
- Do currently undefined sources exist?
  - Review key knowns and unknowns
  - Discuss candidate studies
- From what pathway(s) are fish receiving the majority of their PCBs?
  - Does the task force assess this?

Undefined Sources: What We Know and Don't Know

- Key "knowns"
  - Groundwater PCB load enters near Kaiser facility
- What we suspect
  - Presence of groundwater source directly upstream/upgradient of Kaiser
- What we don't know
  - Whether an unknown dry weather source exists downstream of the USGS gage
  - Groundwater/other interactions between Plantes Ferry and USGS gage
  - Groundwater loading of infiltrated stormwater
  - Presence of unknown loads during high flow periods

Undefined Sources: Candidate Studies
Dry Weather/Low Flow

- Groundwater PCB Load at Mirabeau
  - Additional biofilm monitoring with higher spatial resolution
  - Additional water column sampling at Mirabeau
- Dry Weather Source Downstream of USGS Gage
  - Synoptic survey to support mass balance assessment
- Groundwater/Other Interactions between Plante's Ferry and USGS Gage
  - Further our understanding of groundwater hydrology
  - Synoptic survey with greater spatial resolution

- Others?

Undefined Sources: Candidate Studies
Wet Weather/High Flow

- High-Flow Mobilization of PCB Sources
  - High flow synoptic survey
- Groundwater Loading of Infiltrated Stormwater
  - Mass balance on dry well itself
  - Tracer study
  - Groundwater monitoring
  - Review how long it takes dry wells to drain
  - Review capacity of soils in the vadose zone to trap PCBs

- Others?

Bioaccumulation: Candidate Studies

- Sediment sampling
- Macroinvertebrate sampling
- Food web study
- Sediment source assessment/PCB fate and transport model

- Others?