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

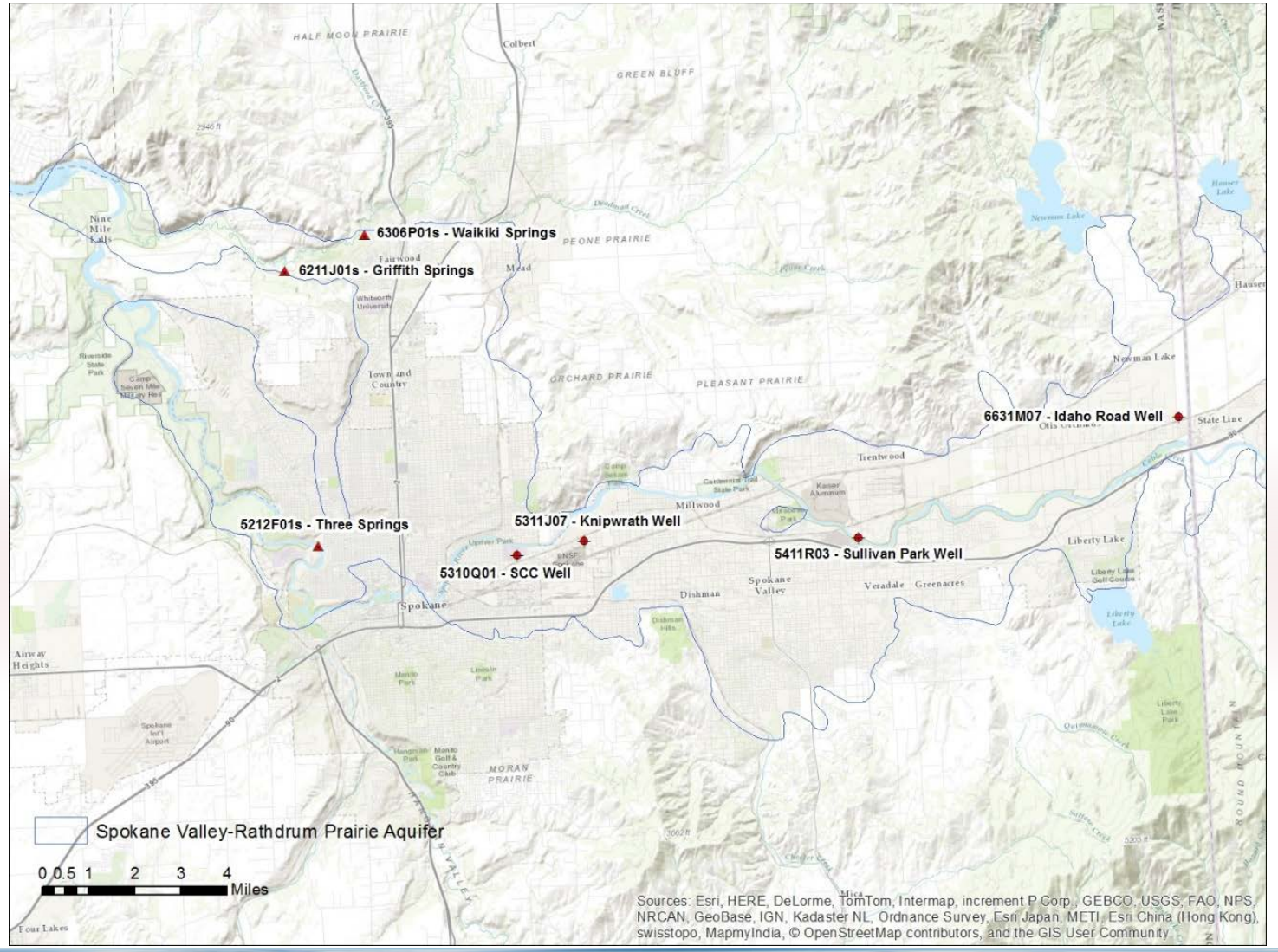
- Groundwater
  - Spokane County/Ecology, 2015-2016
  - Ecology, 2016
  - Kaiser, 2007-2017
  - Ecology, 2013
- Water Column and Discharges
  - Ecology, 2003-2007, 2015, 2016
  - SRRTTF, 2014, 2015, 2016, 2018, 2019
  - Spokane County, 2016
- Atmospheric Deposition
  - Ecology, 2016-2017
- Sediments
  - 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

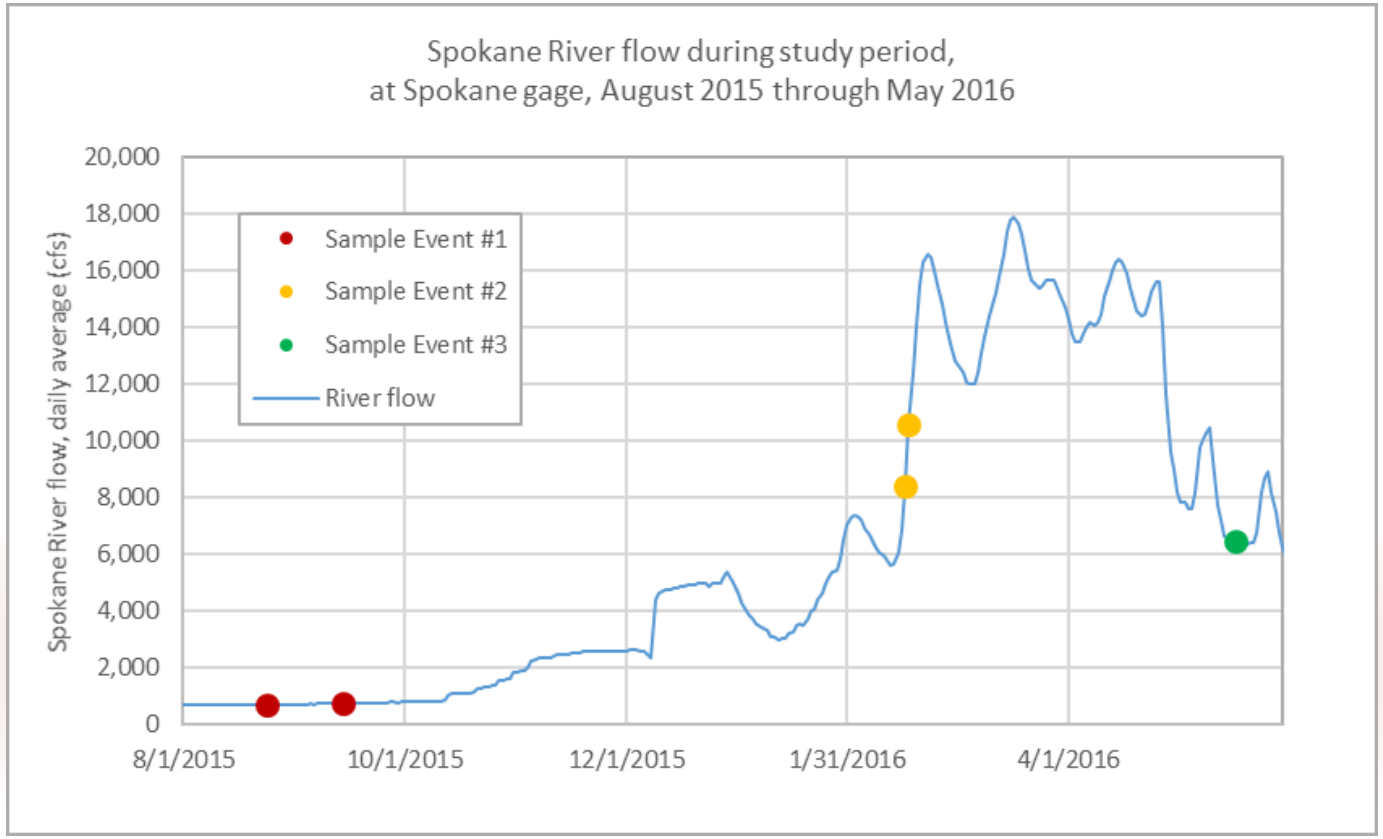
Groundwater: Spokane County/Ecology, 2015-2016

- Seven locations
  - Four groundwater monitoring wells
  - Three surface springs
  - Locations chosen to represent groundwater flowing into the Spokane River or Little Spokane River



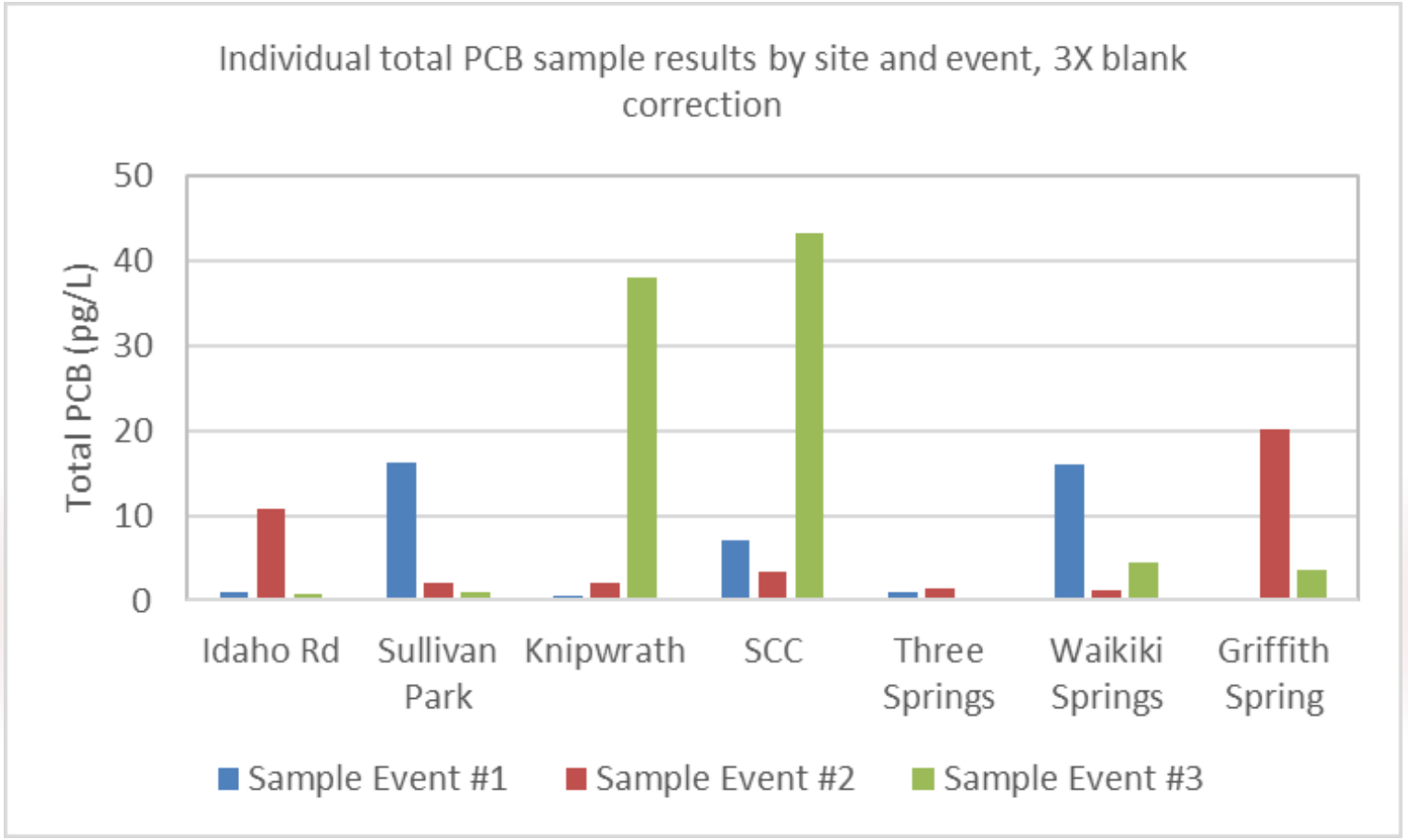
Groundwater: Spokane County/Ecology, 2015-2016

- 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

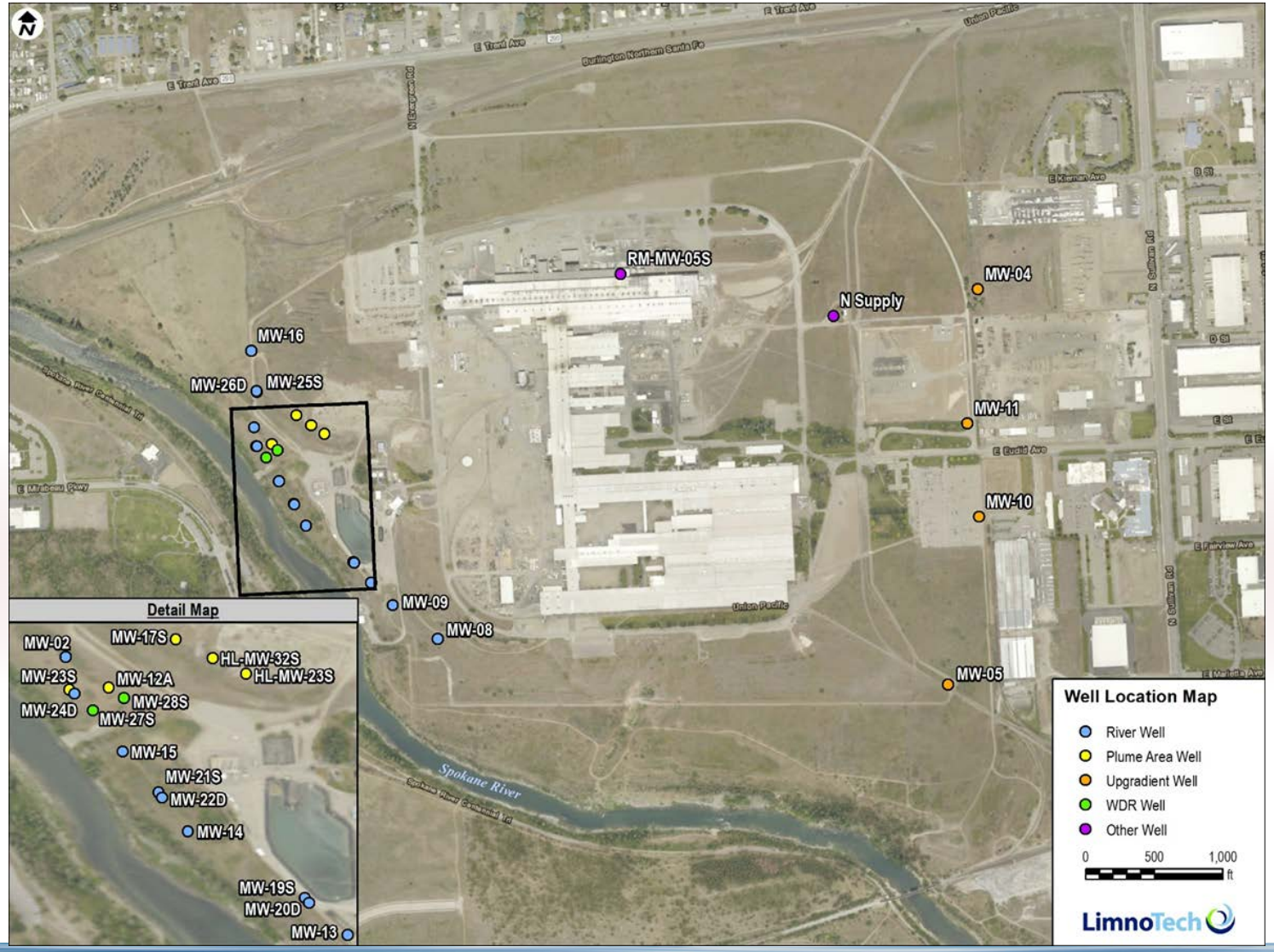
- Concentrations are low
  - Majority are <5 pg/l
- Two observations above 30 pg/l
  - Average of all blank samples was 76.0 pg/L
- Conclusion
  - Results did not indicate a significant source of PCB contamination in groundwater



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

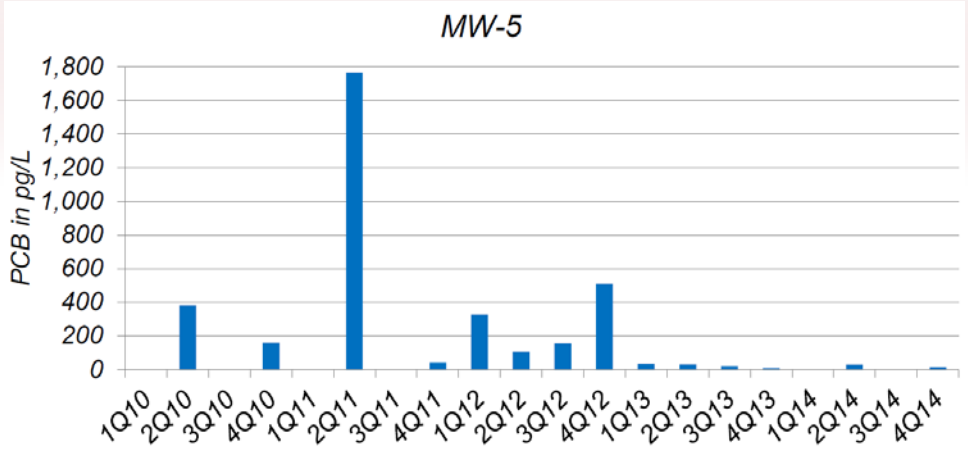
Kaiser Groundwater

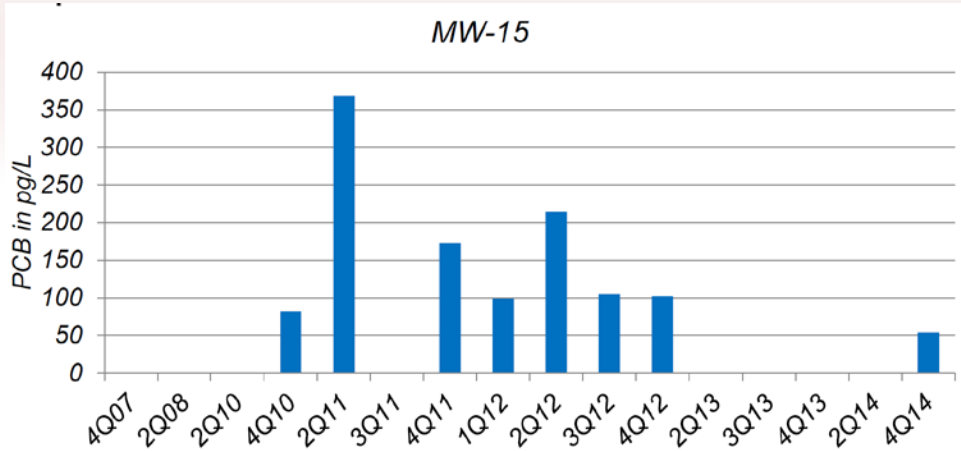


Kaiser Groundwater

Region	Mean PCB sum (pg/L)	Median PCB sum (pg/L)
Plume	8,910	4,800
Upgradient	206	67.9

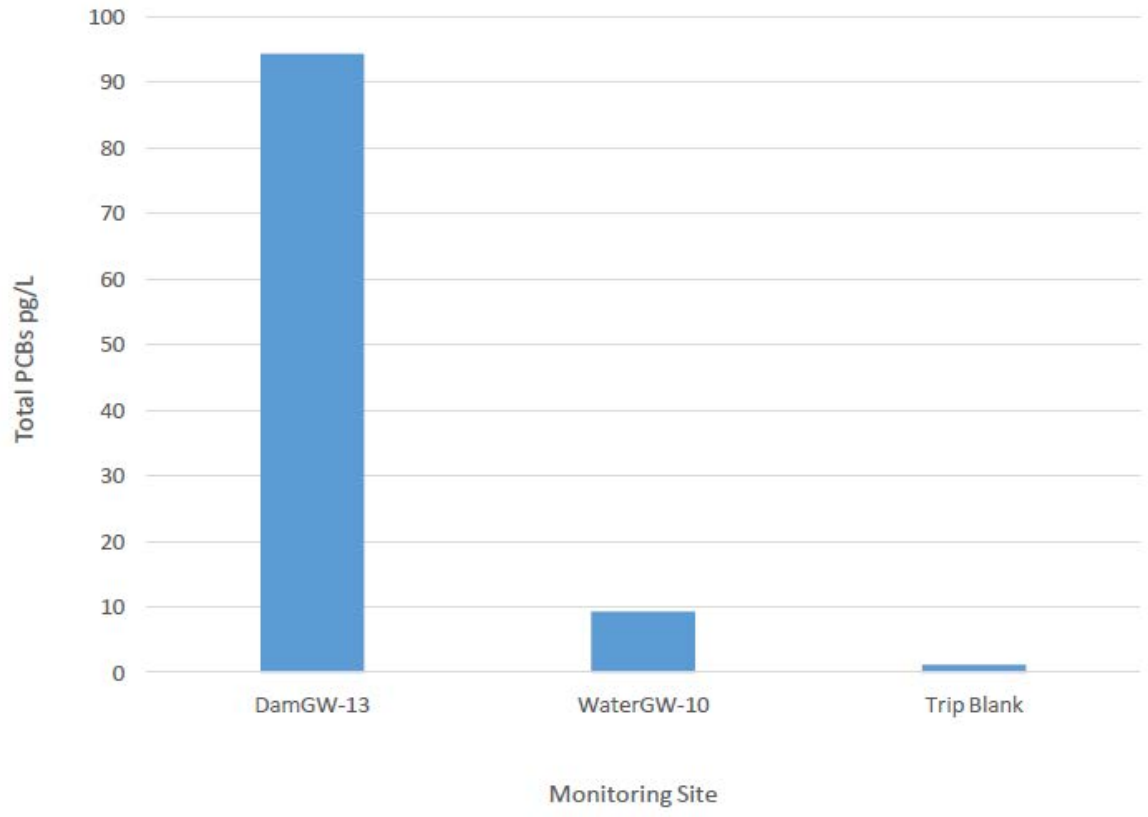
- Elevated concentrations in plume
- Up-gradient concentrations higher than observed in Ecology/County wells
  - Occasional spikes, potentially decreasing over time





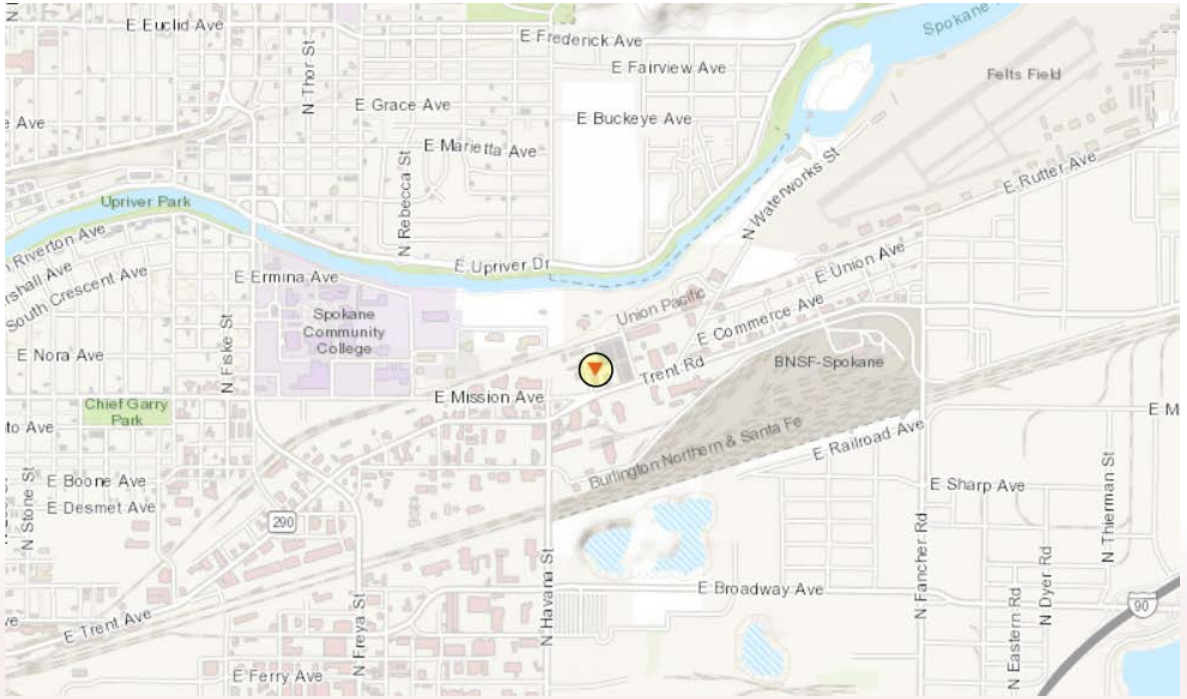
Urban Waters Groundwater Seeps - 2013

- 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

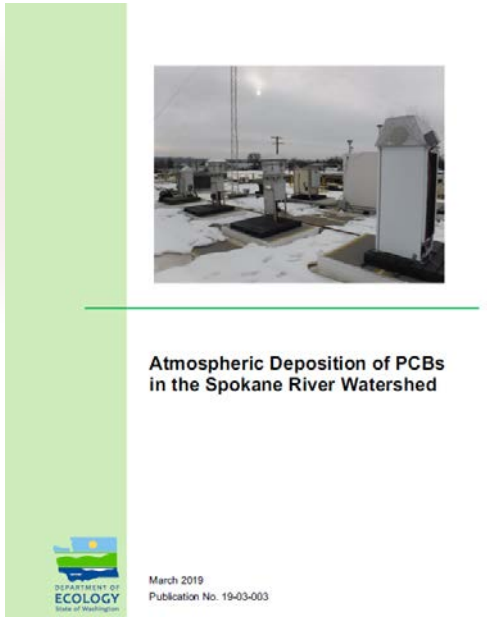


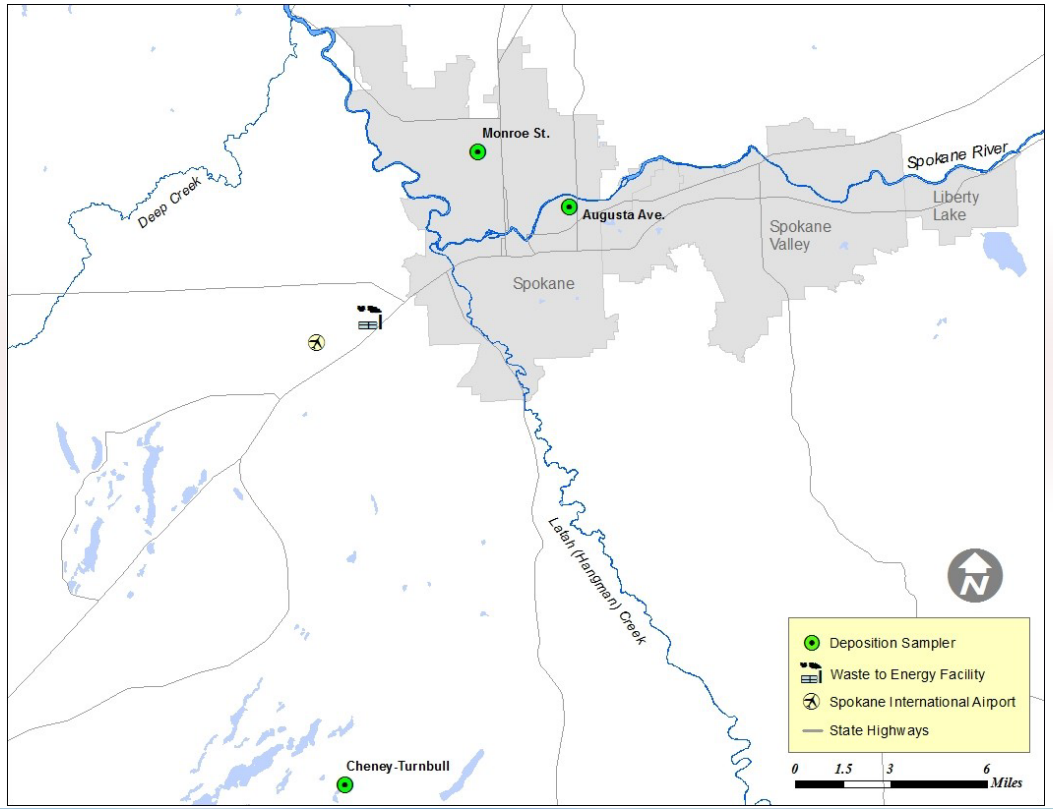
Groundwater: What Has Been Learned

- 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

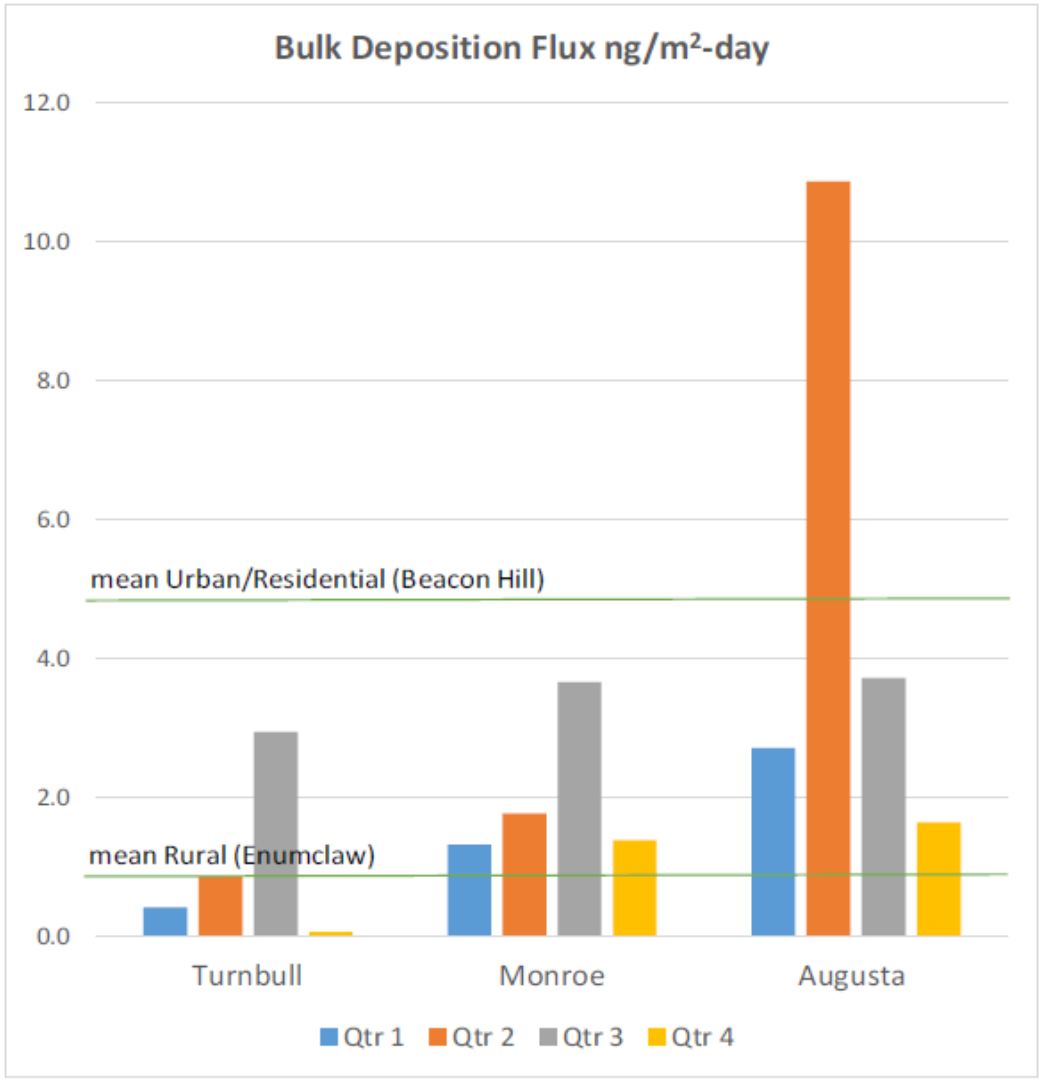
- Quarterly seasonal bulk deposition samples
- Three sites representing different land uses
  - Turnbull National Wildlife Refuge: regional background
  - Monroe Street: urban-residential
  - Augusta Avenue: urban-commercial





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

- Ecology, 2003-2007, 2013 and 2016
- Spokane County, 2016
- SRRTTF, 2014, 2015, 2016a, 2016b, 2019

Water Column and Discharges: Ecology, 2003-2007

- Spokane River PCB Source Assessment, 2003-2007
  - 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.

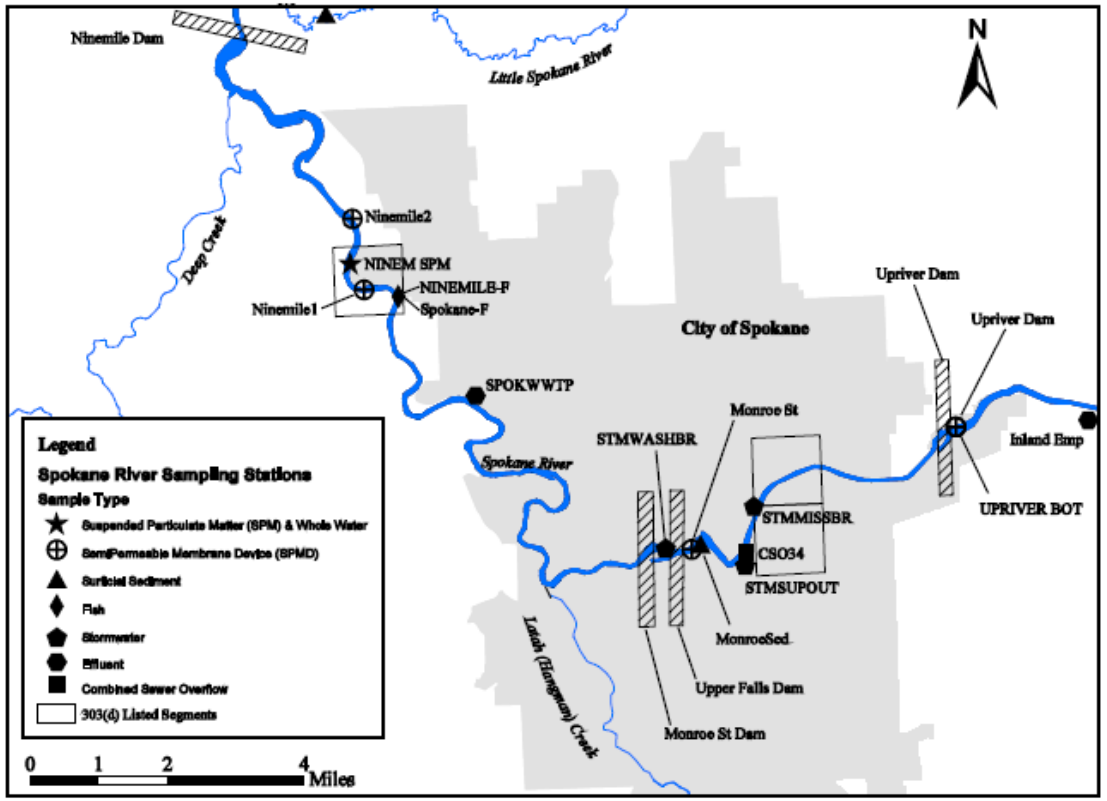
Spokane River
PCB Source Assessment
2003-2007

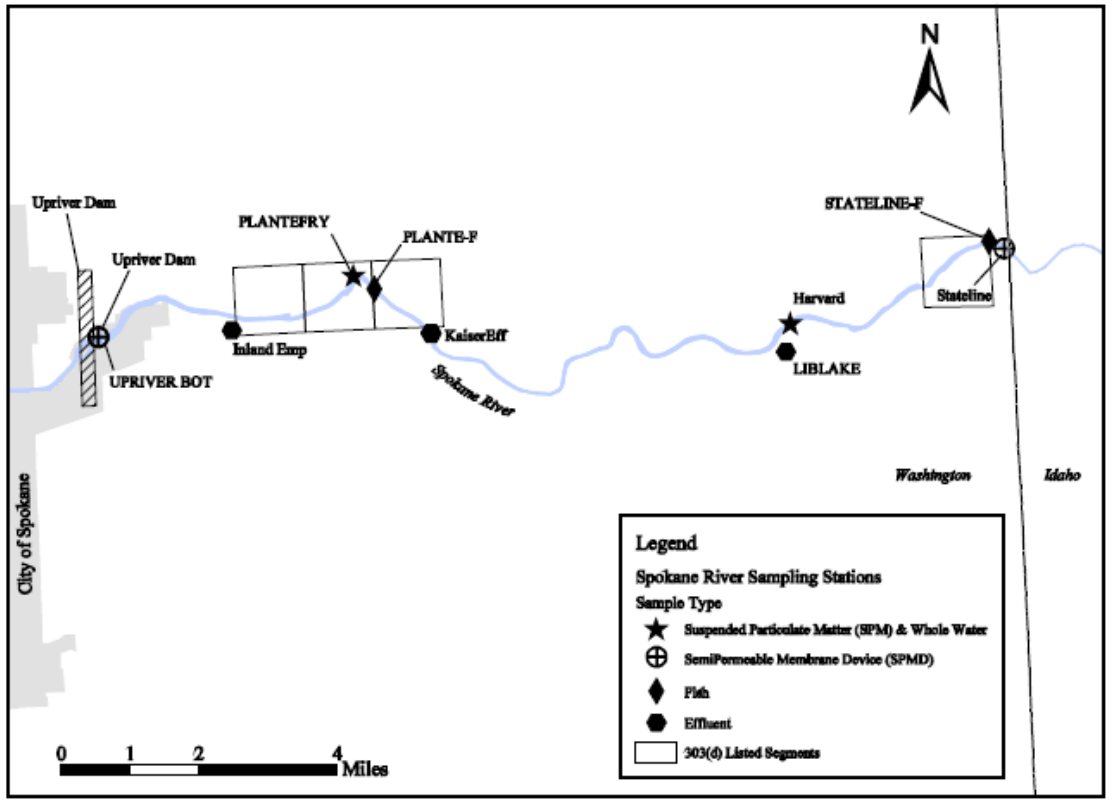
DEPARTMENT OF ECOLOGY
State of Washington

April 2011
Publication No. 11-03-013

Water Column and Discharges: Ecology, 2003-2007

- 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





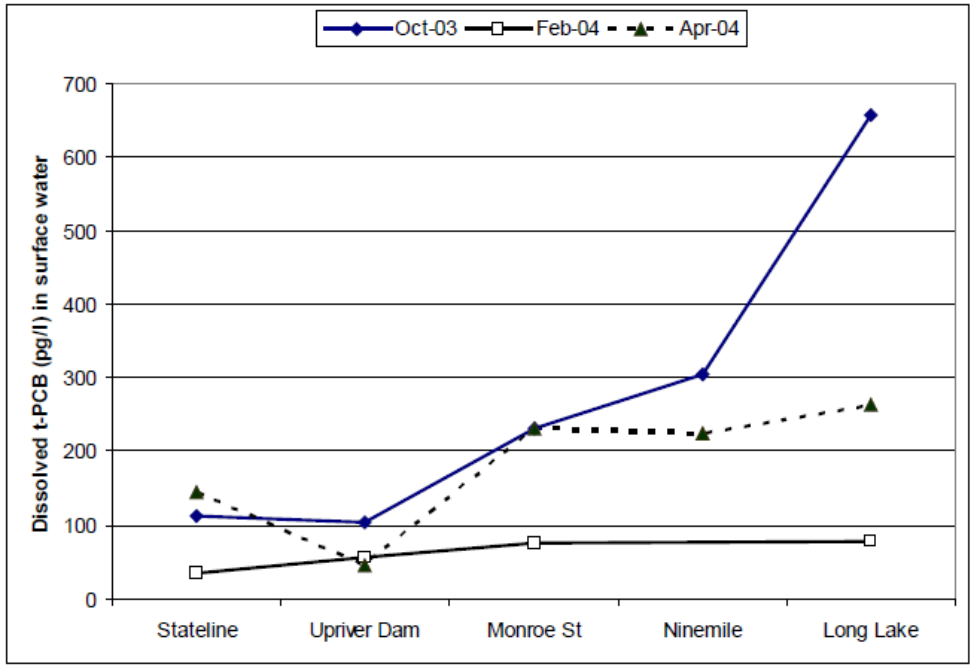
Water Column and Discharges: Ecology, 2003-2007

- 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

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

Water Column and Discharges: Ecology, 2003-2007

- Water column sampling
  - SPMD measures dissolved PCBs



  - Results converted to total PCB

Location	RM	Harmonic Mean Flow (L/sec)	Mean Total PCB C_d (pg/l)	Fraction C_d	Mean Total PCB C_w (pg/l)	Total PCB Load (mg/day)
Stateline	96.1	52,151[a]	97	0.92	106	477
Upriver Dam	80.3	53,081[b]	68	0.88	77	354
Upriver Dam (bottom)	80.3	53,081[b]	138	0.88	157	721
Monroe St.	74.8	82,239[c]	179	0.90	199	1,413
Ninemile	63.6	82,758[d]	265	0.85	311	2,281

Water Column and Discharges: Ecology, 2003-2007

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

Facility	Station	RM	Dates
Liberty Lake Sewer District WWTP	LIBLAKE	92.7	10/21– 22/2003 2/2 – 3/2004 4/26 – 27/2004
Kaiser Trentwood - Effluent	KaiserEff	86.0	10/21 – 22/2003 2/2 – 3/2004 4/26 – 27/2004
Kaiser Trentwood - Lagoon	KaiserLag	--	10/21 – 22/2003 2/2 – 3/2004 4/26 – 27/2004
Kaiser Trentwood - Below Filter	KaiserFilt	--	10/21 – 22/2003 2/2 – 3/2004 4/26 – 27/2004
Inland Empire Paper Company	Inland Emp	82.5	10/21 – 22/2003 2/2 – 3/2004 4/26 – 27/2004
City of Spokane WWTP	SPOKWWTP	67.4	10/21 – 22/2003 2/2 – 3/2004 4/26 – 27/2004

Water Column and Discharges: Ecology, 2003-2007

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

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

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

Water Column and Discharges: Ecology, 2003-2007

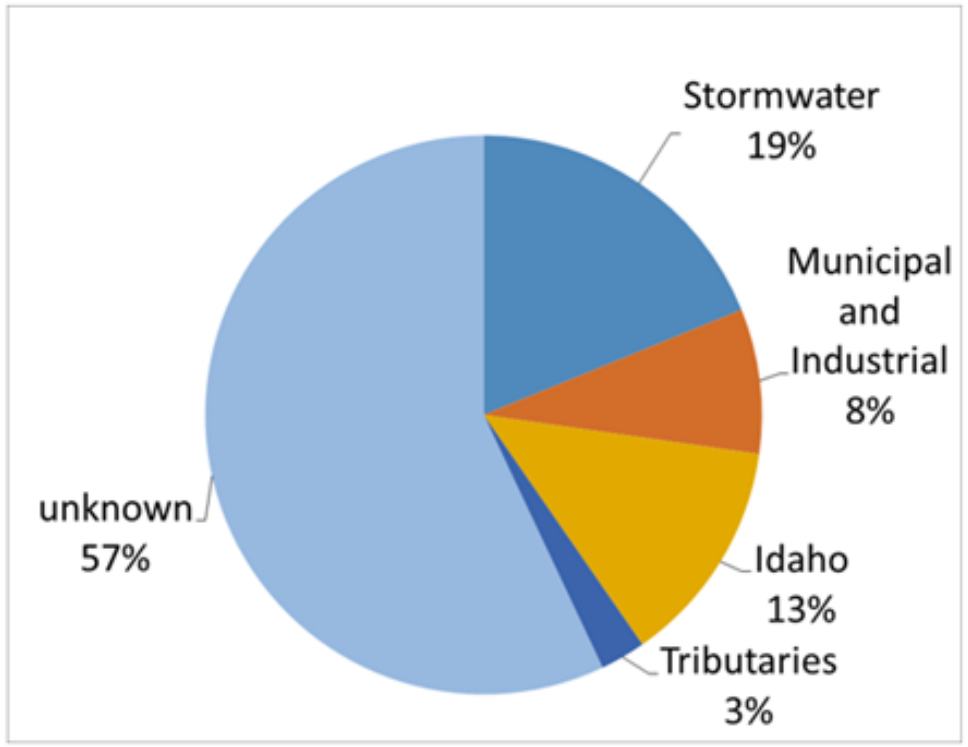
- Urban stormwater
  - Three storm drains and one CSO were sampled during June 2004
    - Sampling conducted by City of Spokane personnel during a runoff event produced by approximately 0.5 inches of rain in a 24-hour period.
  - Parsons/TerraGraphics collected stormwater samples at 14 stations during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

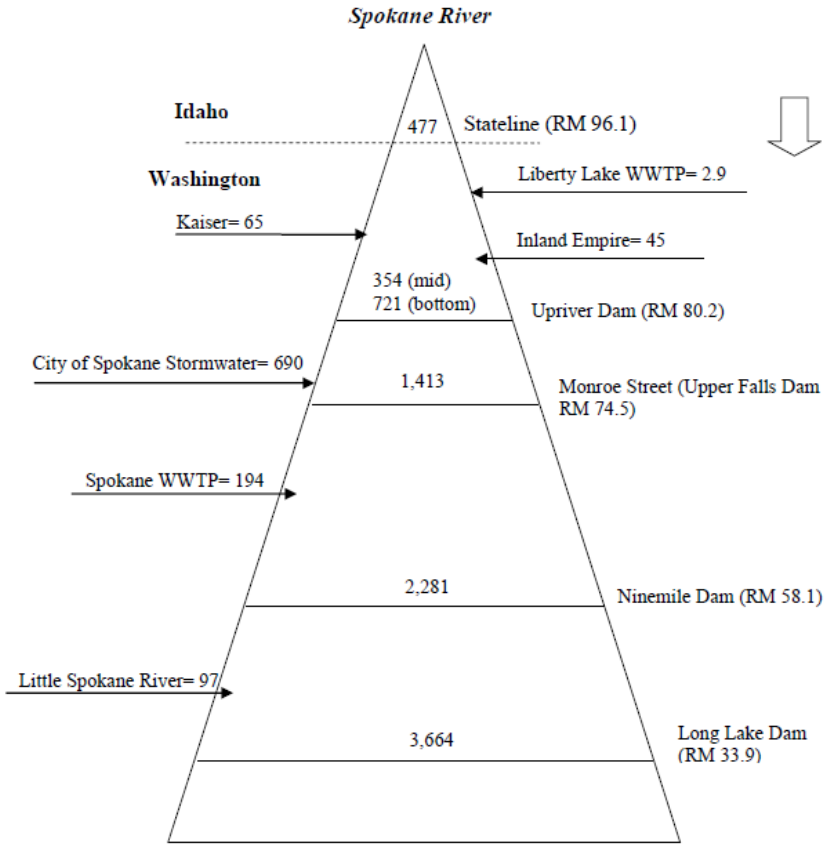
Water Column and Discharges: Ecology, 2003-2007

- 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

Water Column and Discharges: Ecology, 2003-2007

- Overall loading analysis
  - Mass balance assessment conducted to evaluate external loads and in-river load
- Results used to generate loading summary



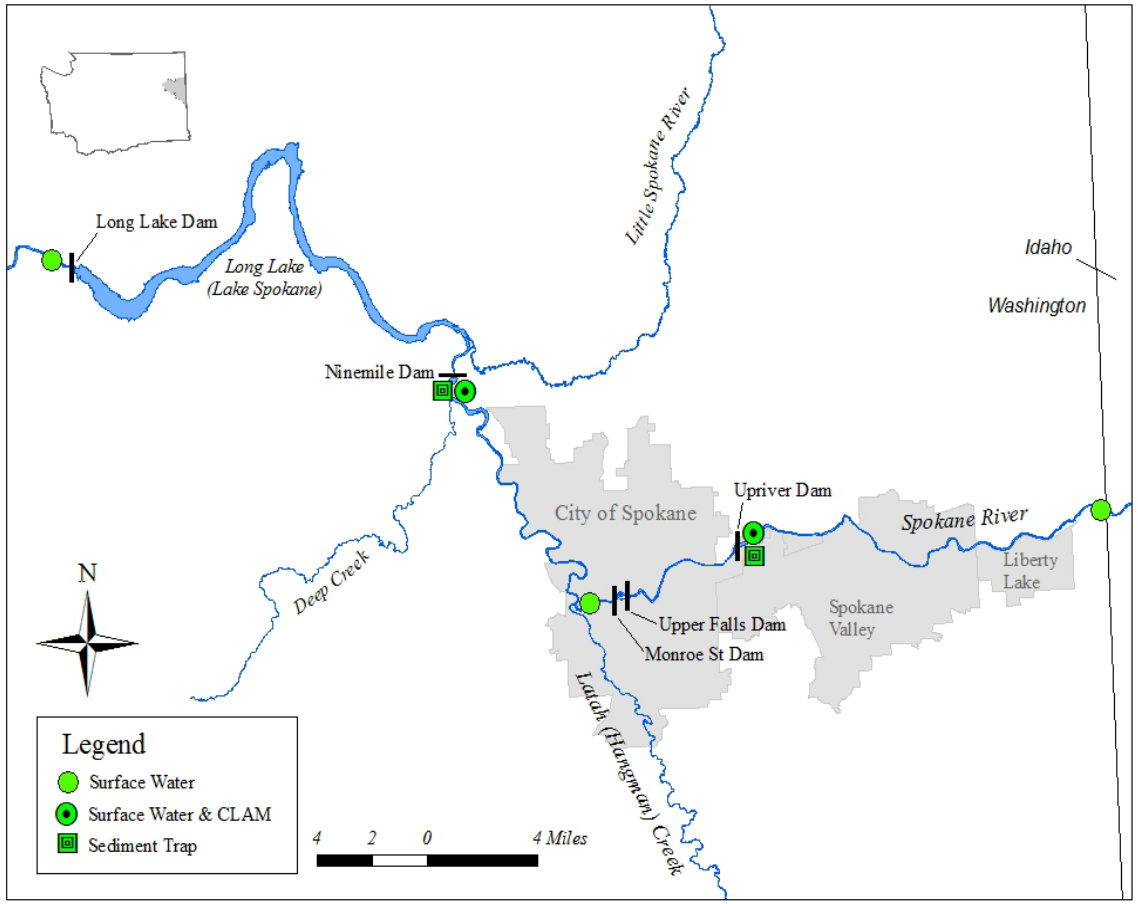


Water Column and Discharges: Ecology, 2012-3

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

Season	Fall			Spring	
Dates	10/23/12 - 10/24/12	10/24/12 - 10/25/12		5/23/13 - 5/24/13	
Location	CLAM		Grab	CLAM	Grab
Stateline	--	--	X	--	X
Upriver Dam	--	X	X	--	X
Above Latah	--	--	X	--	X
Ninemile Dam	X	X	X	--	X

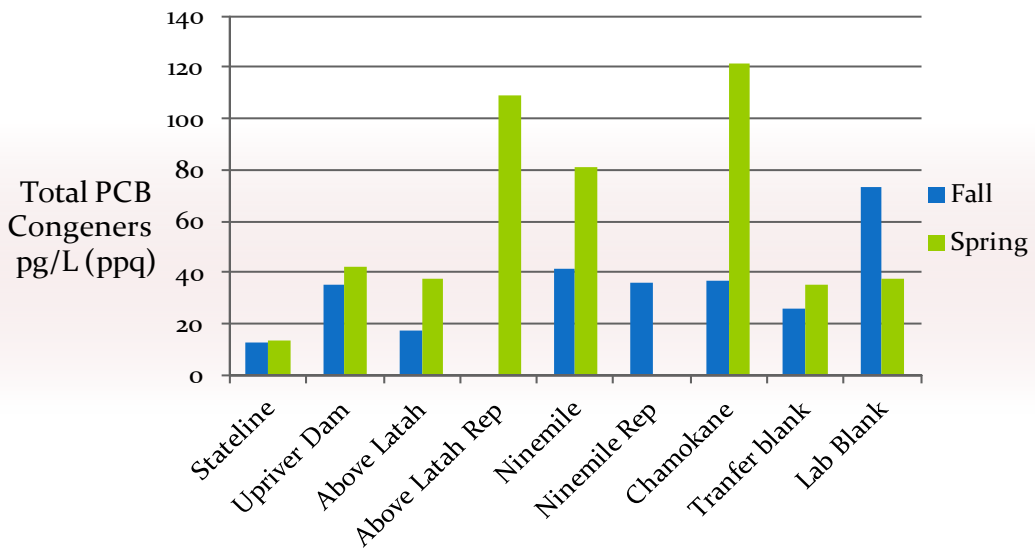
  - Also deployed sediment traps at Ninemile and Upriver Dam



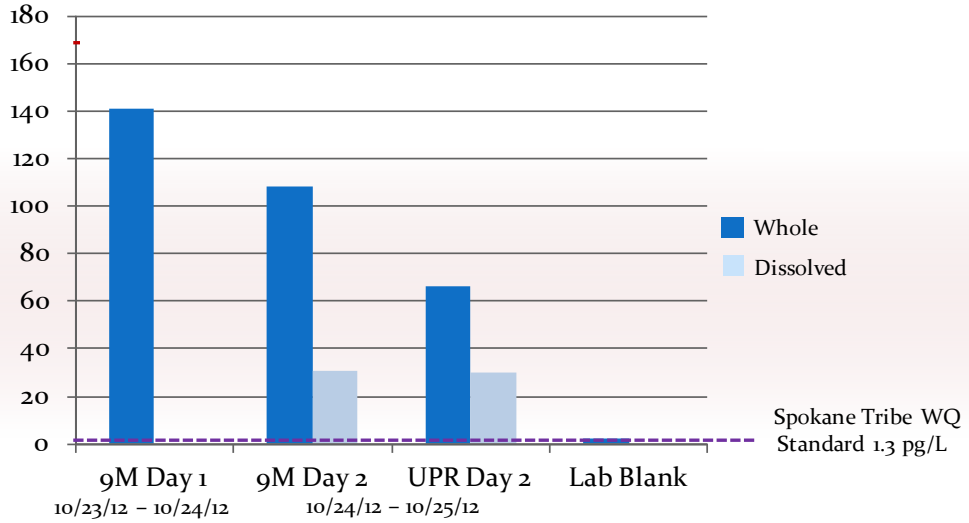
Water Column and Discharges: Ecology, 2012-3

- Observed concentrations

Grab Samples



CLAM



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

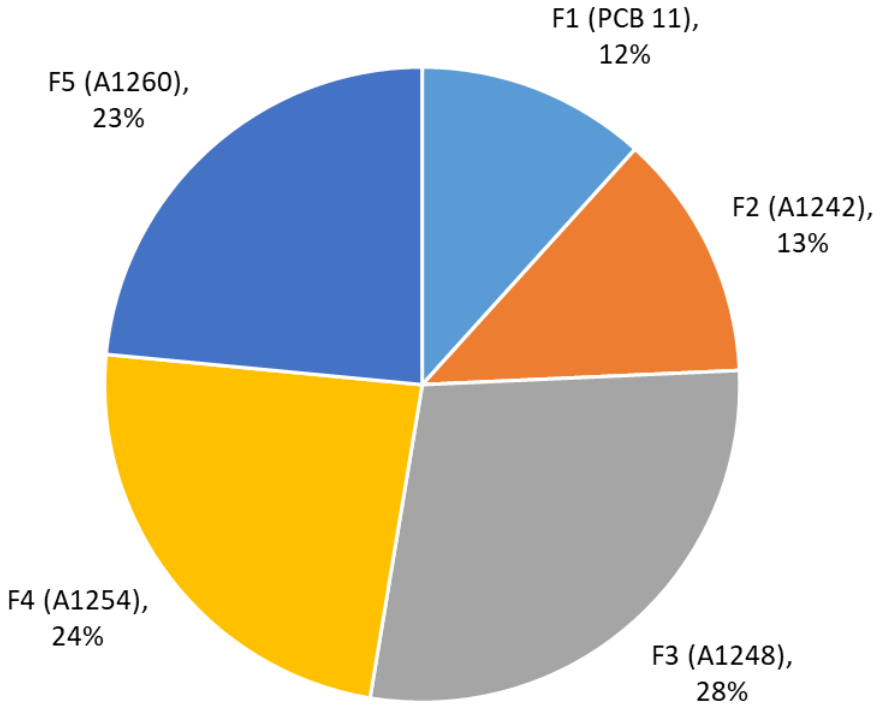
- Source Assessment
  - Spokane County wastewater influent (Spokane County, 2016)
  - Spokane River (SRRTTF, 2019)
- What are the ultimate sources of PCBs?
  - Aroclors?
  - PCB-11?
  - Titanium tetrachloride?

Problem

- 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

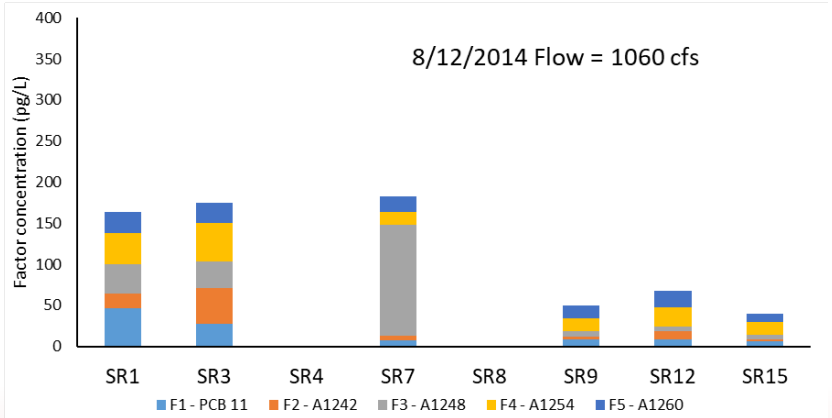
Conclusions of blank study

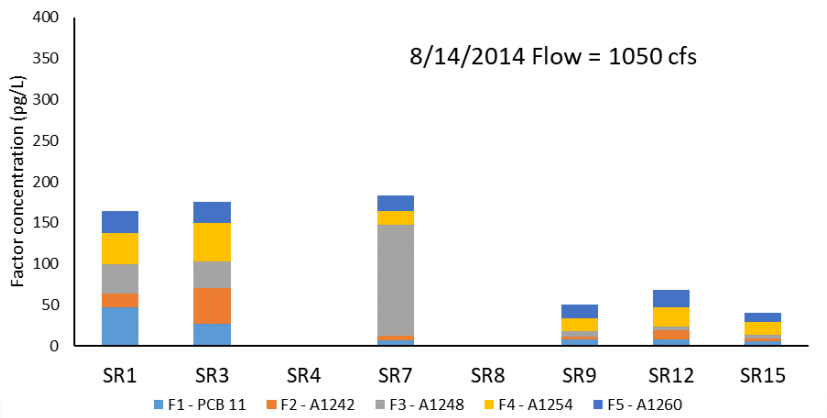
- Some kind of blank correction is necessary
- Blank correction at 3x blank levels results in no data!
- Blank *subtraction* generates phantom factors that have no meaning, so avoid this
- Batch-specific blank censoring works best
- Analyzing the uncorrected data and the blank data is helpful

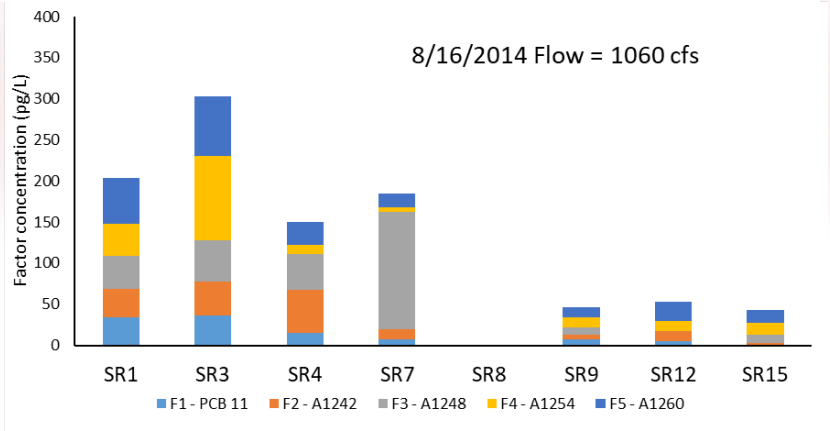
Blank study results

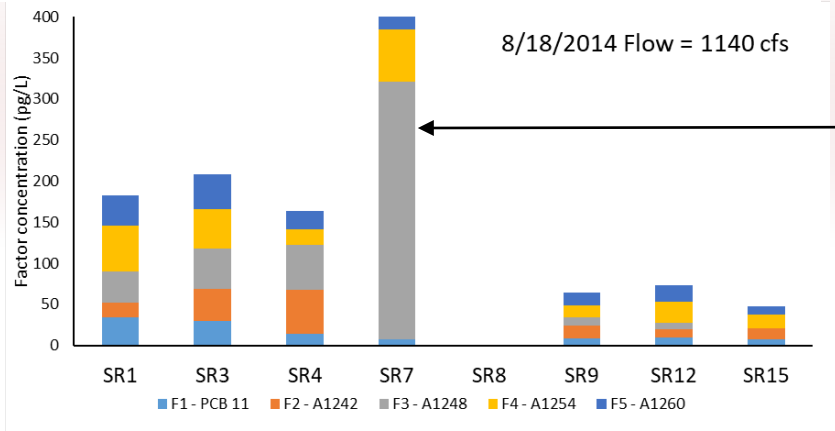
All y-axes max at 400 pg/L
Blank spaces mean no data
All flows are from the Spokane gage.

August 2014 (low flow)



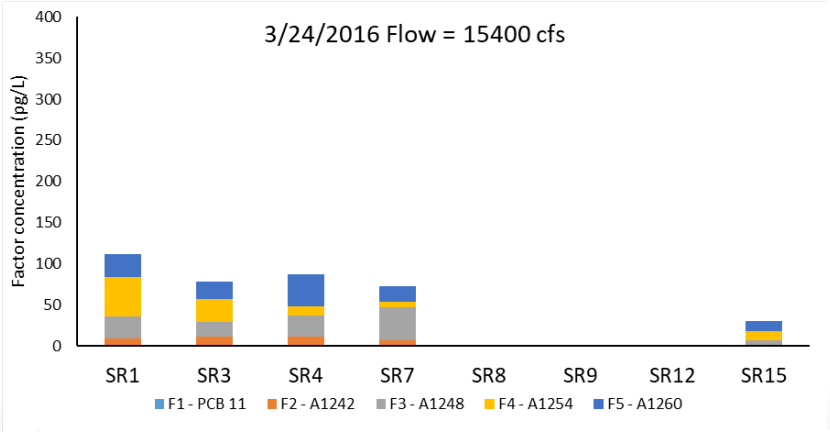


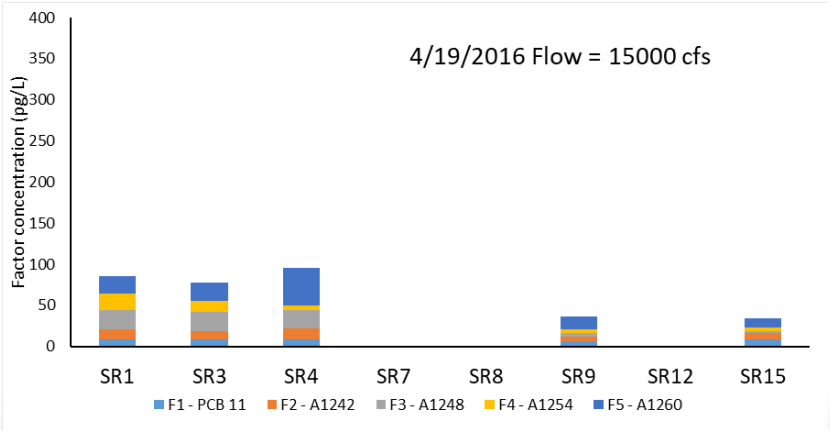


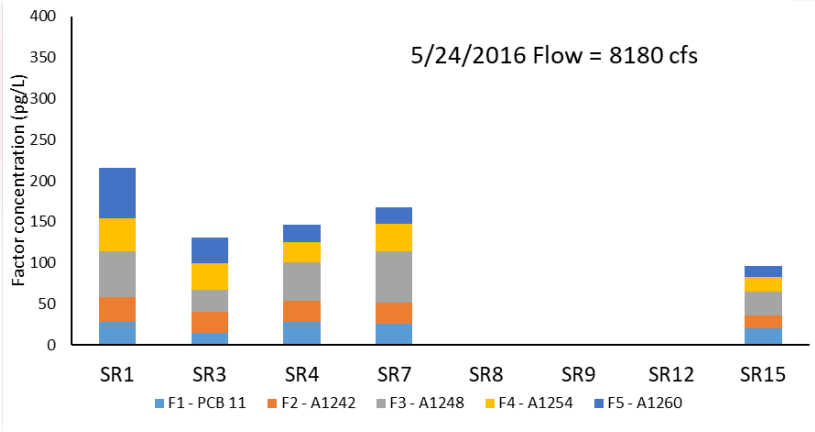


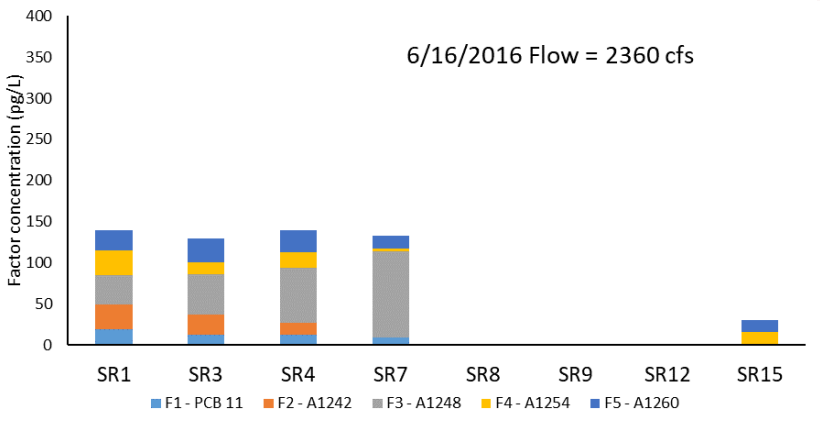
Source of A1248 just above SR7?

Spring 2016 (high flow – snow melt?)

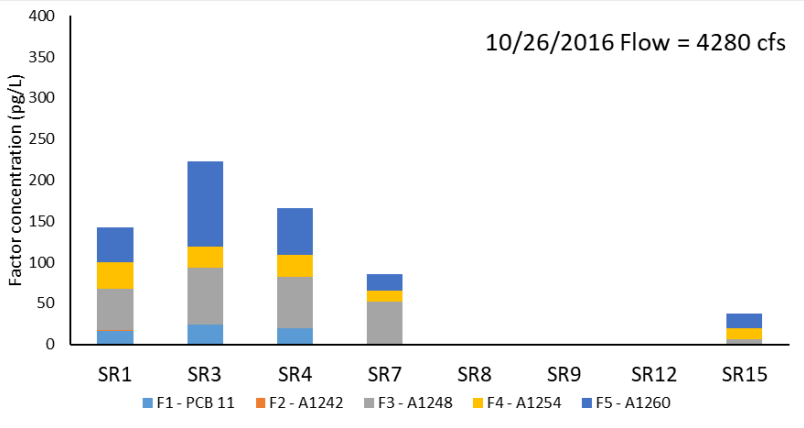


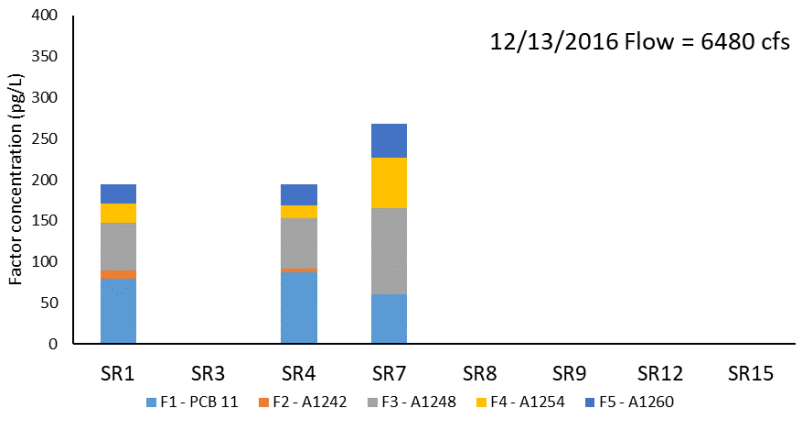






Fall 2016 (medium flow – stormwater?)

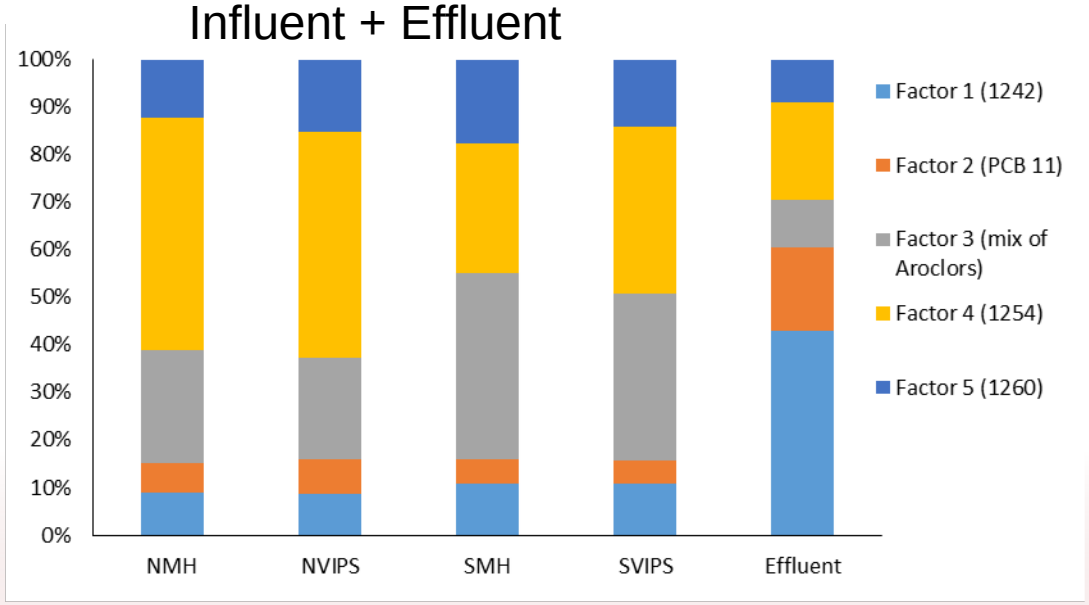




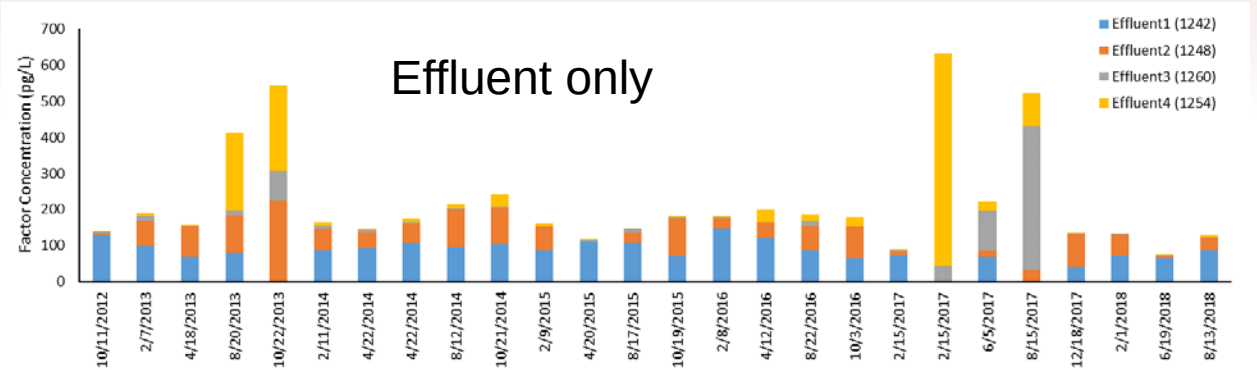
The Oct/Dec 2016 samples have almost no A1242.
Did someone clean up a mess in summer of 2016?

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

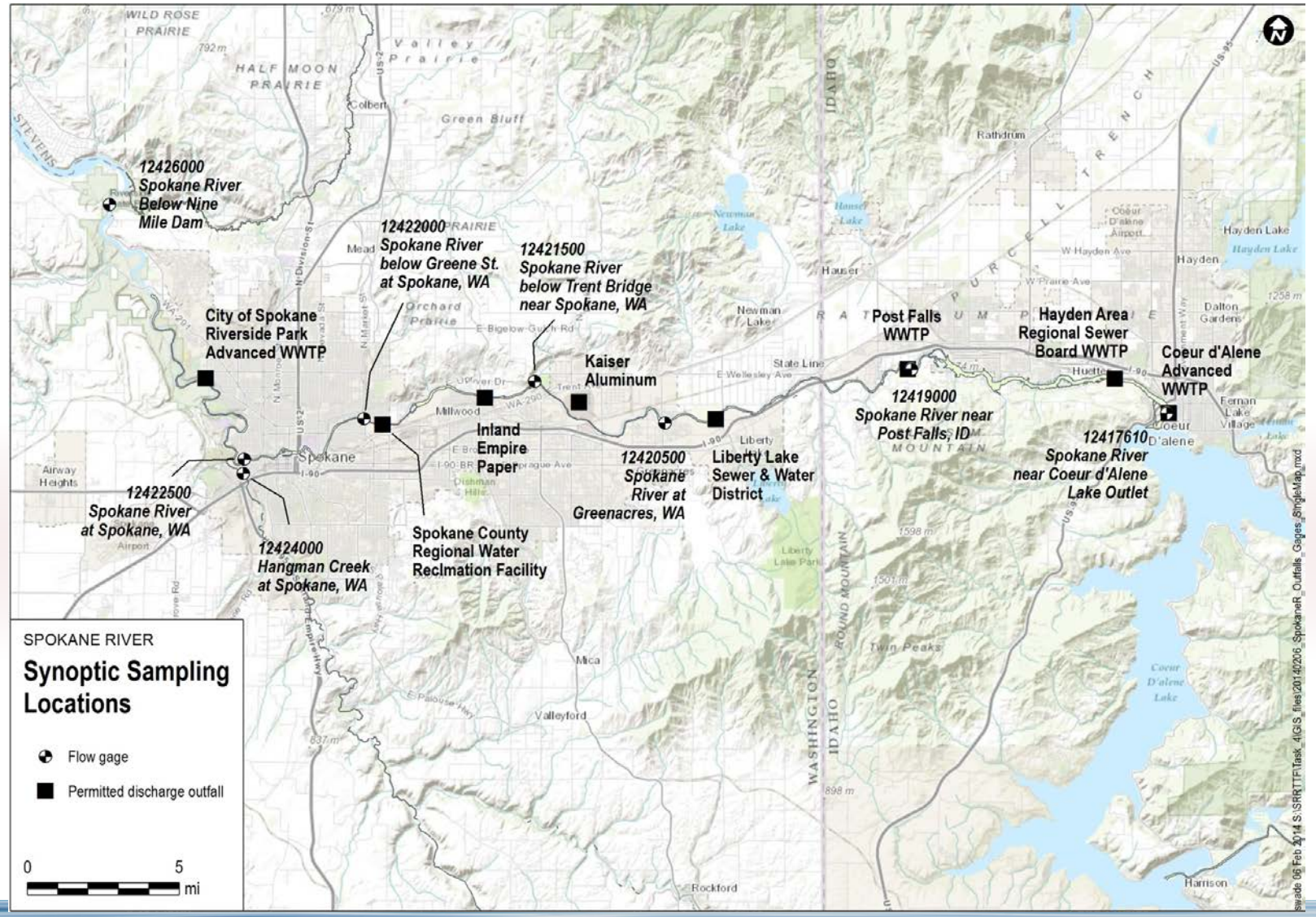


Water Column and Discharges: SRRTTF, 2014

- 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

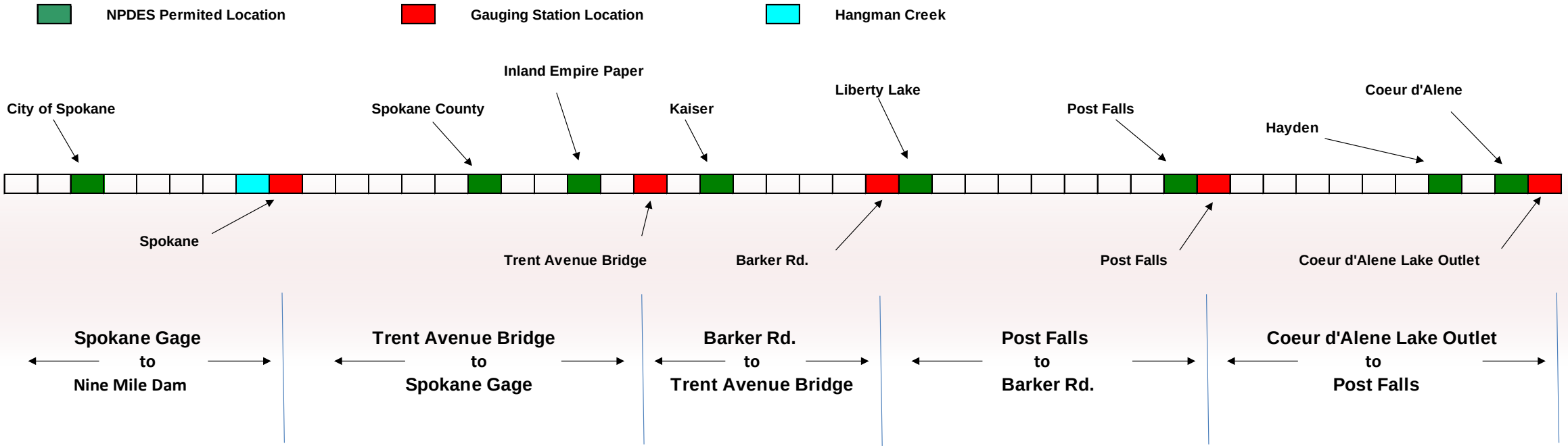
- Sampling locations



Water Column and Discharges: SRRTTF, 2014

- Identify unknown/unmonitored sources

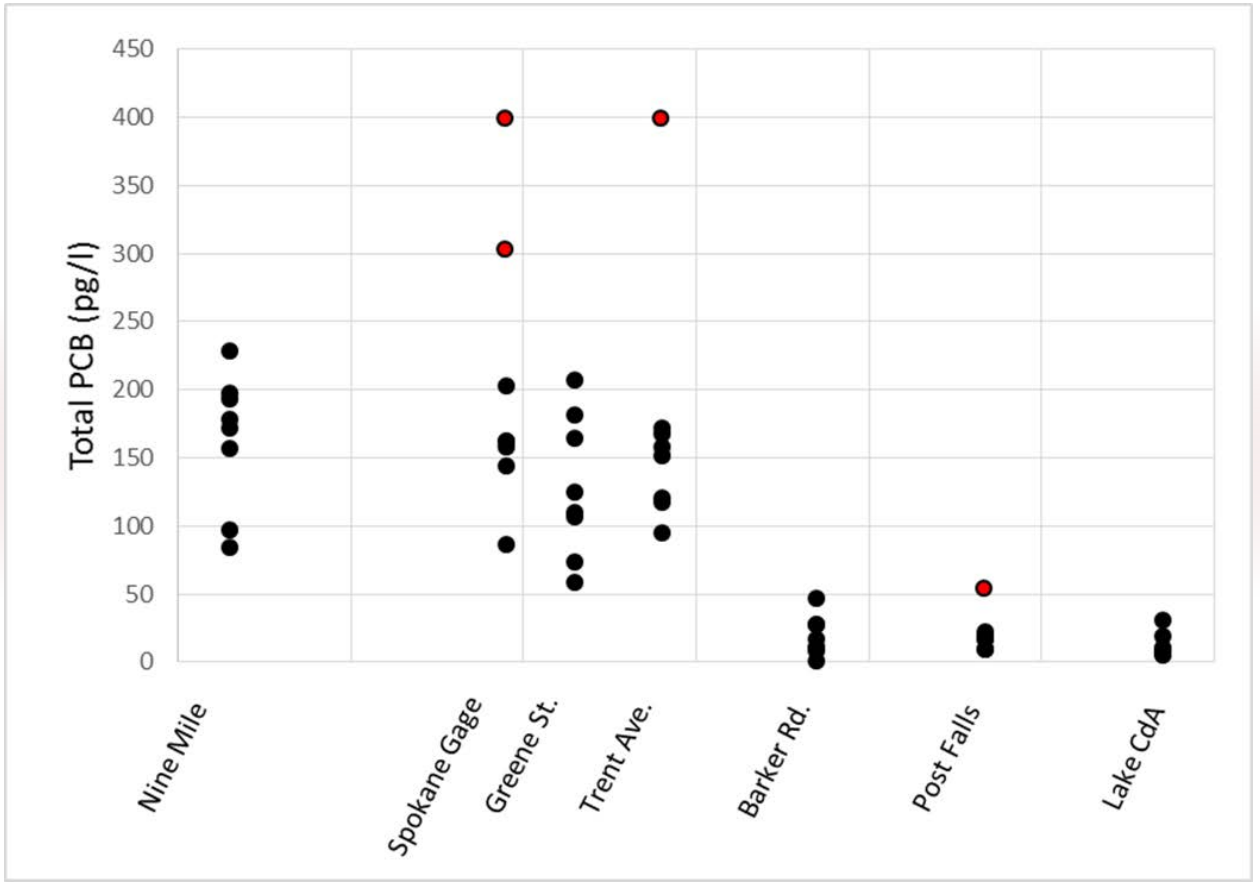
  Unknown source = Downstream load – Upstream load – Known Load



Water Column and Discharges: SRRTTF, 2014

- Observed river concentrations

← Flow



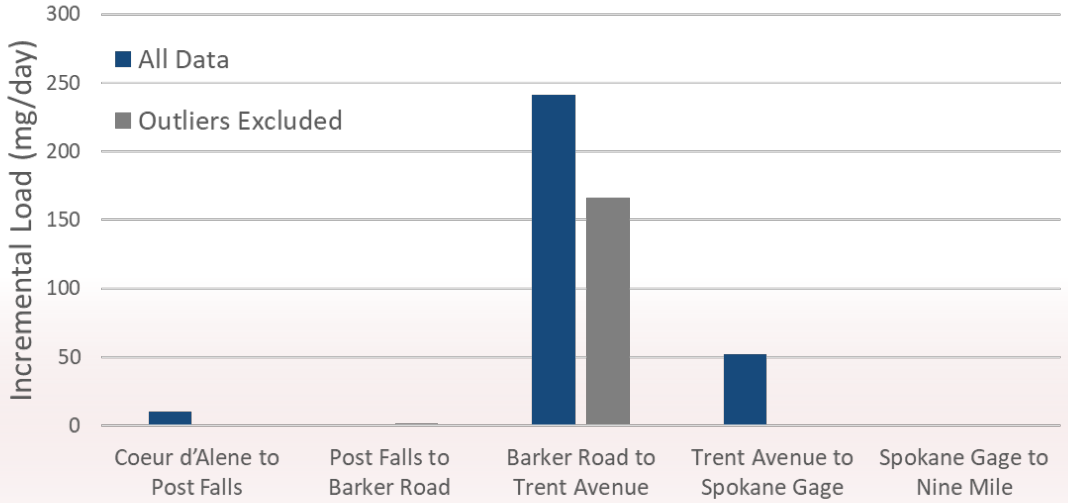
Water Column and Discharges: SRRTTF, 2014

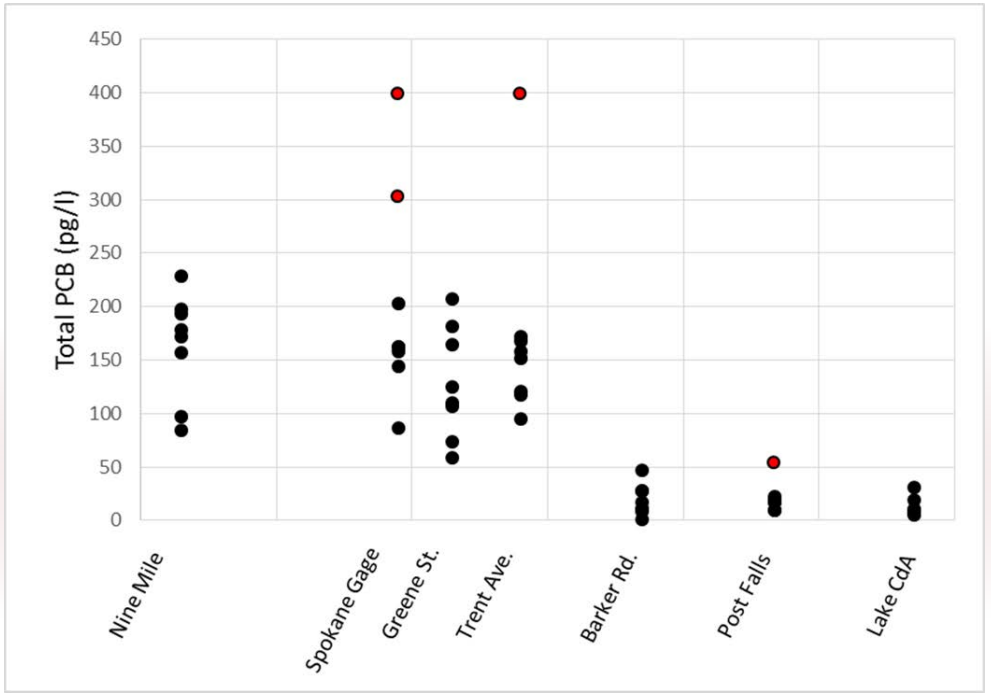
- Observed effluent concentrations

Total PCB (pg/L)				
	8/13	**8/19**	**8/21**	**Composite**
City of Spokane	771/955	23404	1177	878
Spokane County	490	330/290	333	274
Inland Empire Paper	3627	2957	2636/2629	2766
Kaiser Aluminum	3276	4012	4625	2514
Liberty Lake	200	193	260	211
Post Falls	221	219	200	176
Coeur d'Alene	1227	534	531	668

Water Column and Discharges: SRRTTF, 2014

- Estimate of unknown/unmonitored load



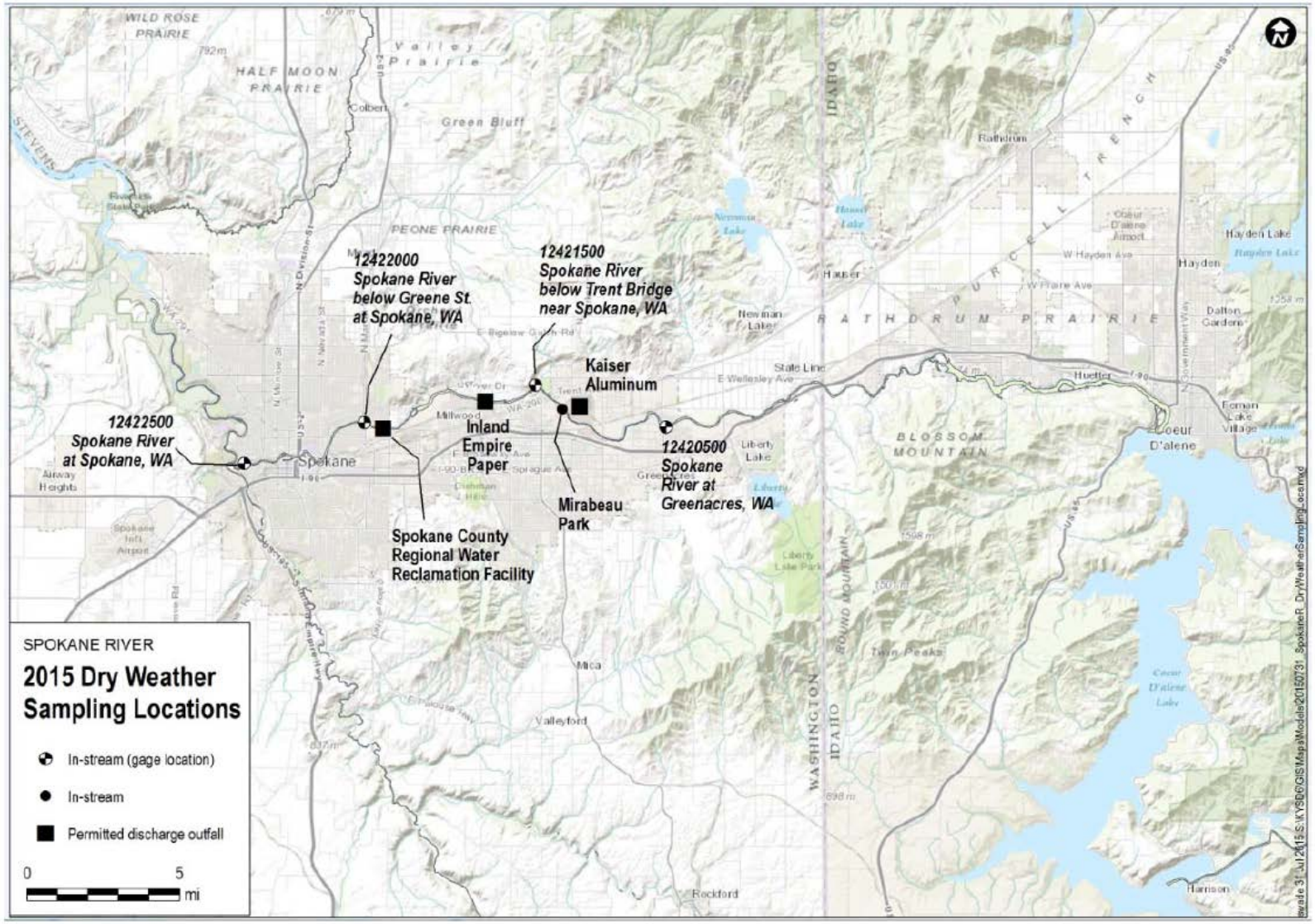


Water Column and Discharges: SRRTTF, 2015

- 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

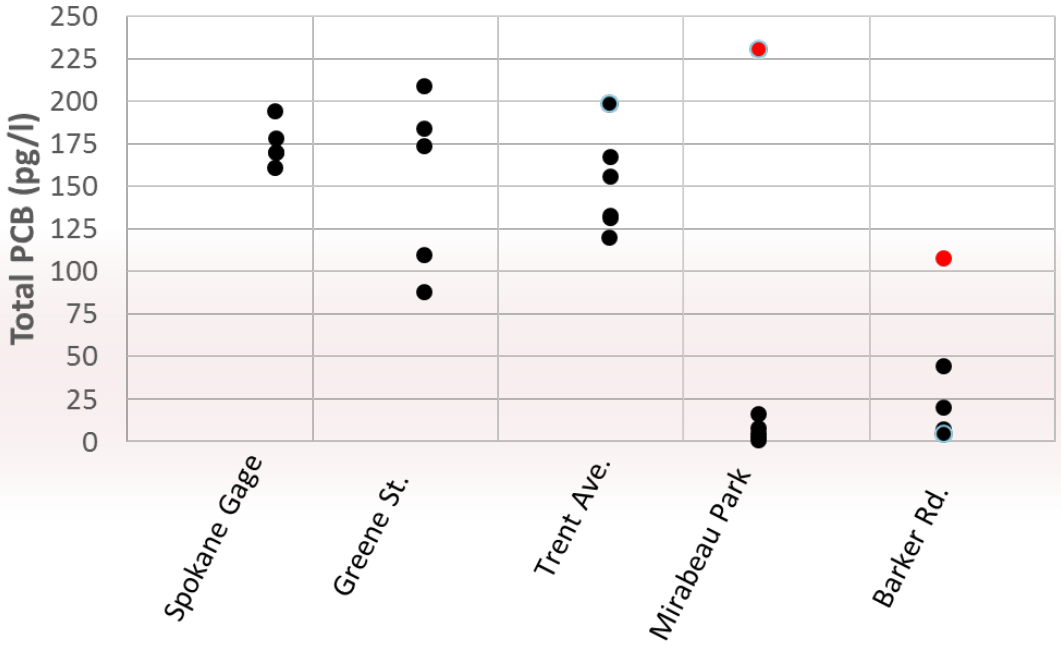
- Sampling locations



Water Column and Discharges: SRRTTF, 2015

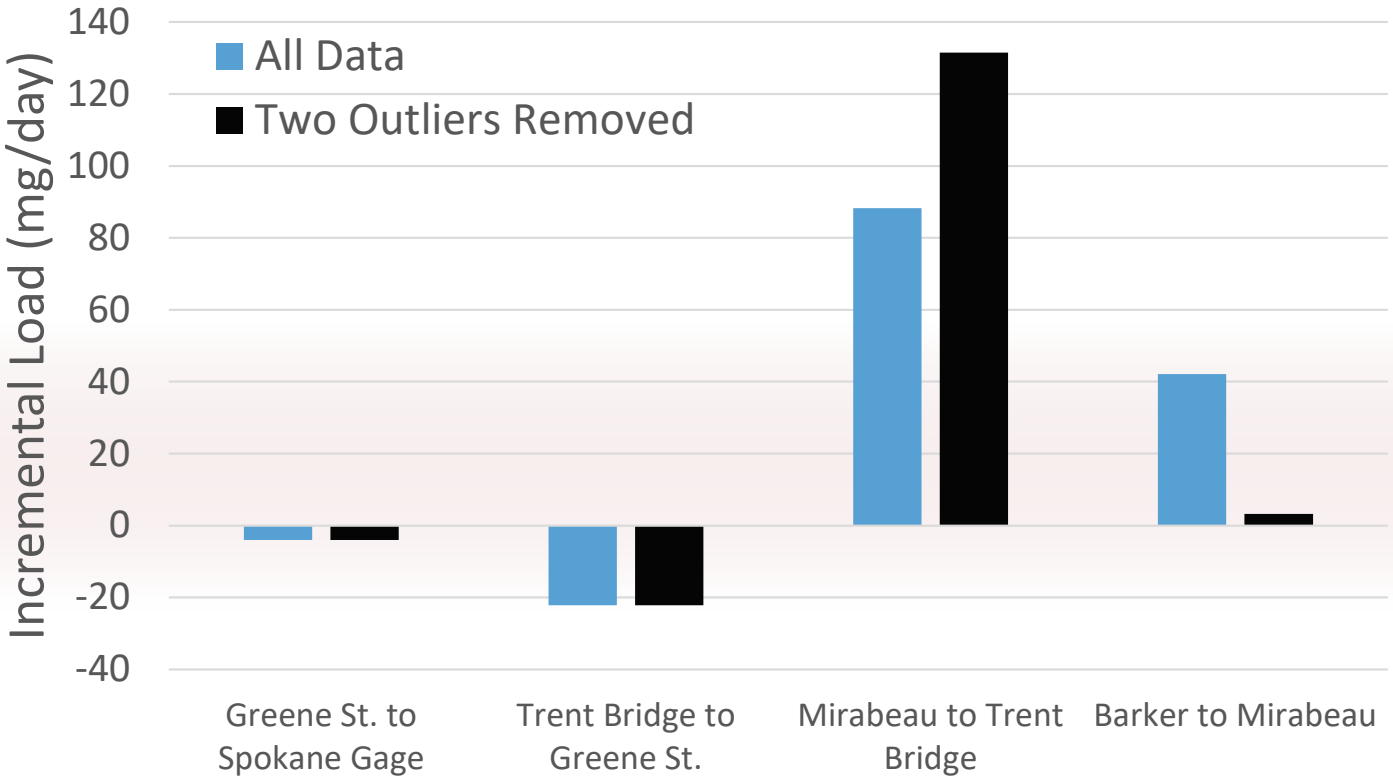
- River concentrations

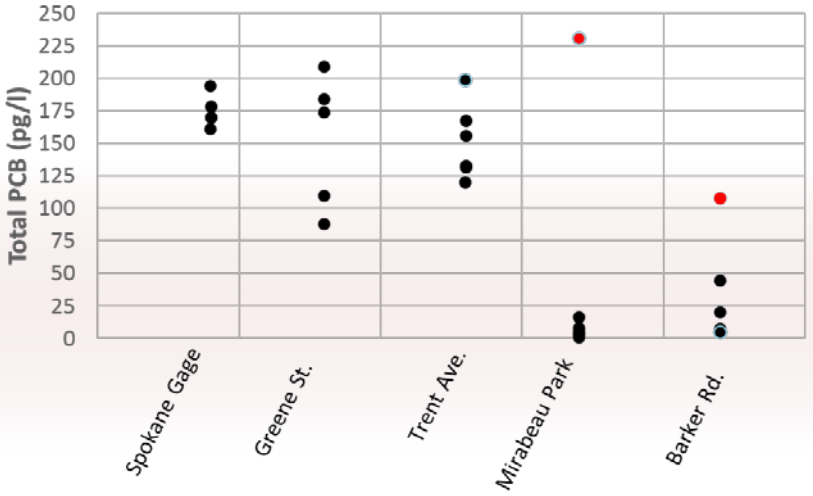
← Flow



Water Column and Discharges: SRRTTF, 2015

- Estimate of unknown/unmonitored load



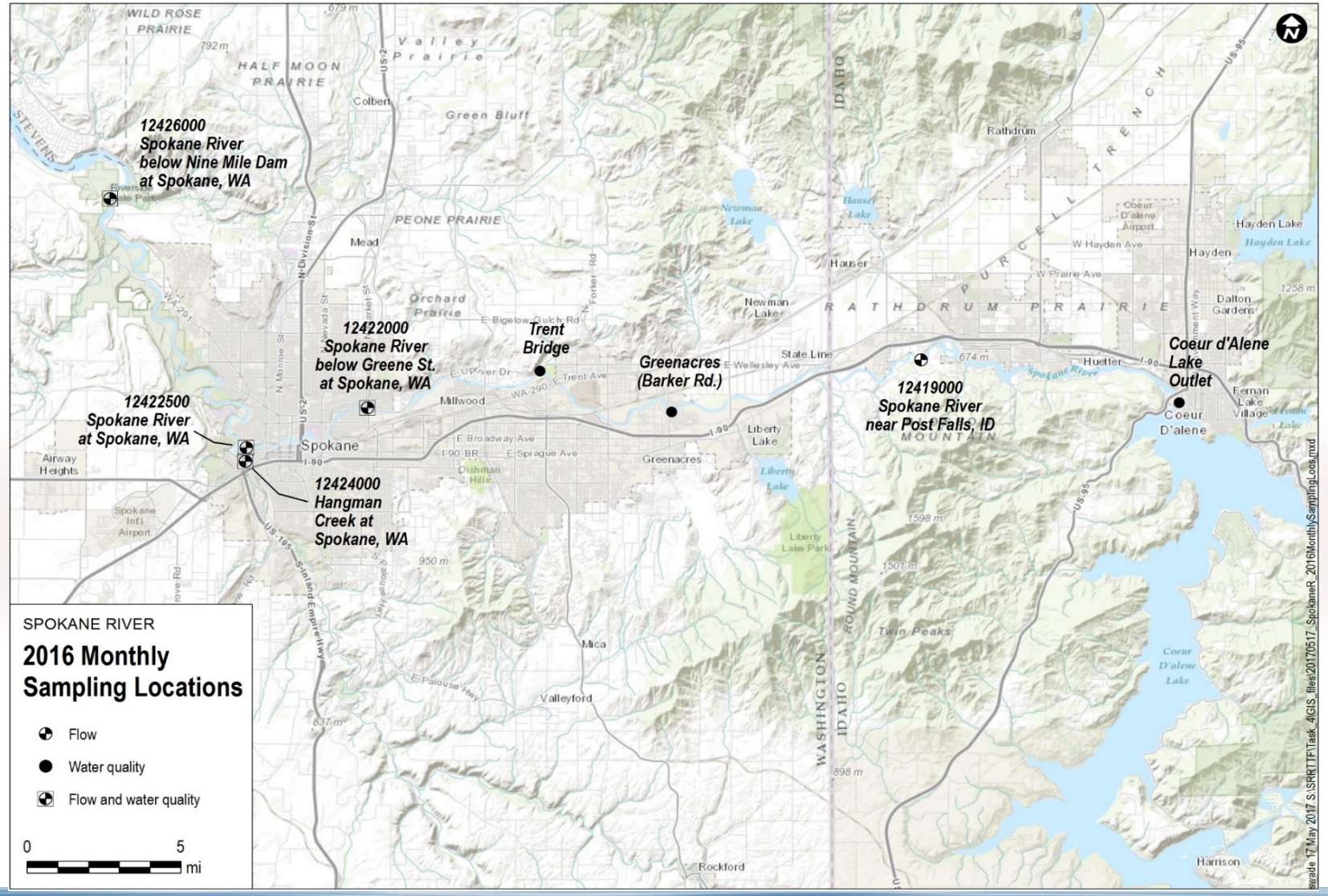


Water Column and Discharges: SRRTTF, 2016a

- 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

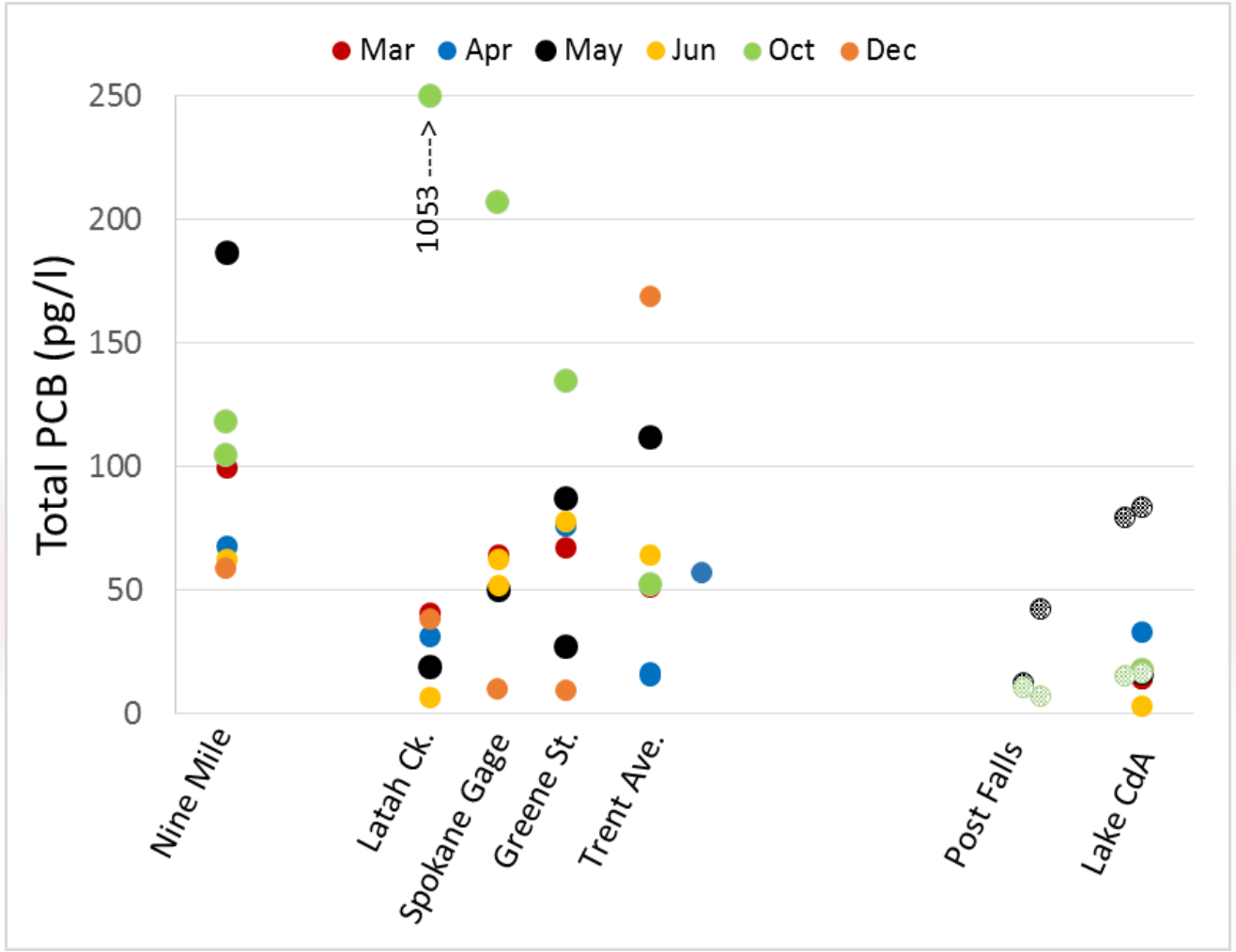
Water Column and Discharges: SRRTTF, 2016a

- Sampling locations



Water Column and Discharges: SRRTTF, 2016a

- Observed concentrations

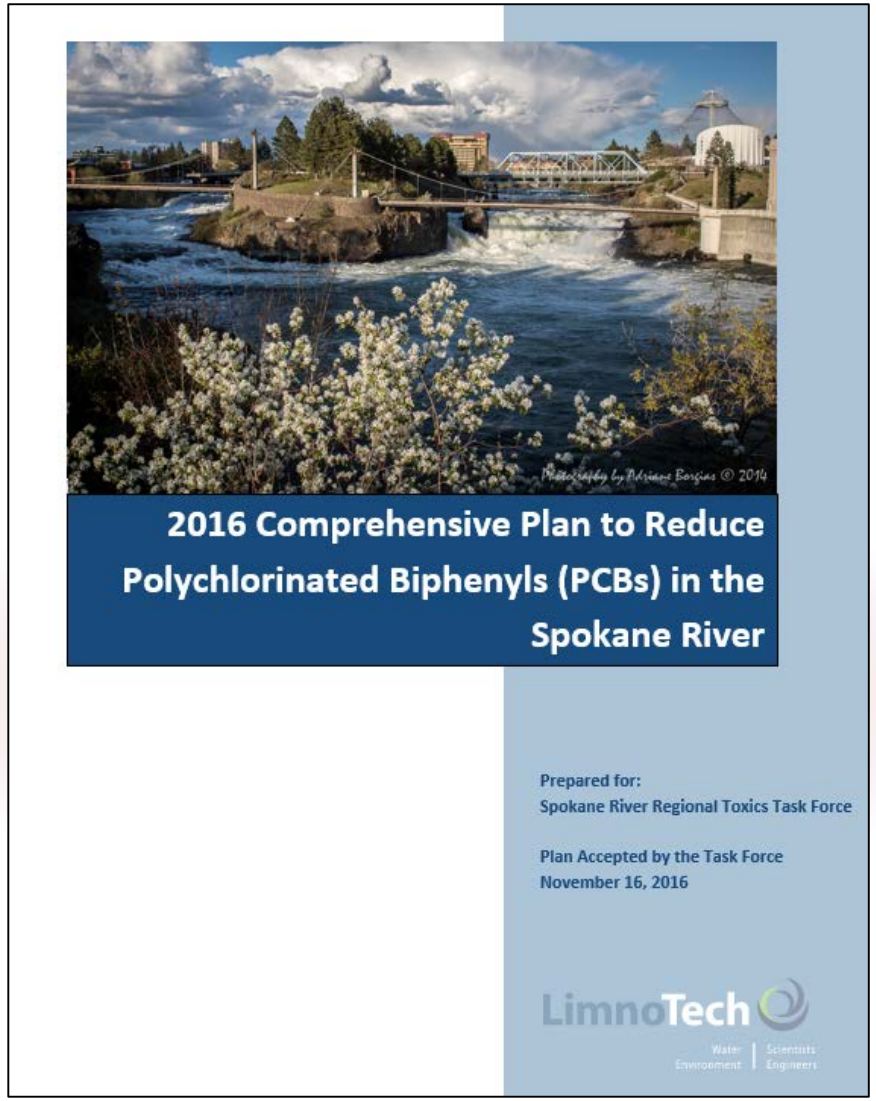


Water Column and Discharges: SRRTTF, 2016a

- 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

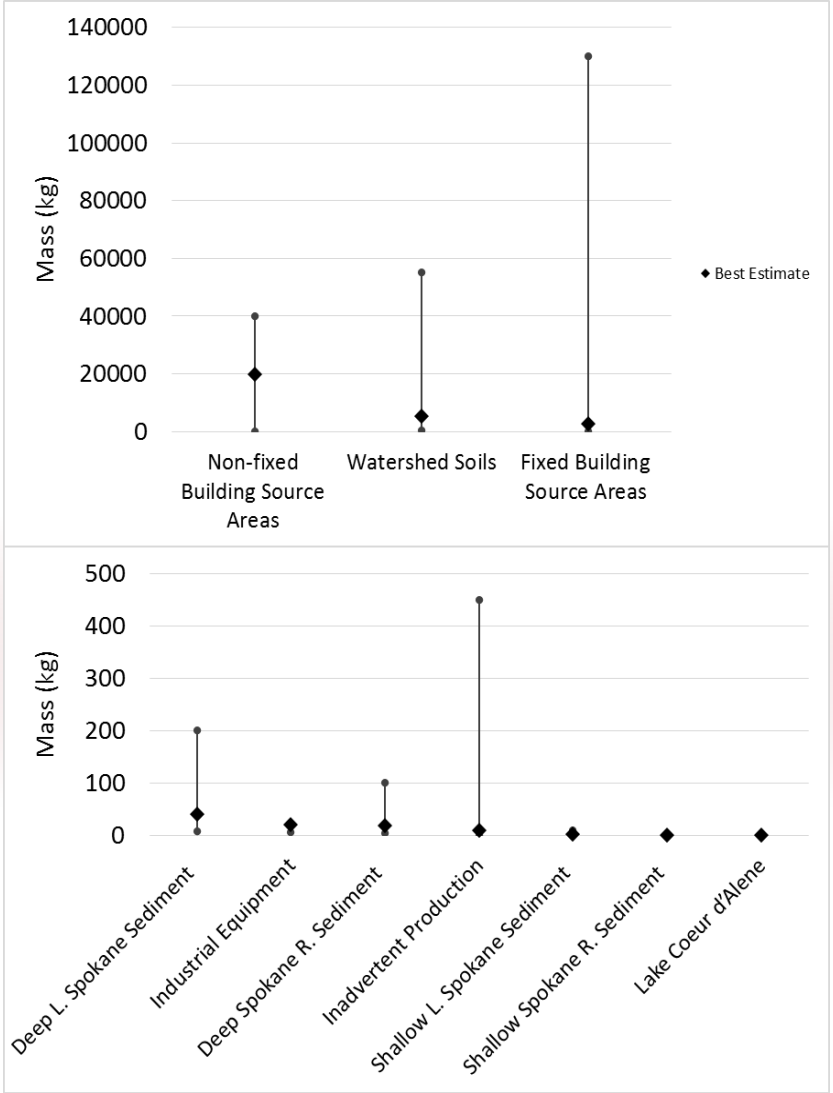
Water Column and Discharges: SRRTTF, 2016b

- 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

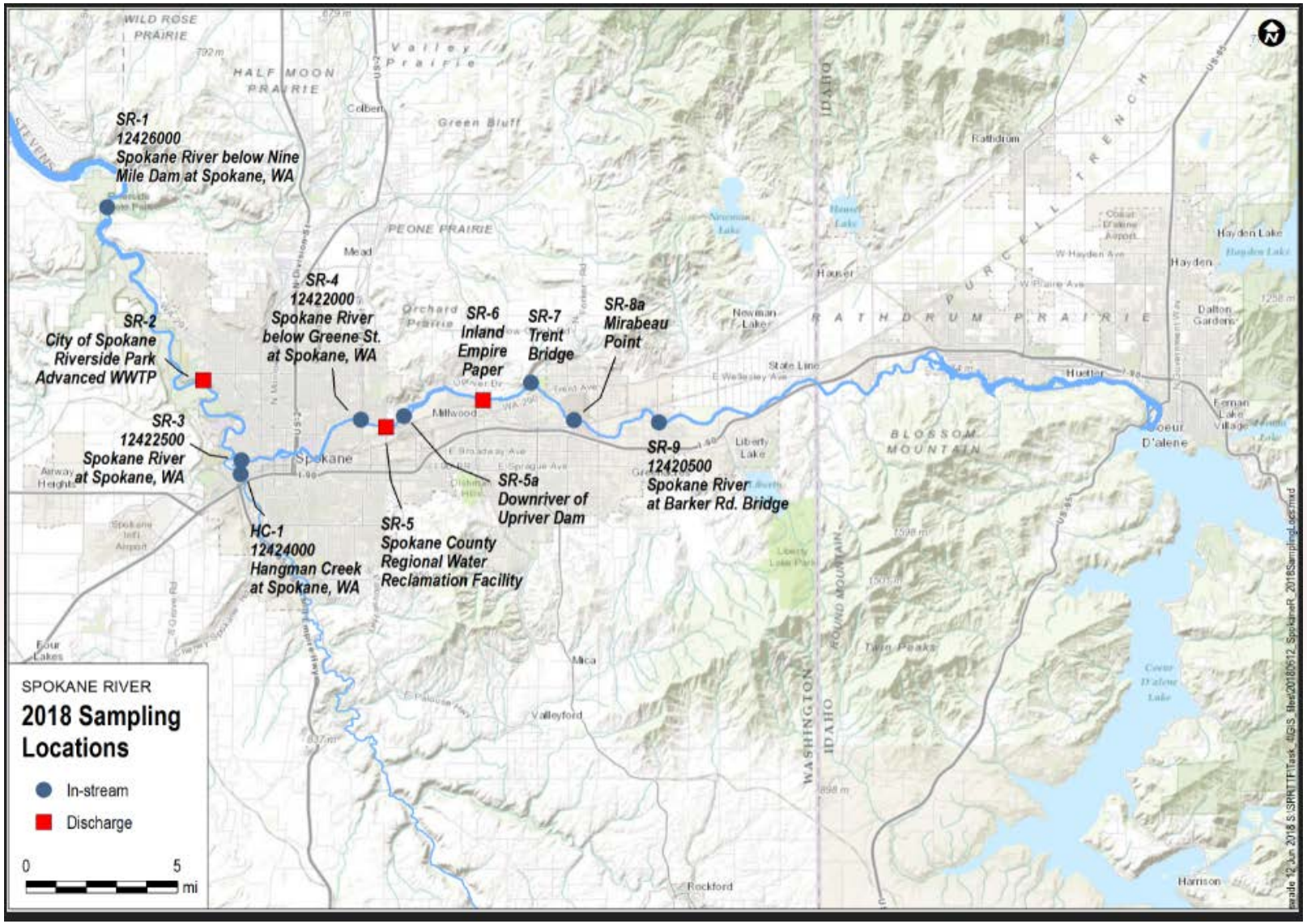
Delivery Mechanism	PCB Loading Rate (mg/day)
Upstream sources (Lake Coeur d'Alene)	33 - 444
Groundwater loading	60 - 300
Tributaries	
Latah Creek	~0 - 215
Little Spokane River	15-200
WWTPs[1]	
Total Industrial	126 - 165
Total Municipal	51 - 125
Idaho	4-10
Washington	47-115
MS4 stormwater/CSOs	15 - 94
Bottom sediments	0.2 - 20
Fish hatcheries	Unknown
Atmospheric deposition to surface water	<0

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

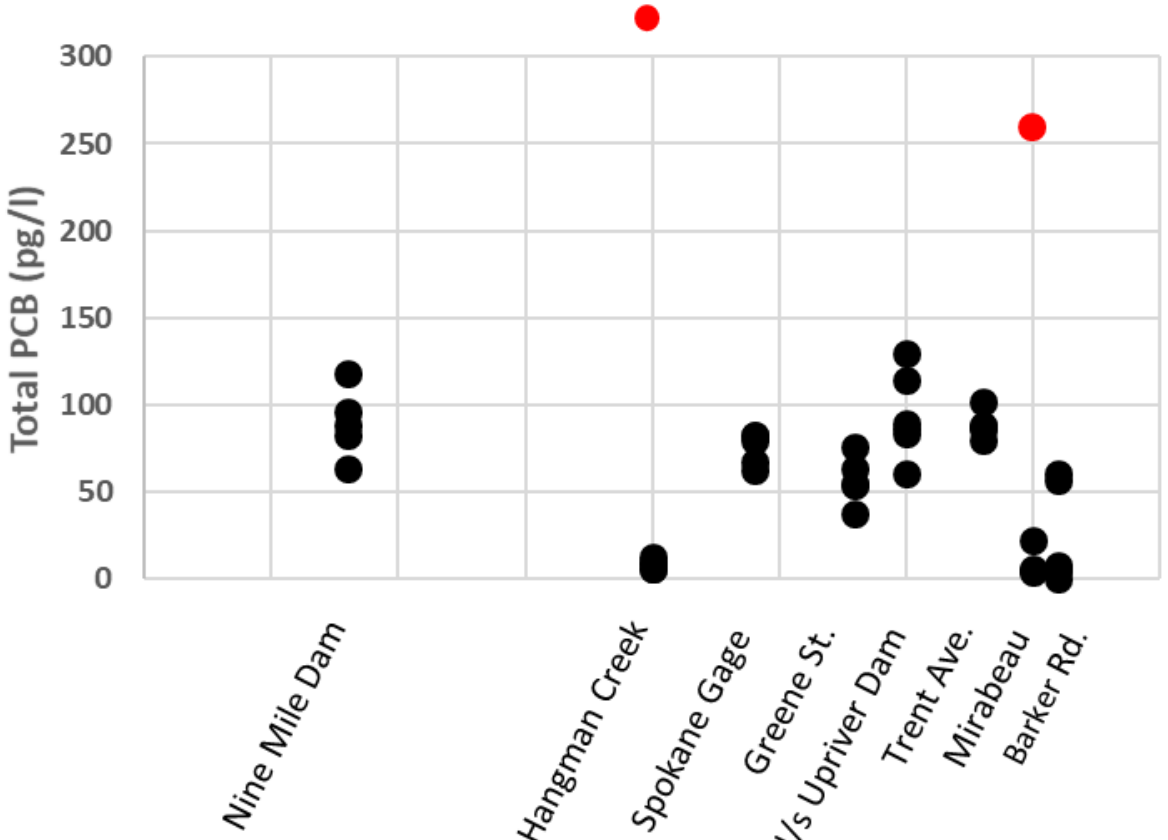
Water Column and Discharges: SRRTTF, 2018

- Sampling locations



Water Column and Discharges: SRRTTF, 2018

- Observed concentrations



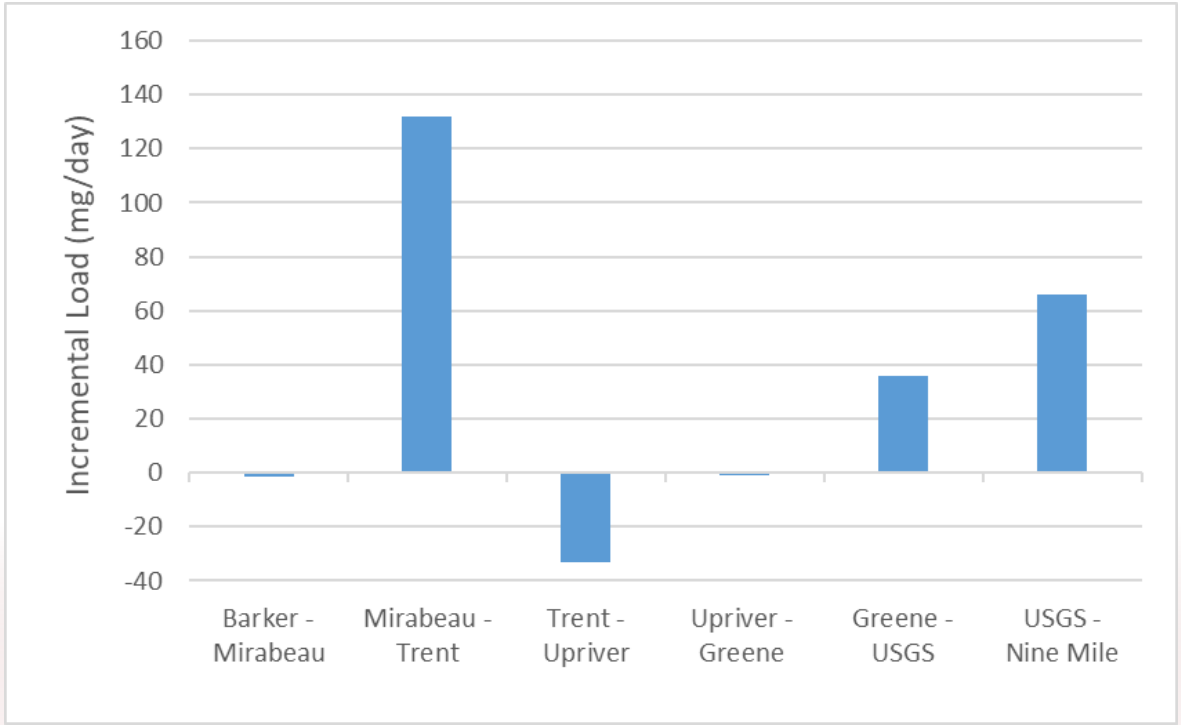
Water Column and Discharges: SRRTTF, 2018

- Observed effluent concentrations

	8/4	8/6	8/8
Inland Empire Paper	1937	1691	1122
Spokane County	234.5	240.9	221.6
City of Spokane	644.5	521.8	439.2
Kaiser	1537		

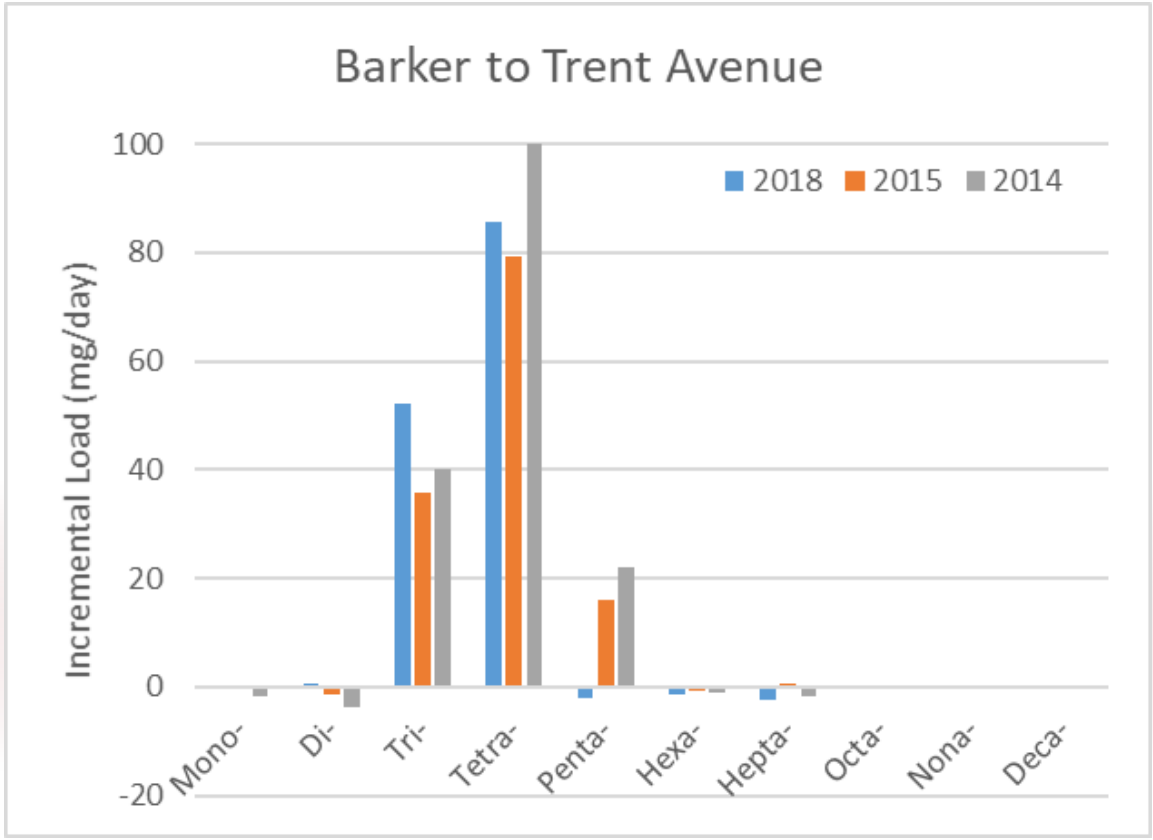
Water Column and Discharges: SRRTTF, 2018

- 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



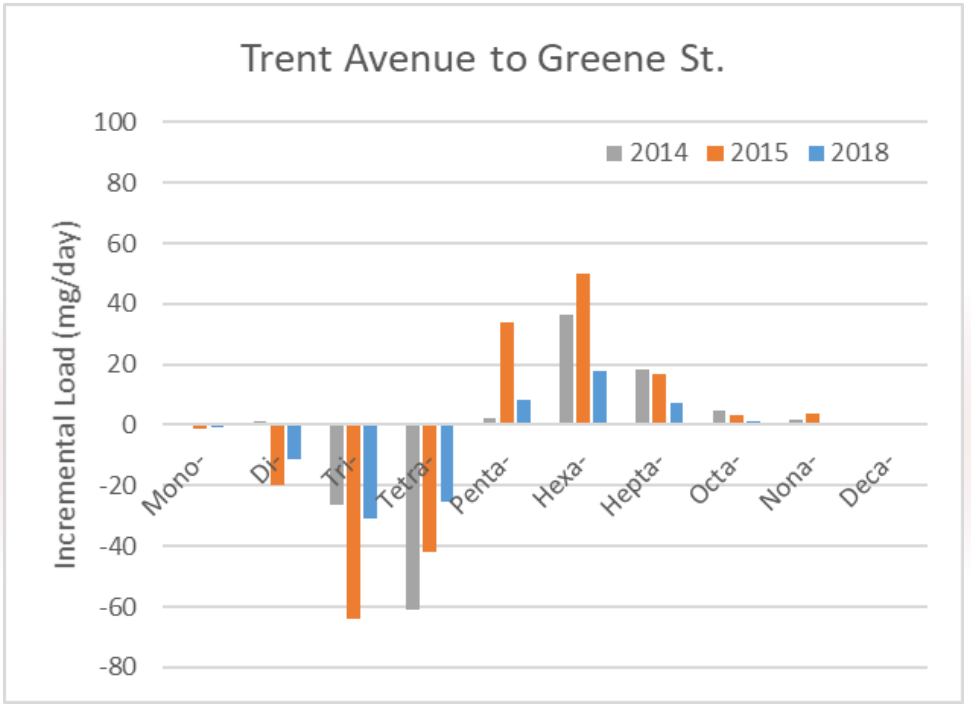
Water Column and Discharges: SRRTTF, 2018

- 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



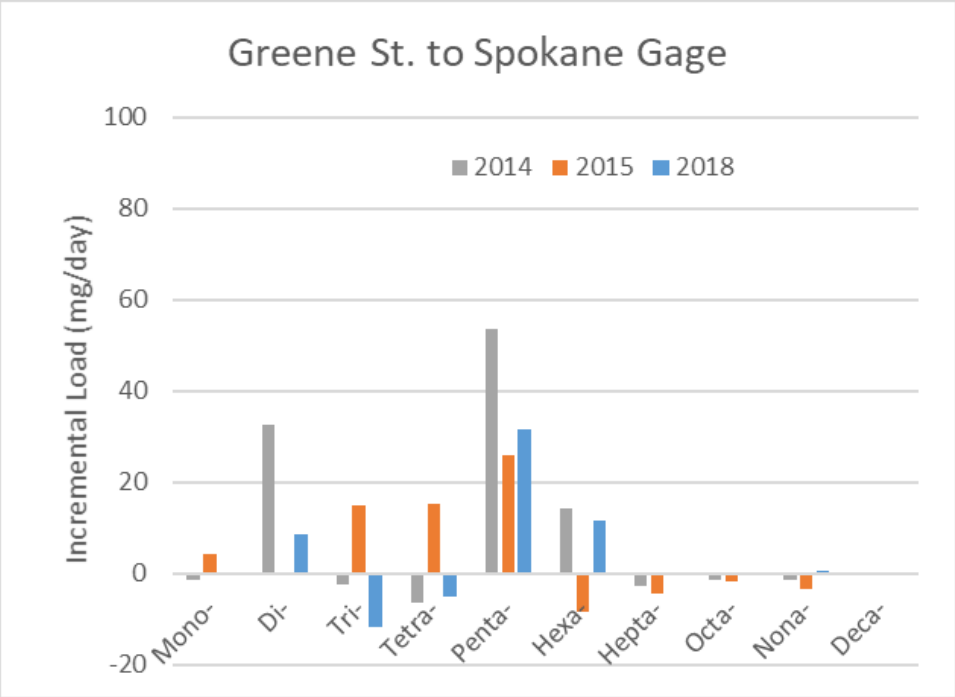
Water Column and Discharges: SRRTTF, 2018

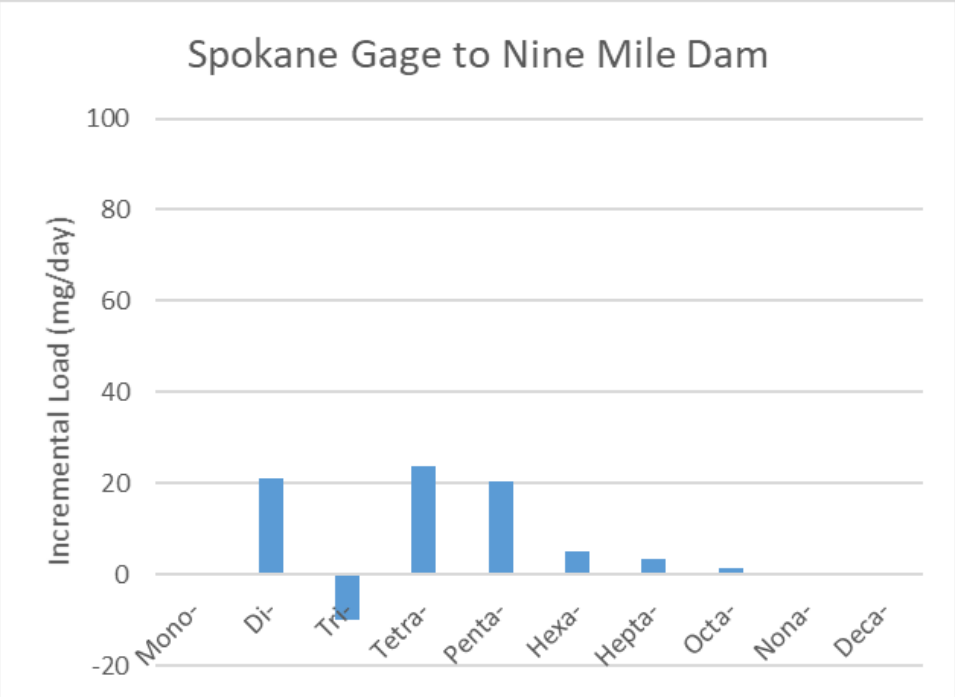
- Homolog-specific mass balances
- Consistent pattern seen between Trent and Greene St.
  - Loss of di- through tetra- homologs
  - Gain of penta- through hepta- homologs



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

Evaluation of Fish Hatcheries as Sources of PCBs to the Spokane River

DEPARTMENT OF ECOLOGY
State of Washington

April 2018
Publication No. 18-03-014

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

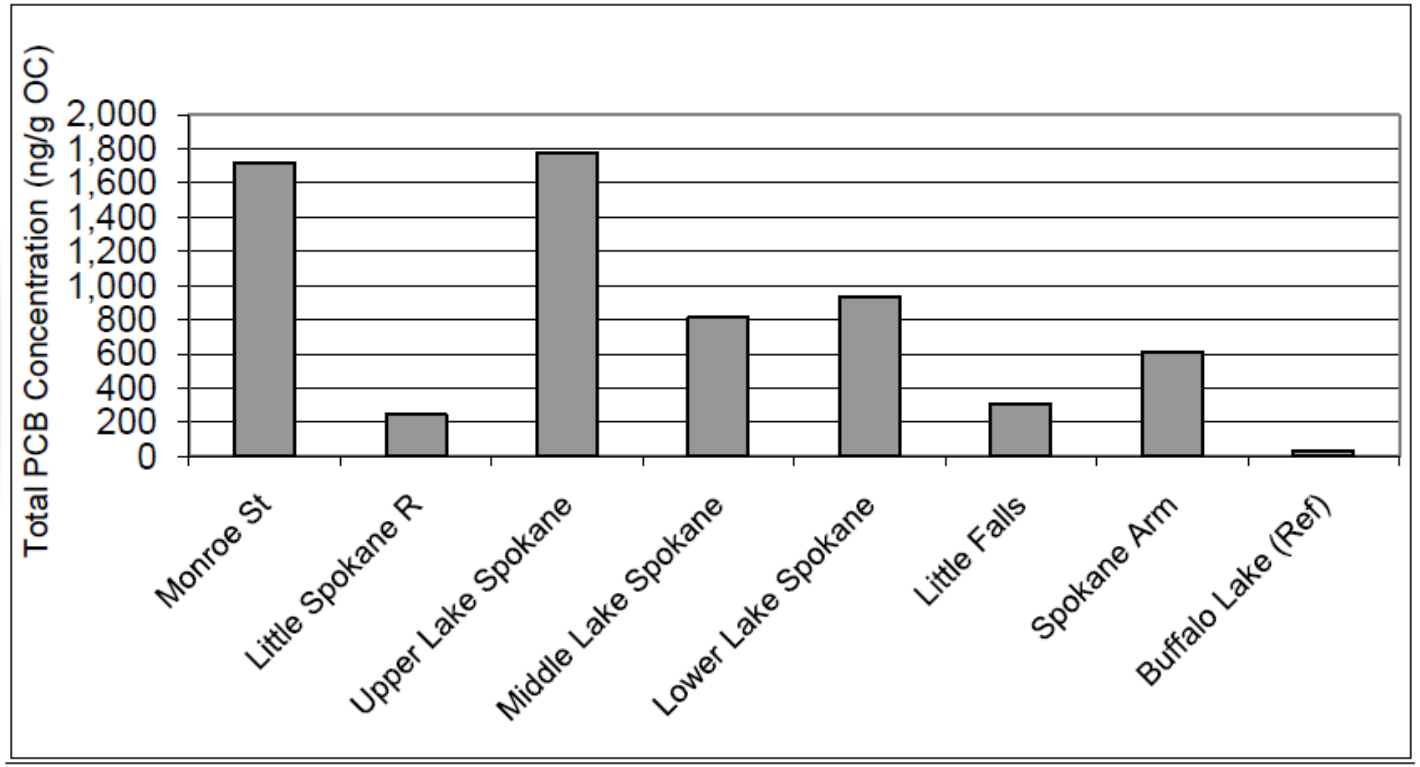
- Characterize sources
  - PCBs originate from Aroclors and PCB-11
  - Reasonable understanding of wastewater loads
  - Coarser understanding of stormwater loads
  - Coarse understanding of some groundwater loads
- Make progress
  - “Snapshots” of river concentrations at selected times
    - < 50 pg/l coming into Spokane; 50-150 pg/l in Spokane area

Sediments

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

Sediments: Ecology, 2003-2007

- 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



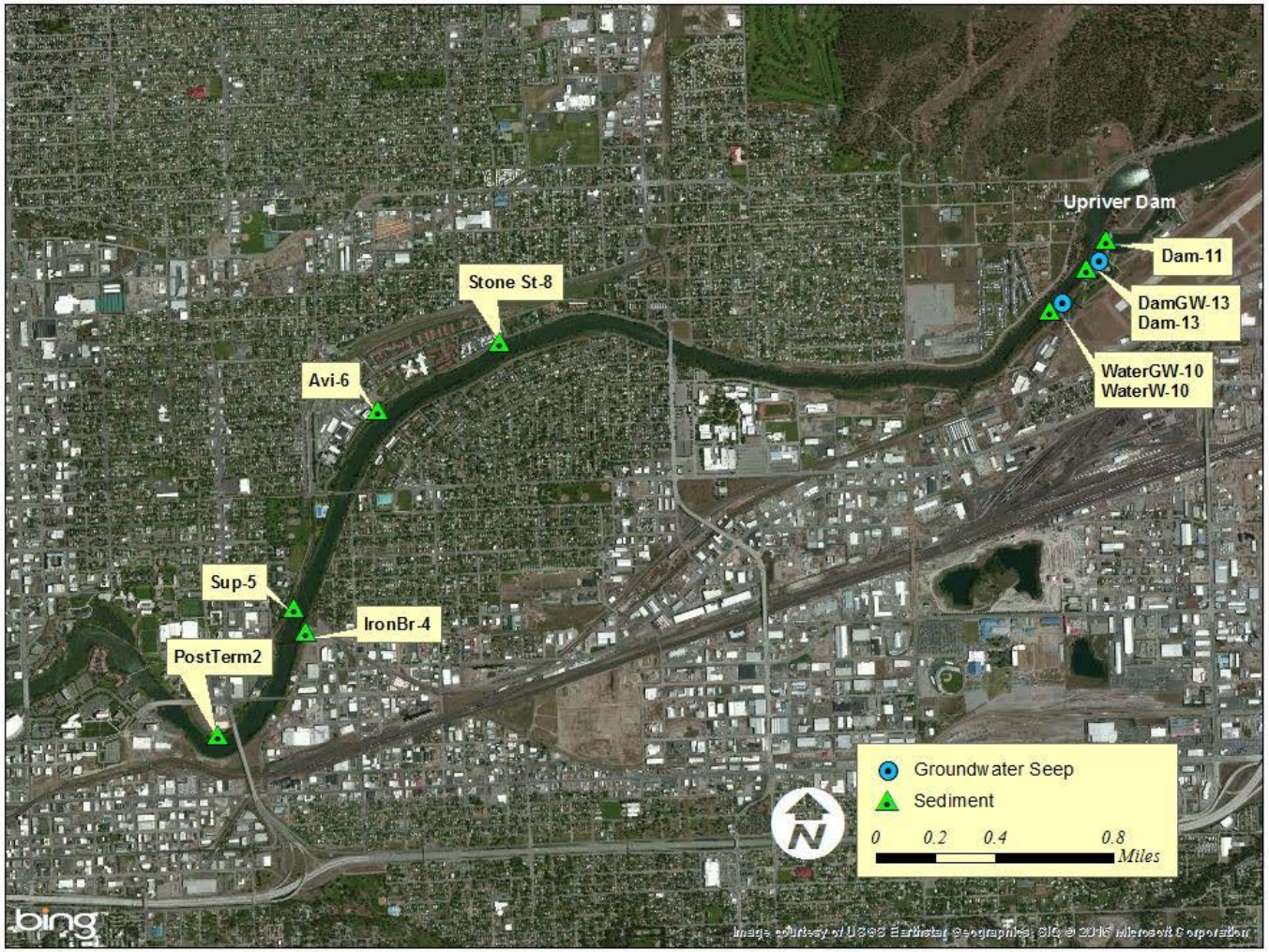
Spokane River
PCB Source Assessment
2003-2007

DEPARTMENT OF ECOLOGY
State of Washington

April 2011
Publication No. 11-03-013

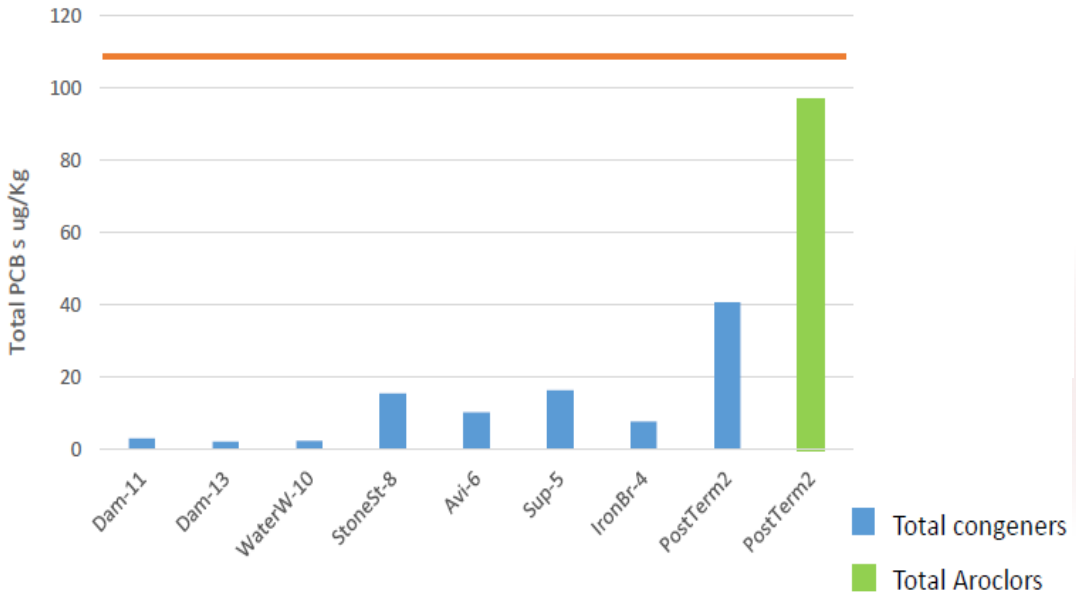
Sediments: Ecology, 2013

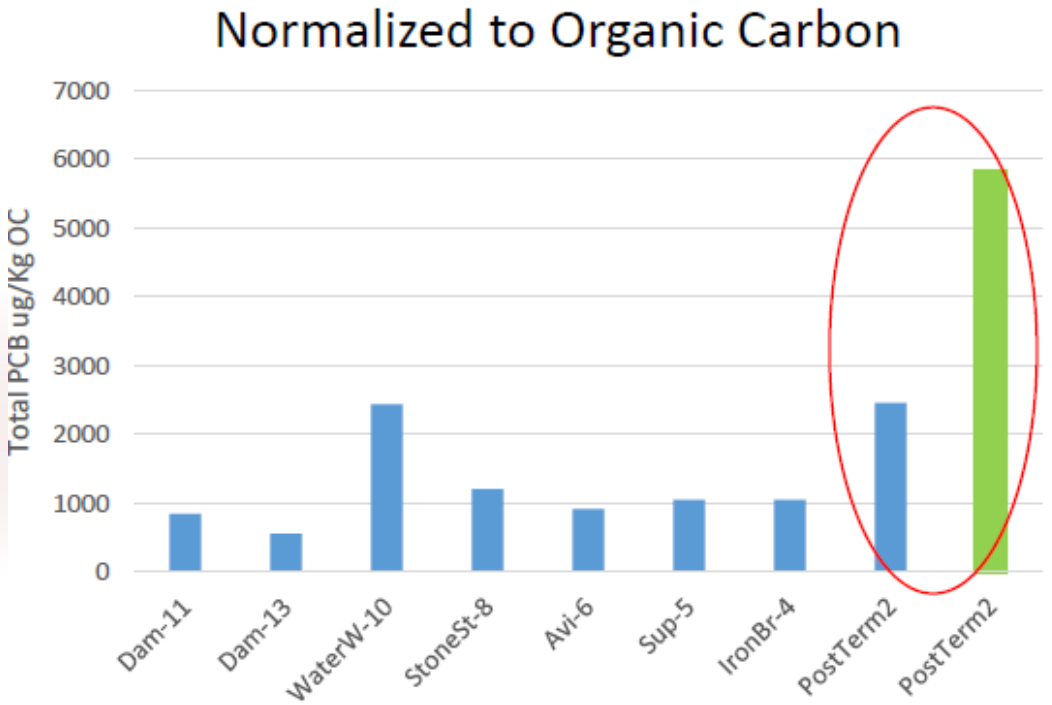
- Samples collected by Ecology Urban Waters Program at eight locations in late August 2013



Sediments: Ecology, 2013

- Concentrations generally low, higher at PostTerm2 station

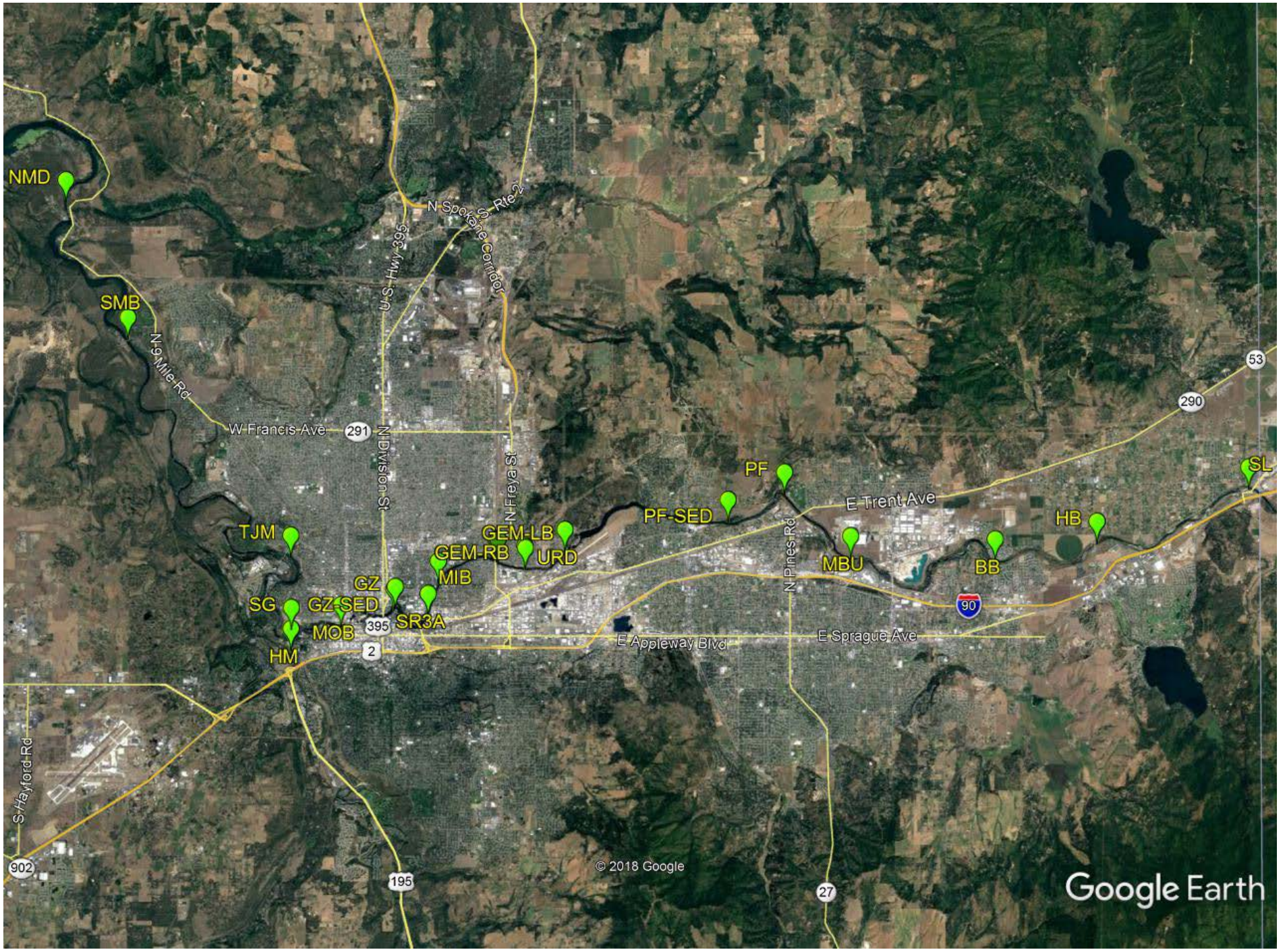




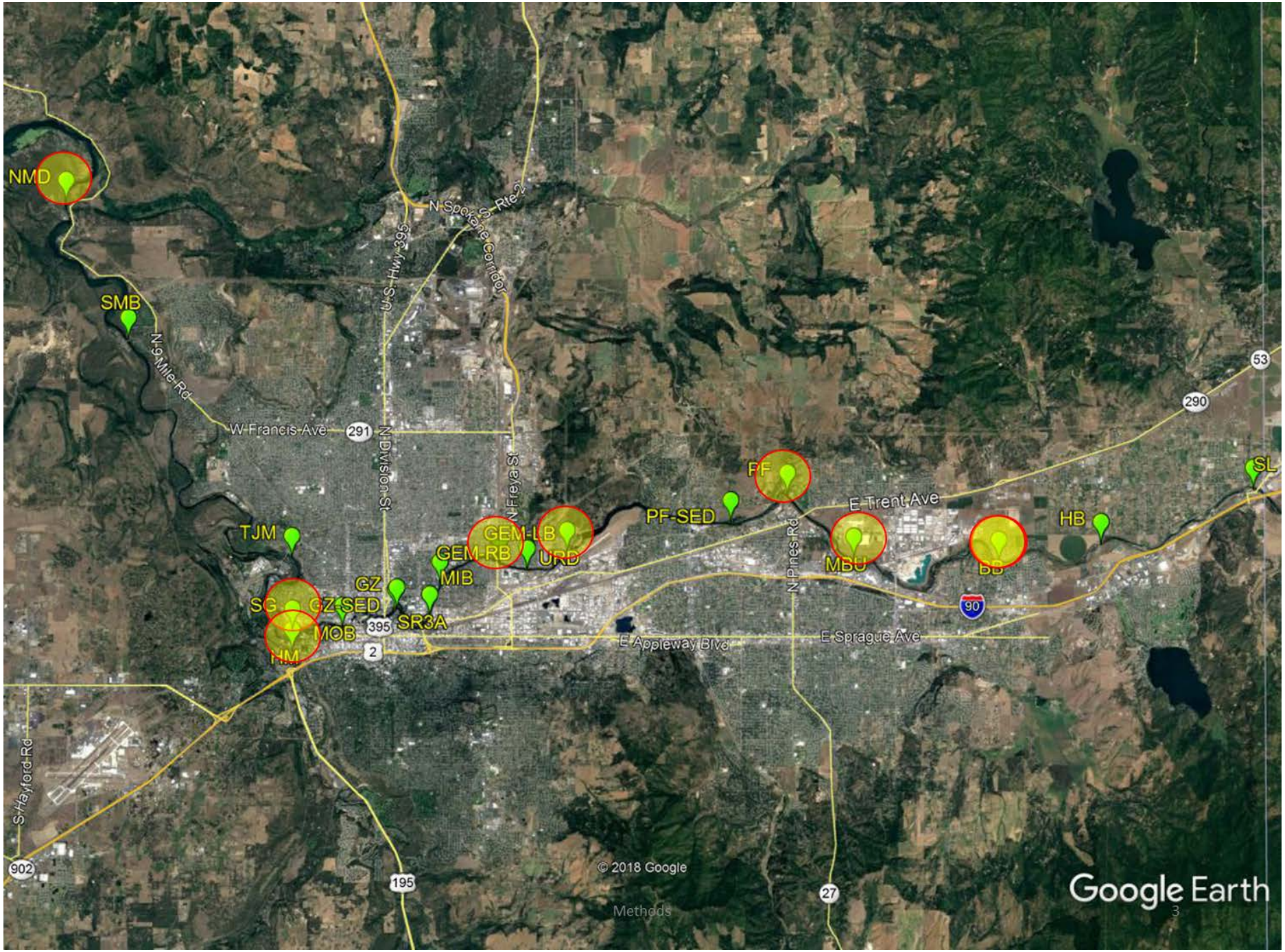
Sediments: Ecology, 2018

- 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)

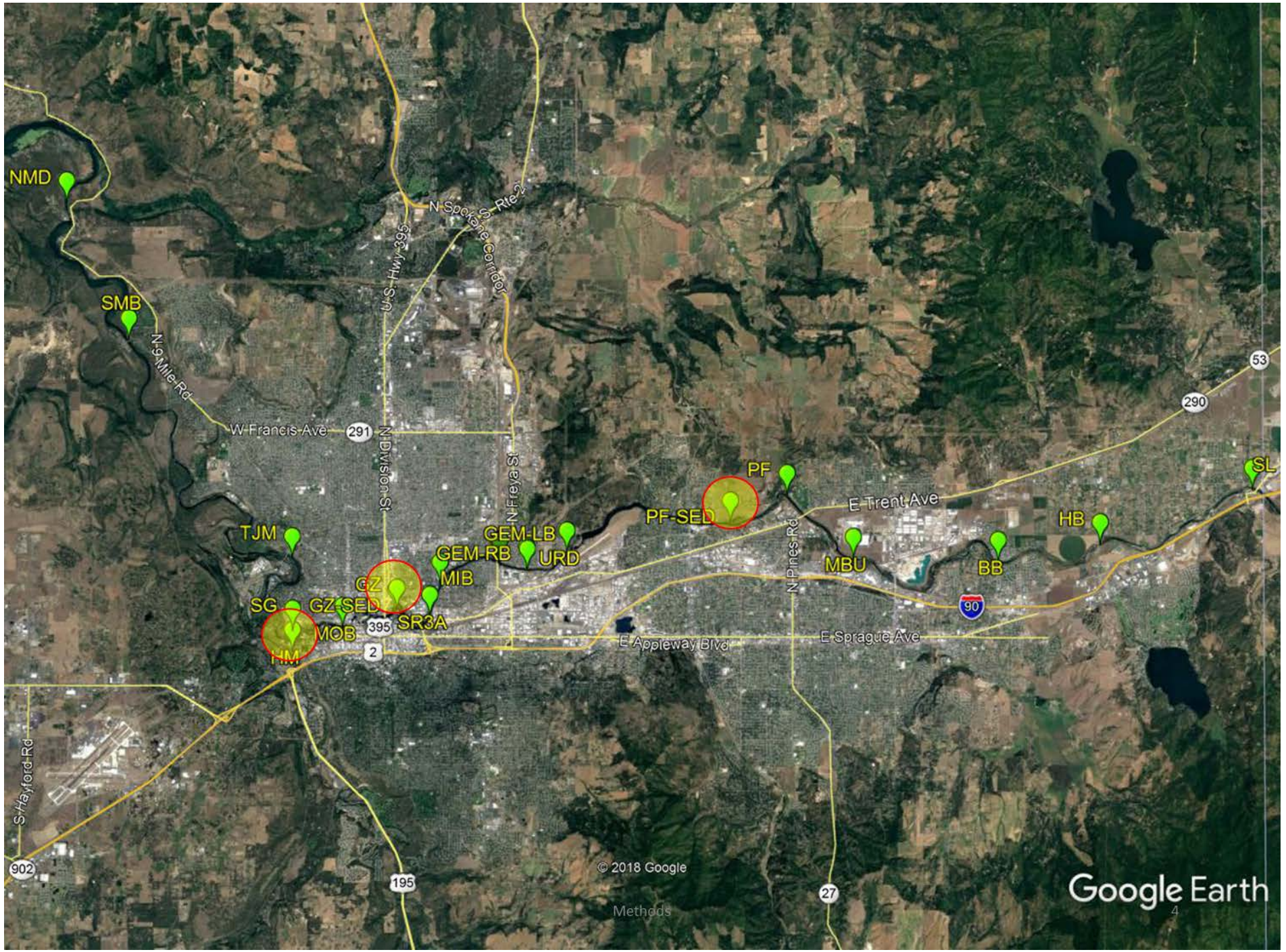
- Biofilm Sites



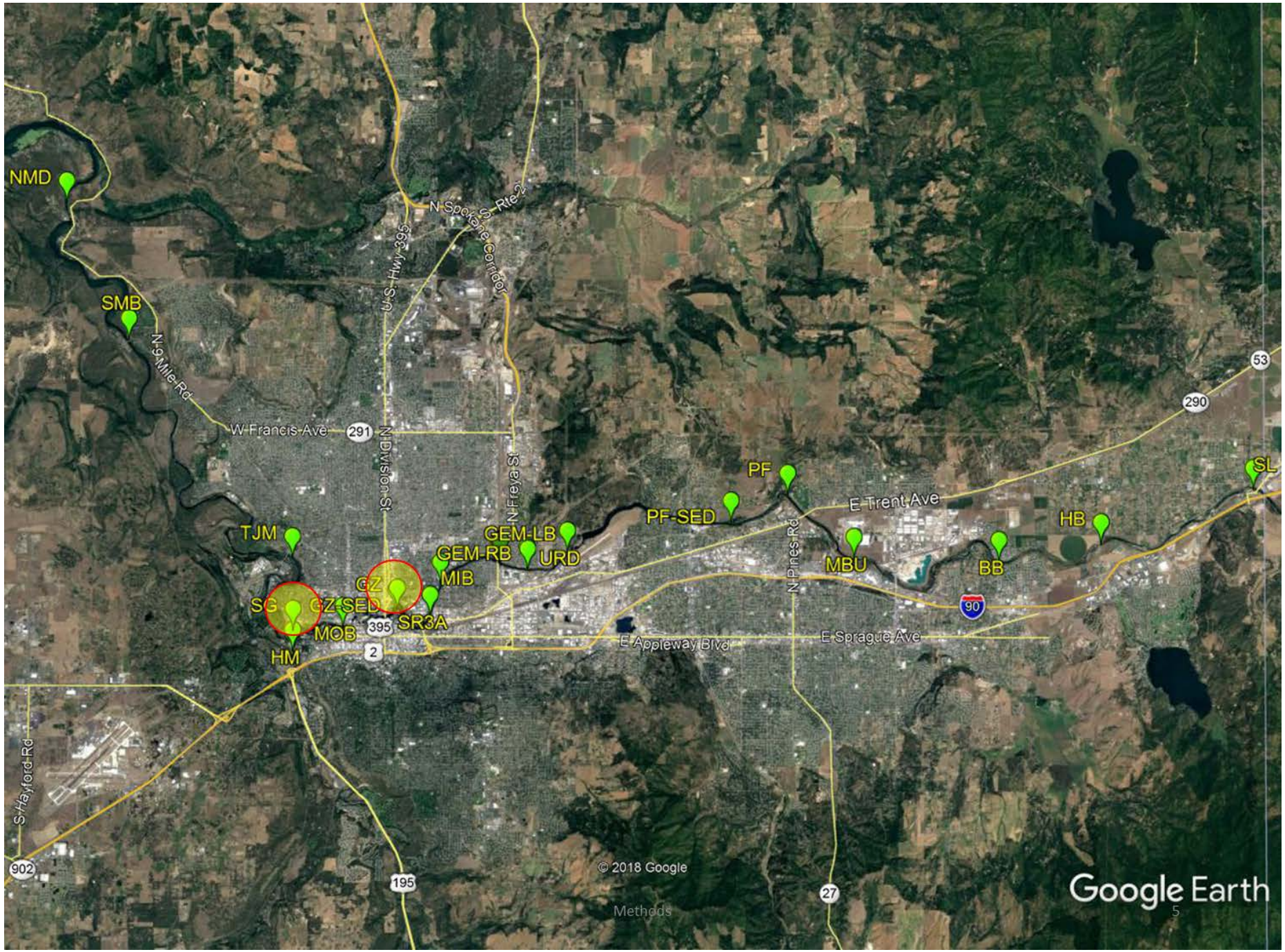
- Synoptic Survey Sites



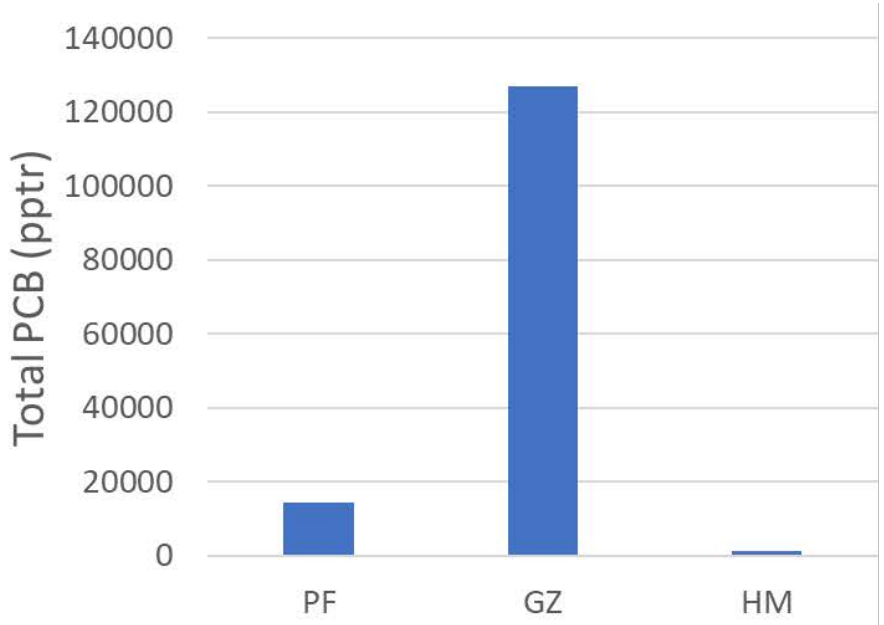
- Sediment Sites

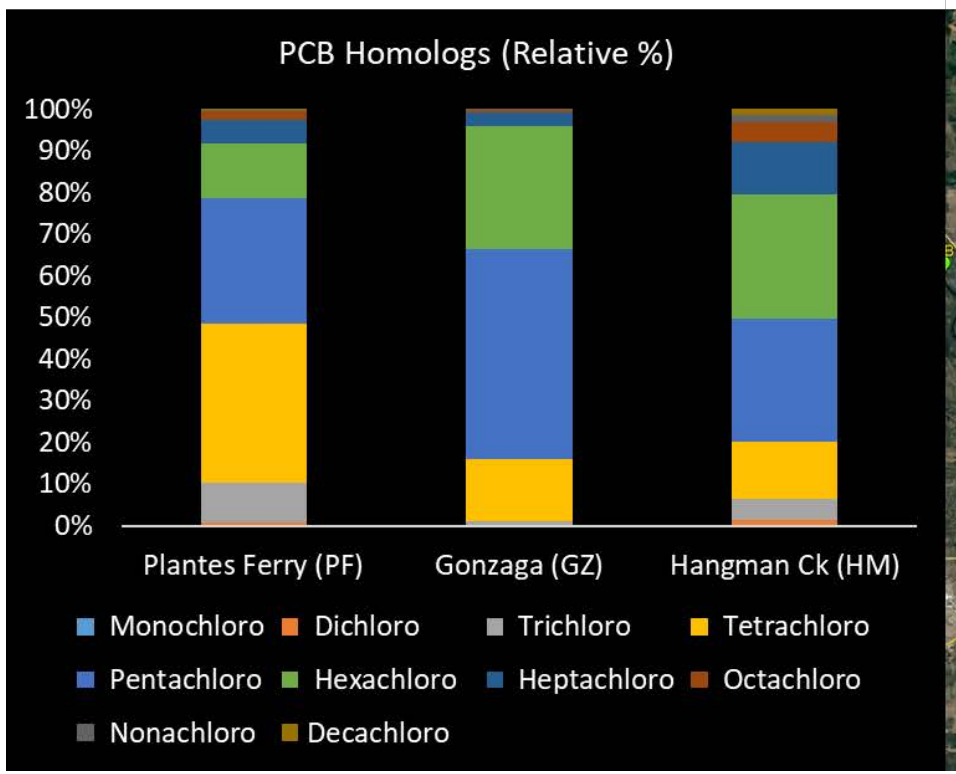


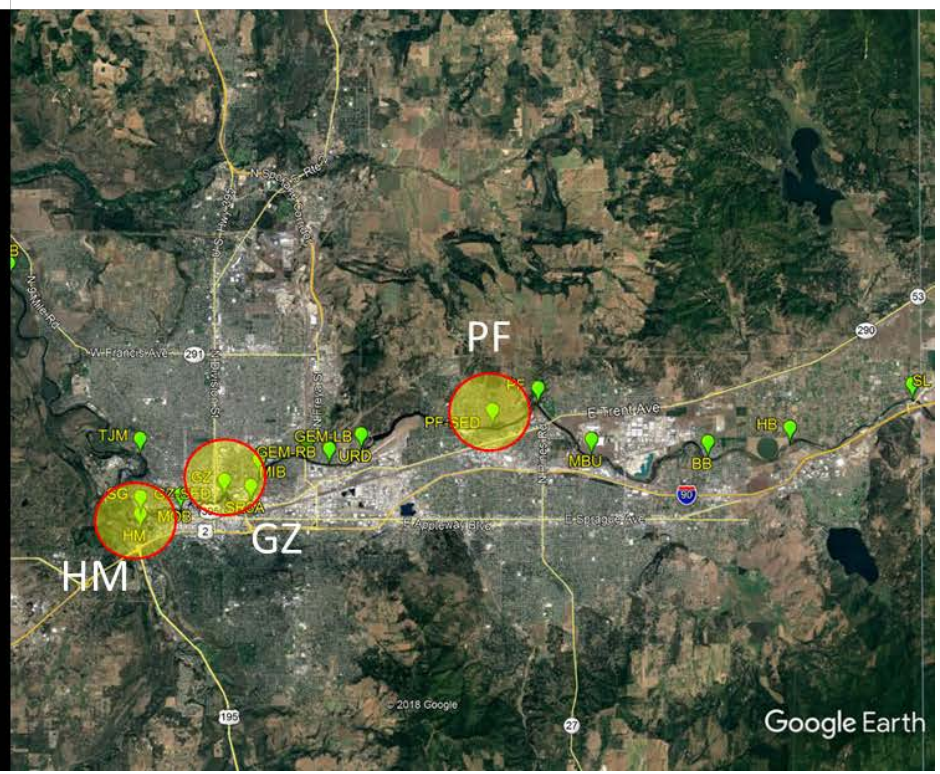
- Macro-invertebrate Sites

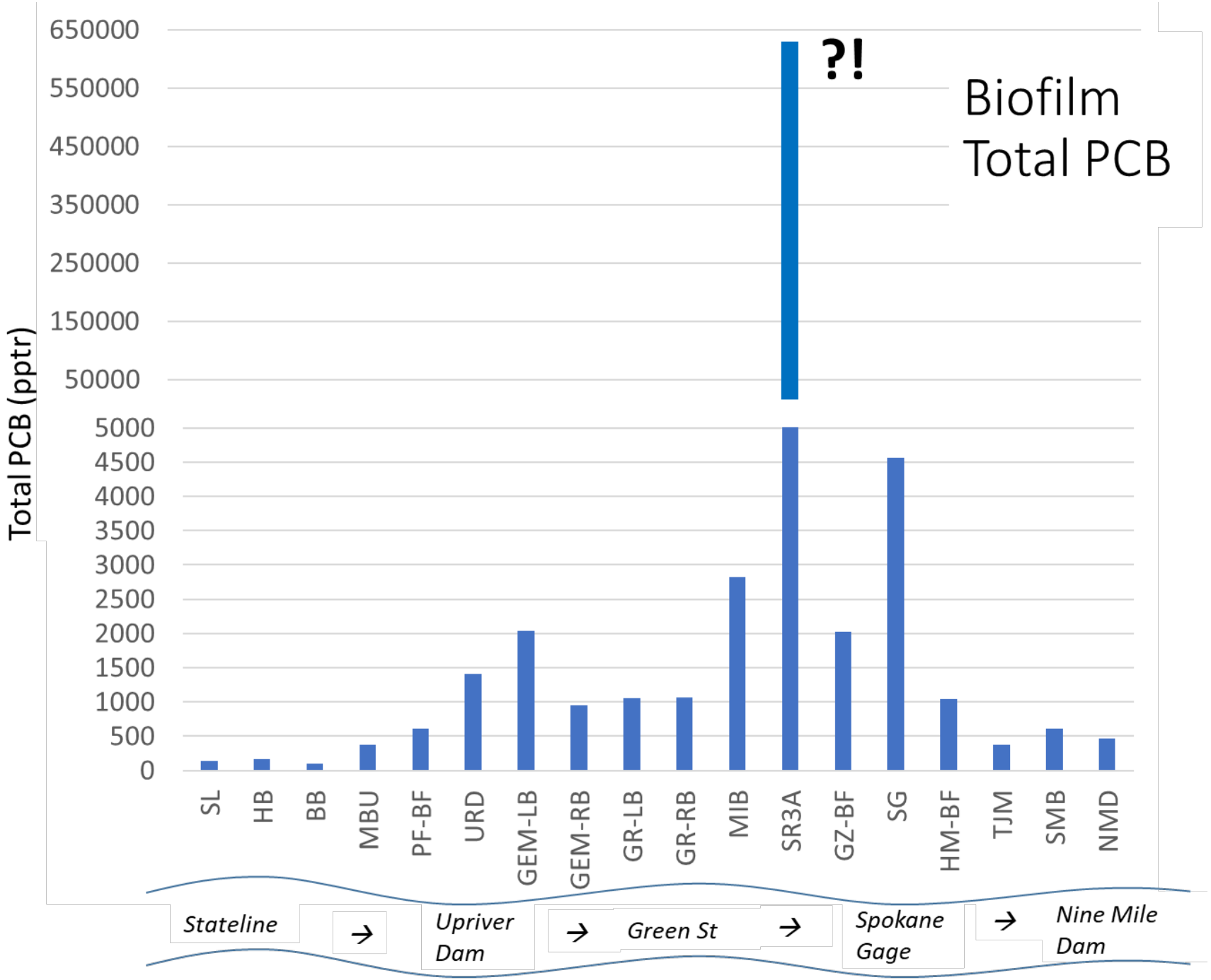


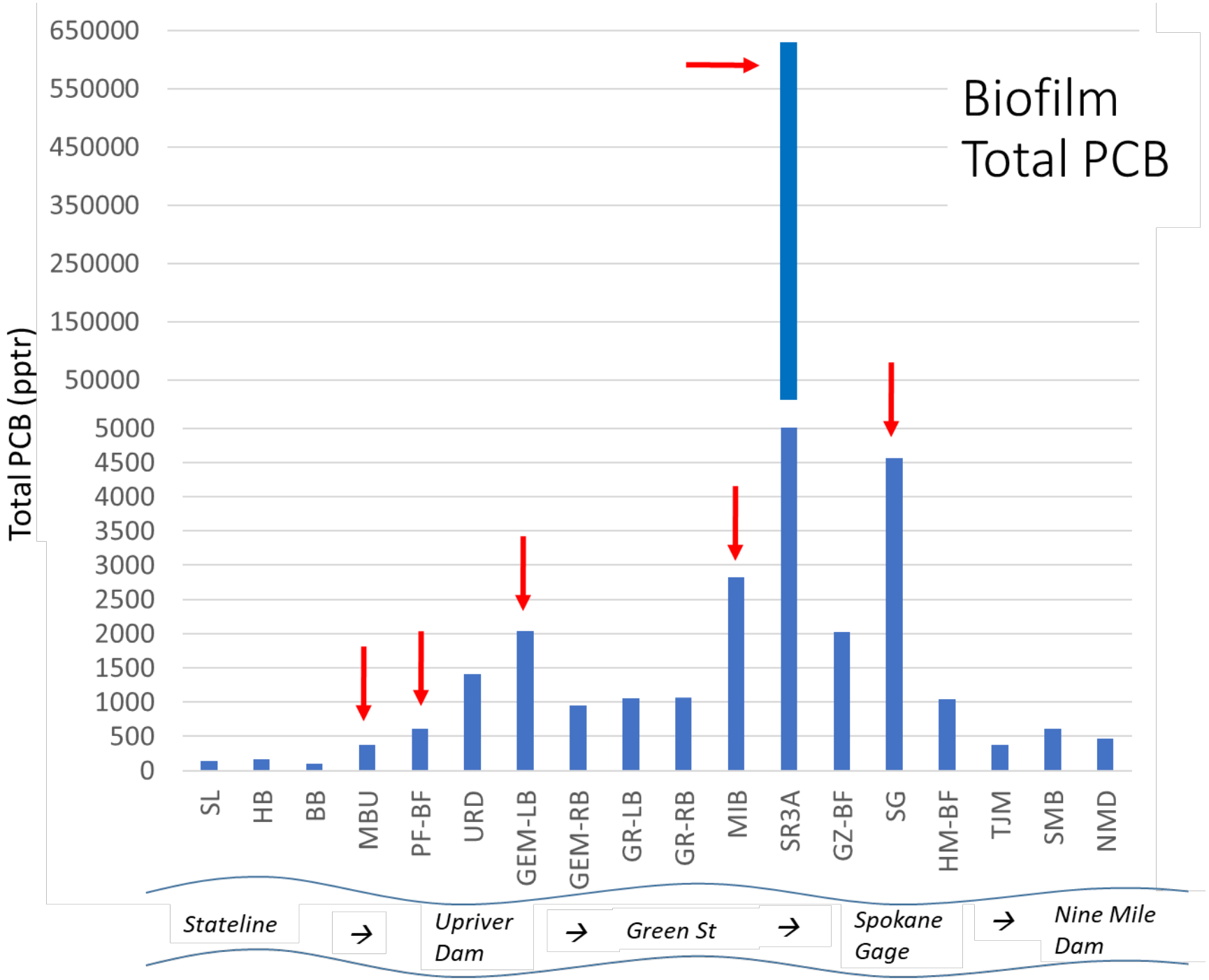
Findings: Sediment








Biofilm
Total PCB
?!
Total PCB (pptr)
650000
550000
450000
350000
250000
150000
50000
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
SL
HB
BB
MBU
PF-BF
URD
GEM-LB
GEM-RB
GR-LB
GR-RB
MIB
SR3A
GZ-BF
SG
HM-BF
TJM
SMB
NMD
Stateline
→
Upriver Dam
→
Green St
→
Spokane Gage
→
Nine Mile Dam


Biofilm
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650000
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2500
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1500
1000
500
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SL
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BB
MBU
PF-BF
URD
GEM-LB
GEM-RB
GR-LB
GR-RB
MIB
SR3A
GZ-BF
SG
HM-BF
TJM
SMB
NMD
Stateline
Upriver Dam
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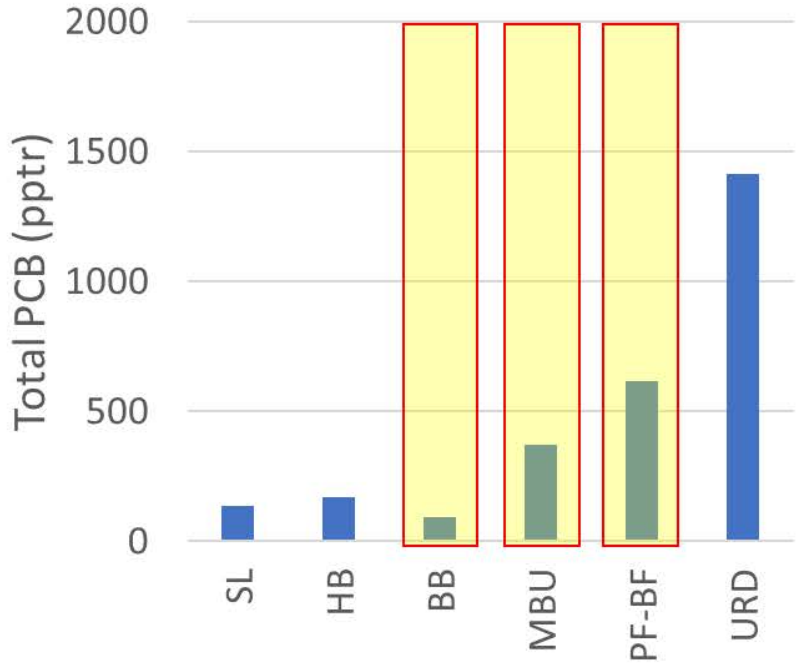
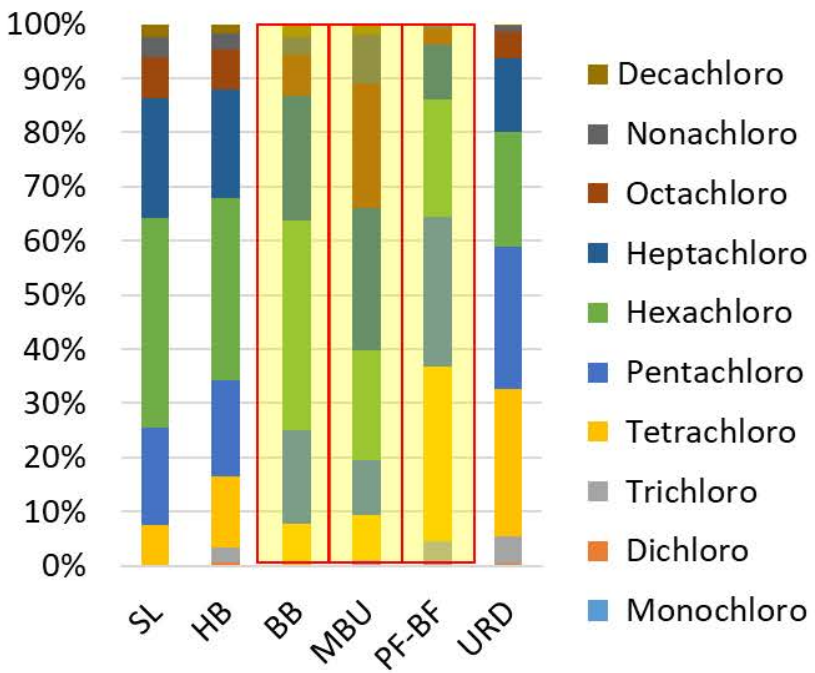
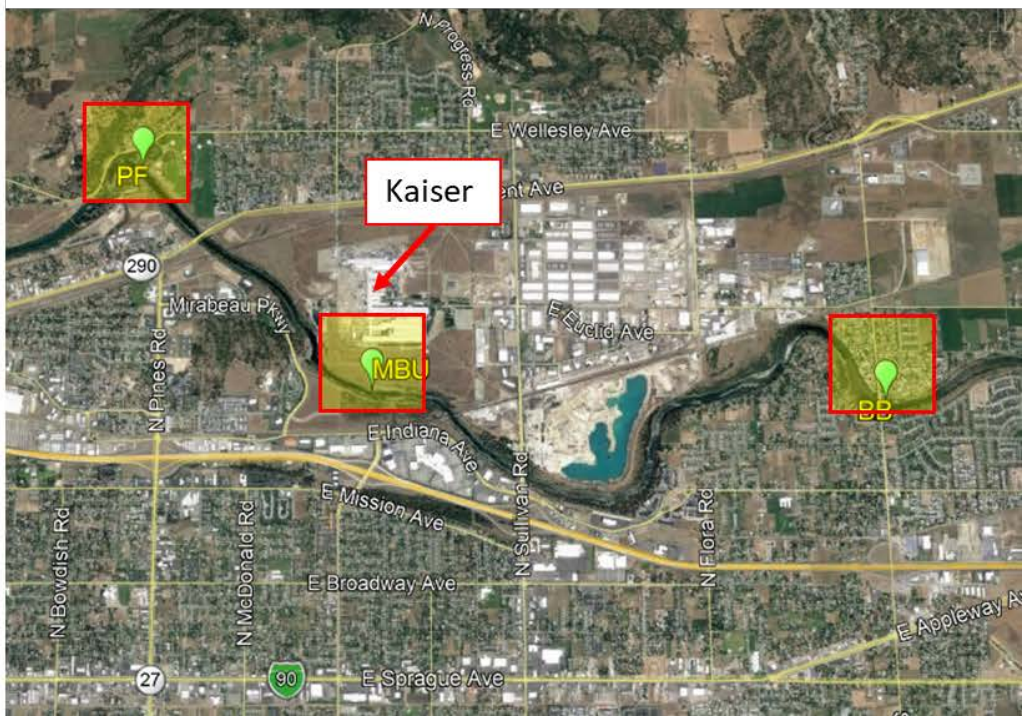
Spokane Gage
Nine Mile Dam

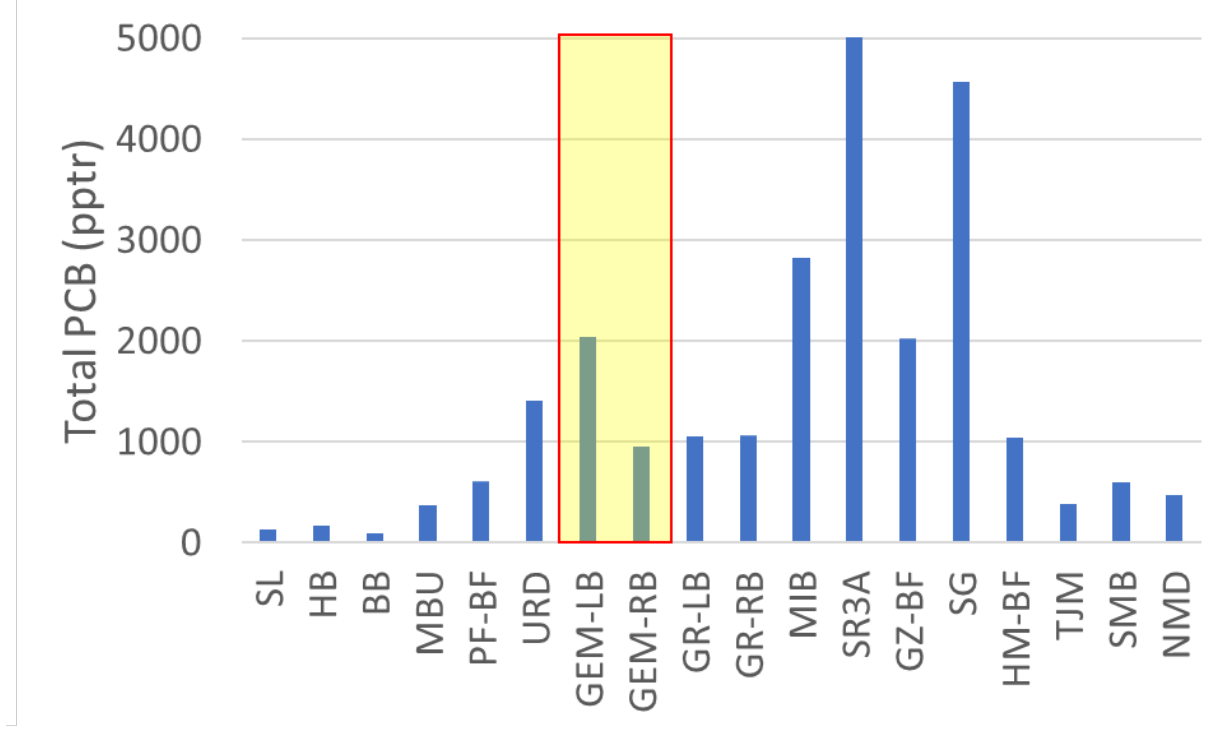


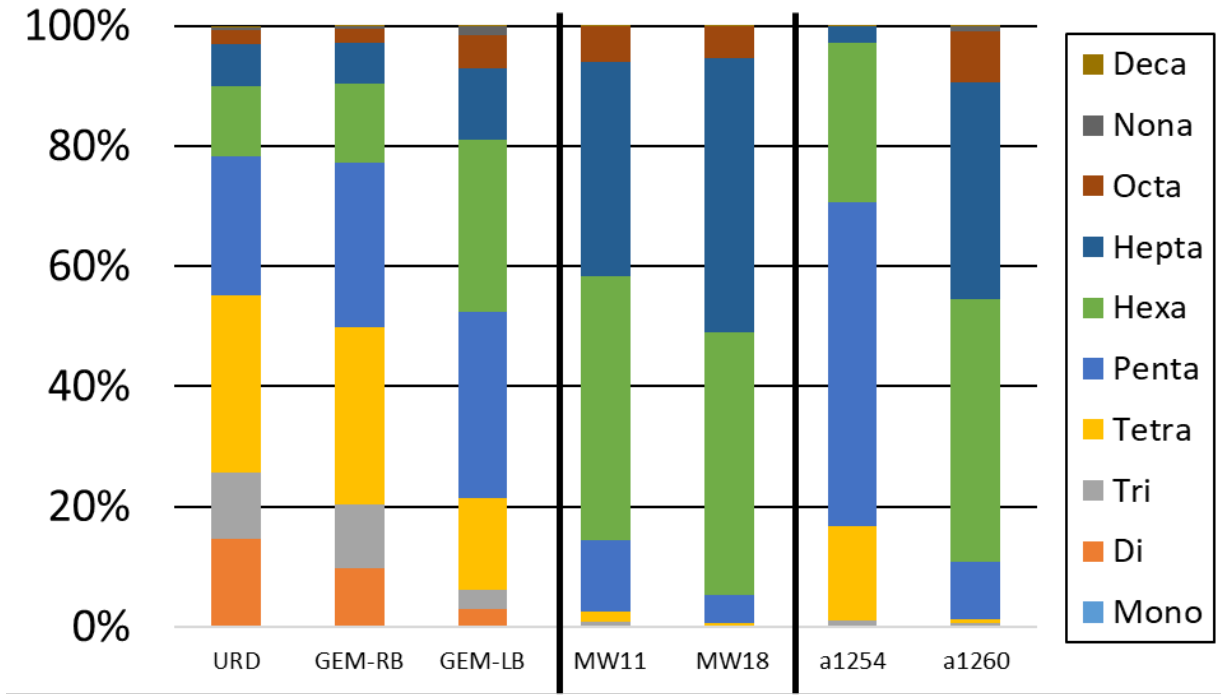


Biofilm: Mirabeau (MBU) & Plantes Ferry (PF)

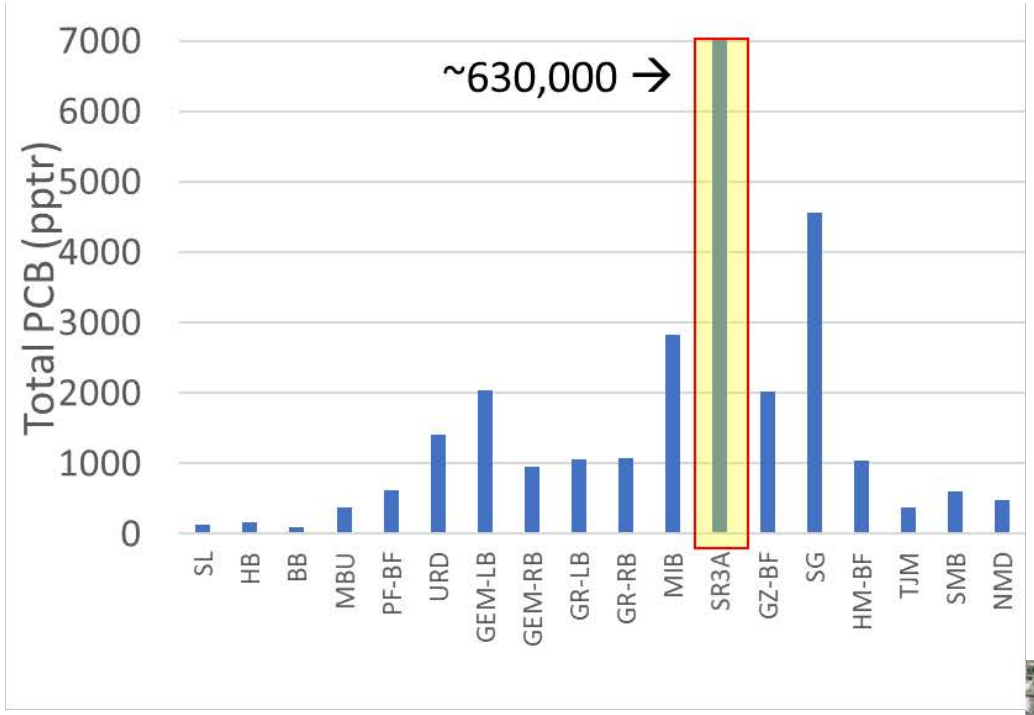


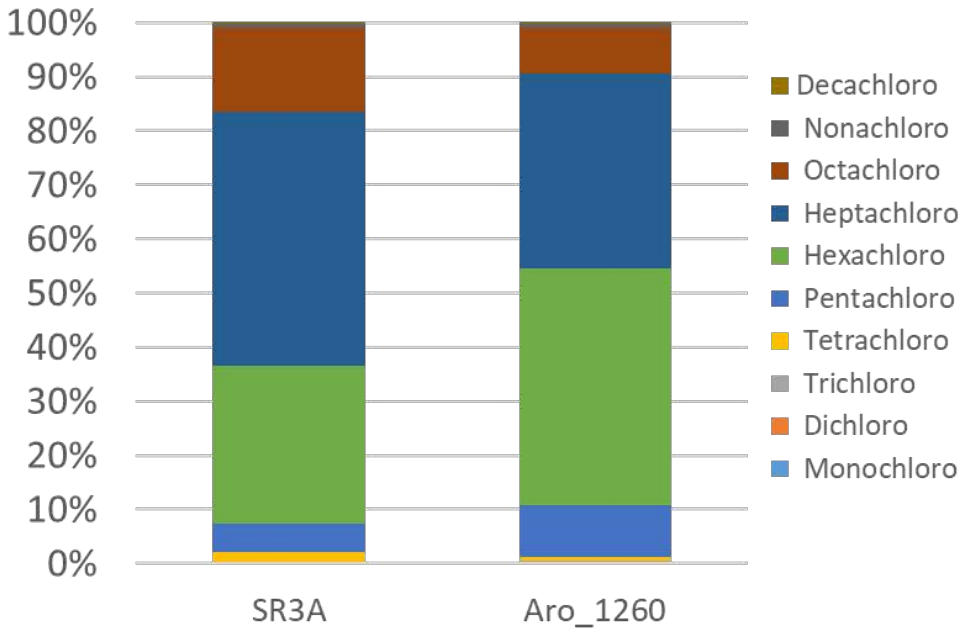
Biofilm: GE Mission (GEM-LB & GEM-RB)

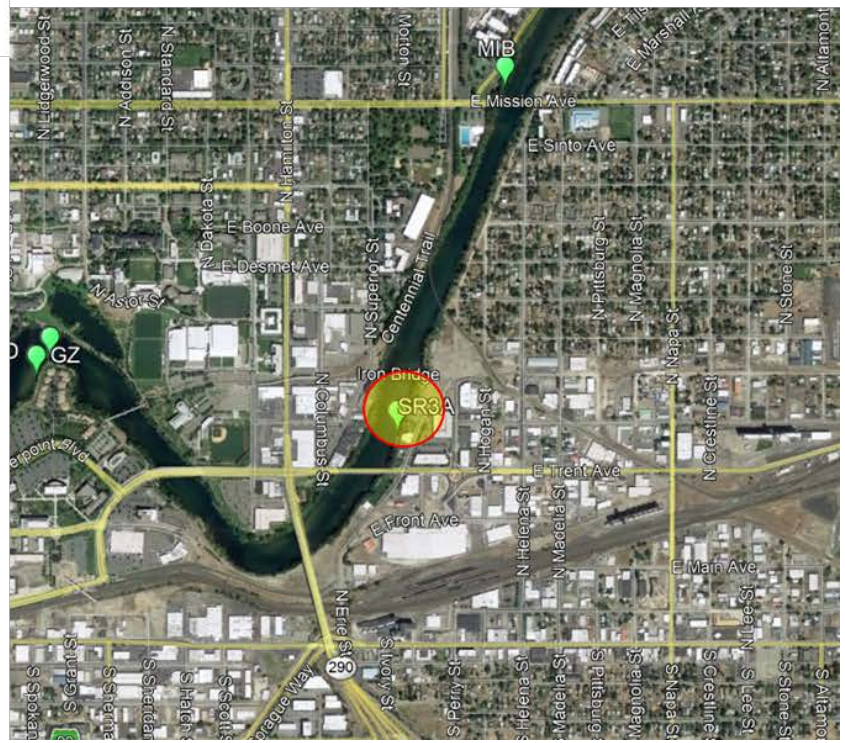




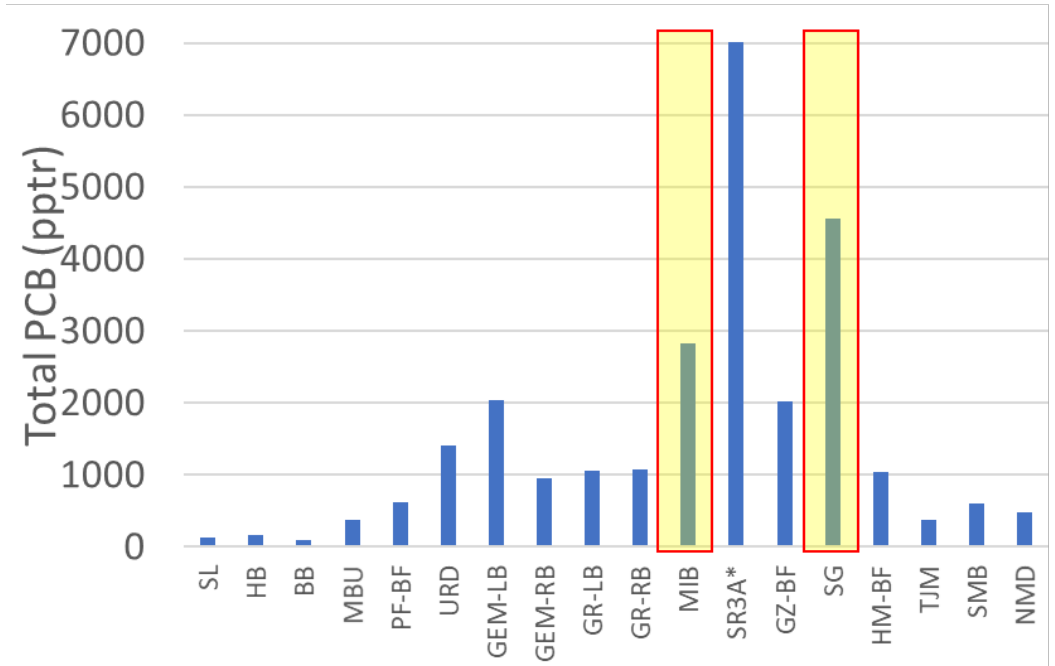
Biofilm: SR3A (upstream of Trent Bridge)

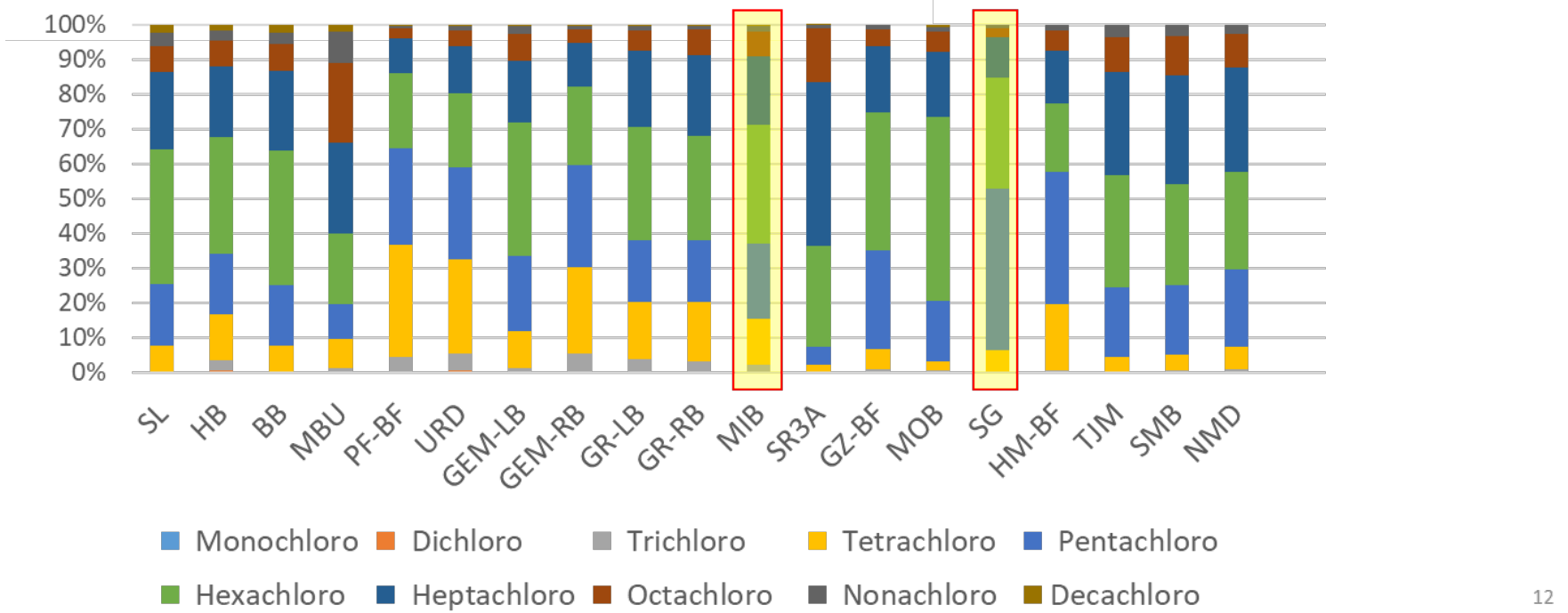


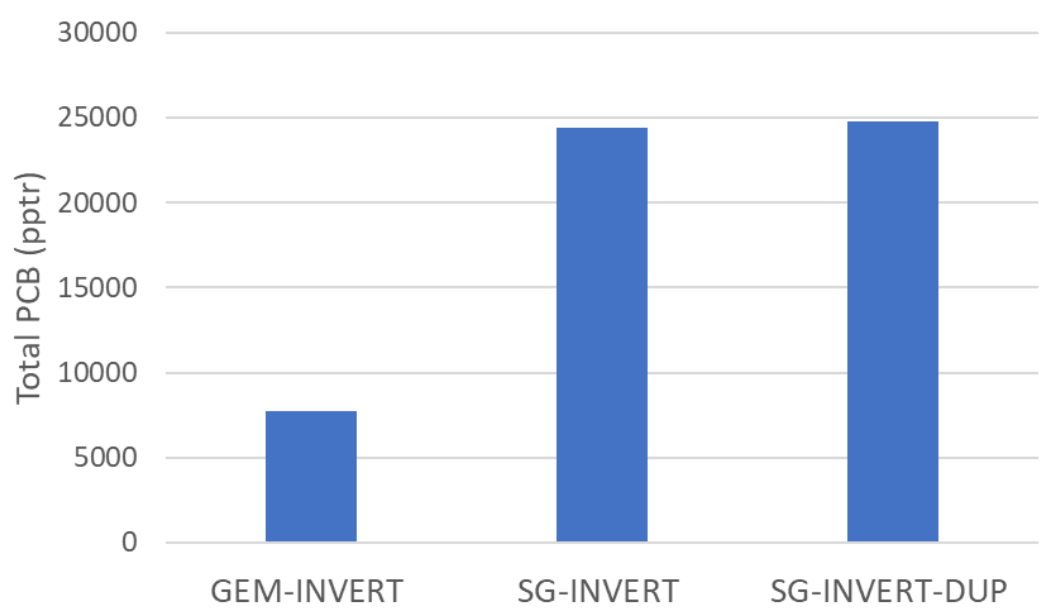


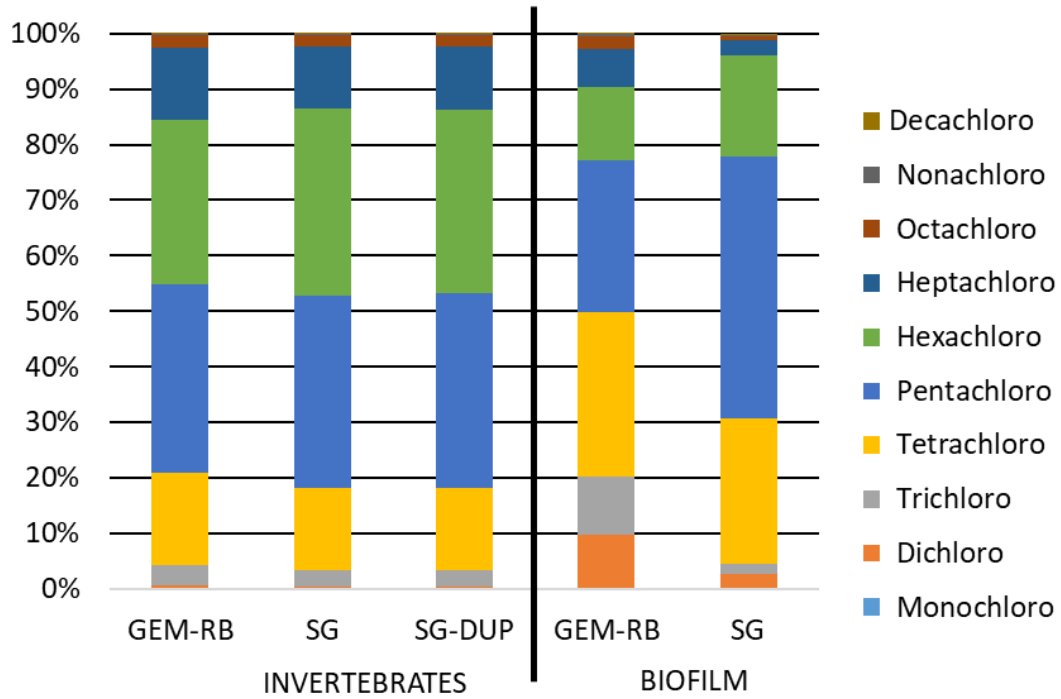


Biofilm: Mission Bridge (MIB) & Spokane Gage (SG)









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

Location and Tissue Type	Total PCB Concentrations Measured by:					
	Aroclor Analysis					Congener Analysis
	1993[a]	1994[b]	1996[c]	1999[d]	2001[e]	2005[f]
Rainbow trout - fillet						
State line	--	--	--	106	--	55
Plante Ferry	918	424	799	891	--	153
Above Monroe Dam*	--	145	76	226	--	73
Ninemile	490	371	76	143	--	
Mountain whitefish - fillet						
Above Monroe Dam	--	568	381	339	--	234
Ninemile	522	139	444	632	--	139
Little Spokane	--	222	145	--	--	--
Upper Lake Spokane	--		--	--	73	43
Lower Lake Spokane	780	113	--	--	--	76
Largescale suckers - whole						
State line	--	--	--	120	--	56
Plante Ferry	2,005	531	530	283	--	122
Above Monroe Dam	--	201	116	445	--	1,823
Ninemile	1,210		345	680	--	--
Little Spokane	--	440	366	--	--	--
Upper Lake Spokane	--	--	--	--	265	327
Lower Lake Spokane	410	820	--	--	357	254

Fish: Ecology, 2005

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

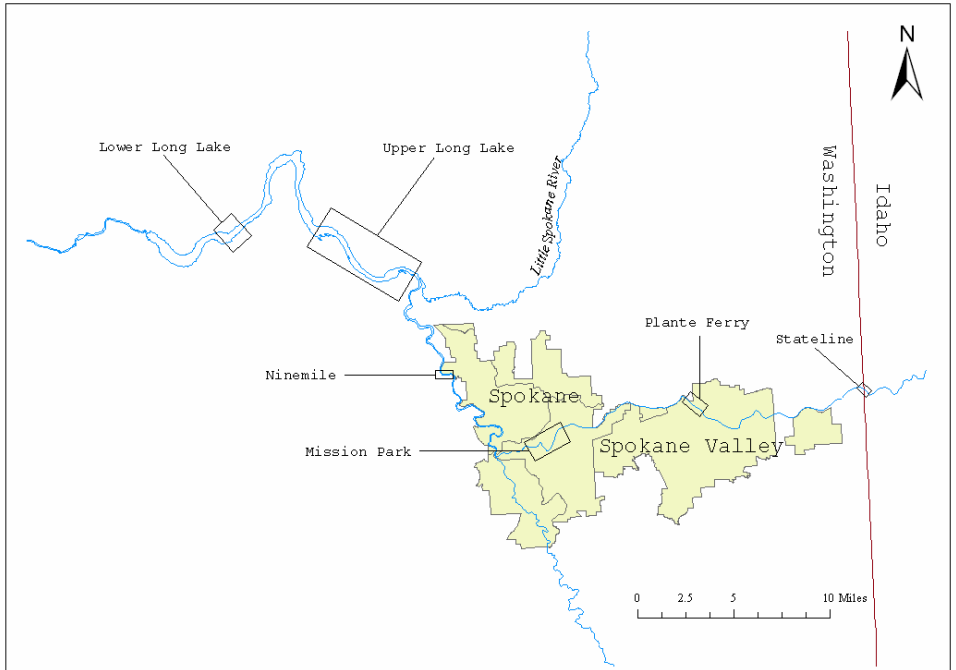
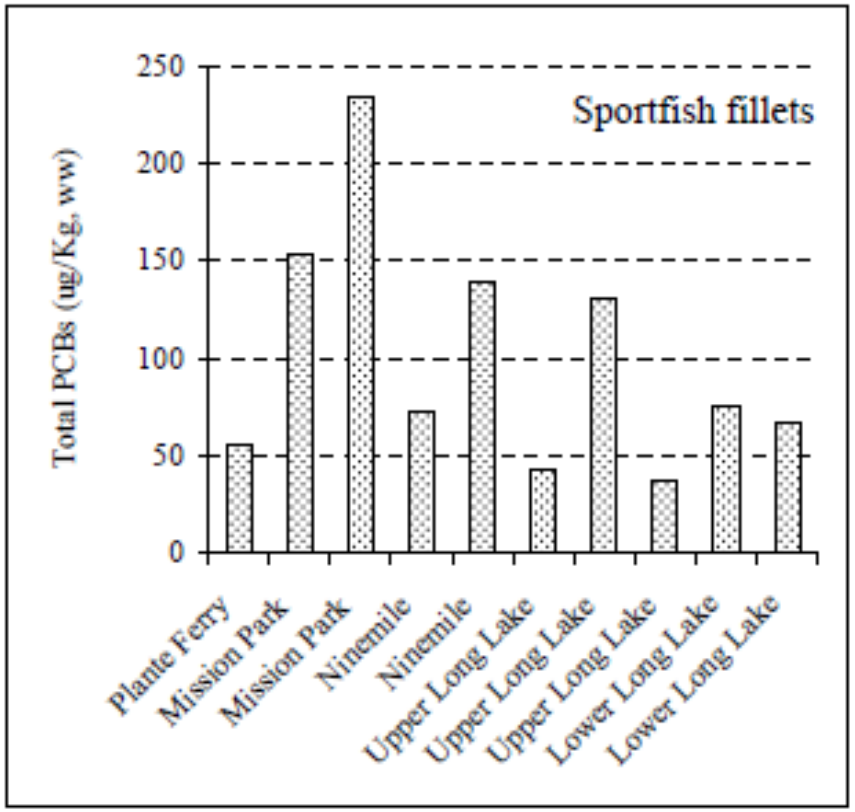


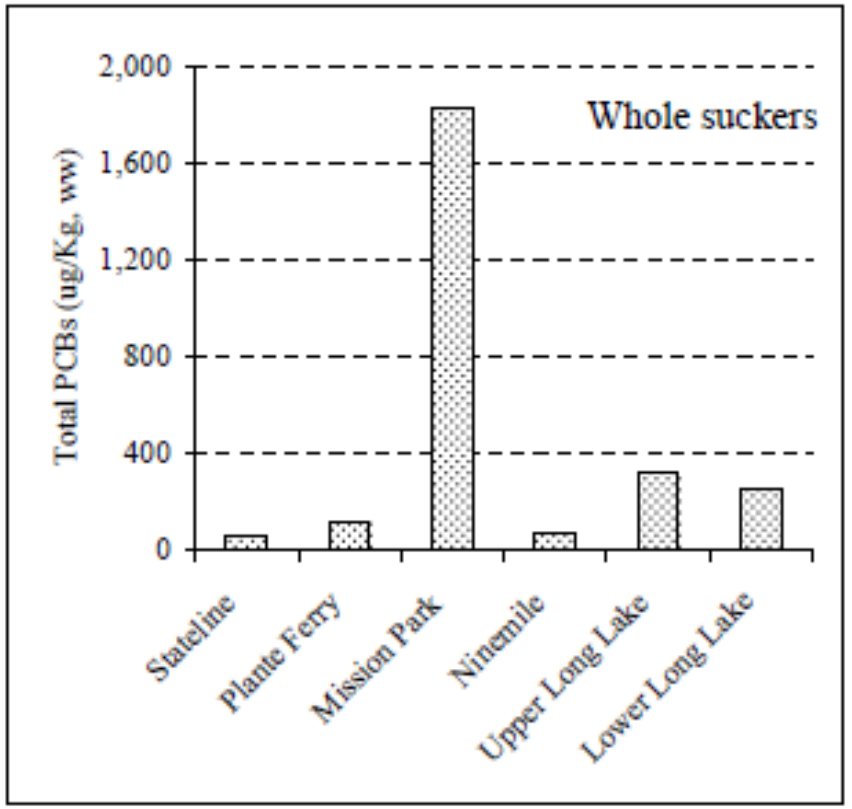
Figure 1. Approximate Location of Spokane River Fish Samples Collected in 2005

Reach	Approximate River Mile	Species
Stateline	96.1-95.5	Largescale sucker
Plante Ferry	86.0-85.0	Rainbow trout Largescale sucker
Mission Park	78.5-74.5	Rainbow trout Mountain Whitefish Largescale sucker
Ninemile	64.5-63.5	Rainbow trout Mountain Whitefish Bridgelip sucker
Upper Long Lake (Spokane River)	56.3-50.6	Mountain whitefish Smallmouth bass Brown trout Largescale sucker
Lower Long Lake (Spokane River)	40.8-39.4	Mountain whitefish Smallmouth bass Largescale sucker

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

	Spokane River 2005		Statewide*	
	Fillet	Whole Body	Fillet	Whole Body
N =	24	24	98	28
Mean	104	442	155	151
Median	78	135	28	87
Minimum	36	16	1.2	7.1
Maximum	280	3,000	1,943	622
90th percentile	213	1,181	297	334

Fish: Ecology, 2012

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

Freshwater Fish Contaminant Monitoring Program

2012 Results

DEPARTMENT OF ECOLOGY
State of Washington

May 2014

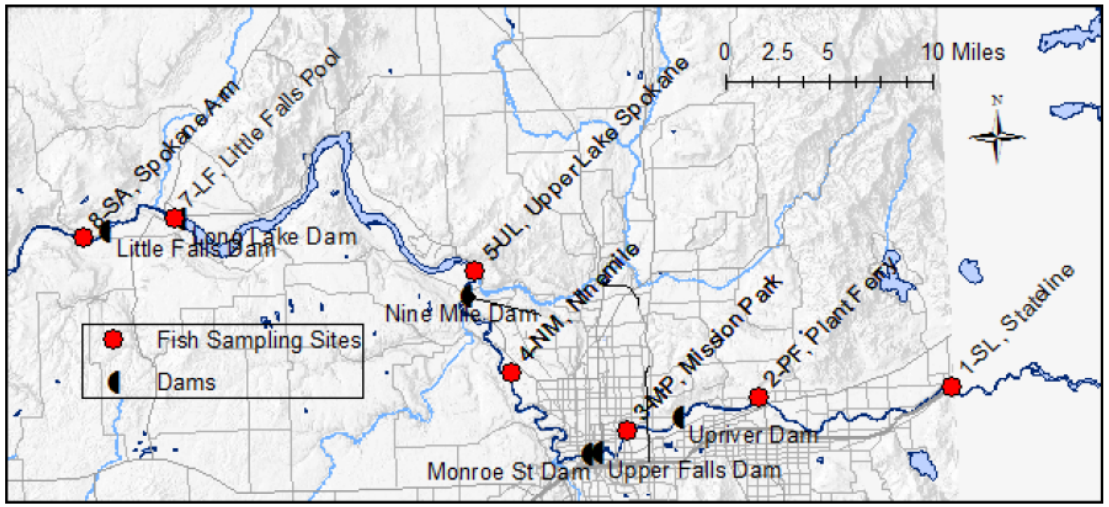
Publication No. 14-03-020

Fish: Ecology, 2012

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

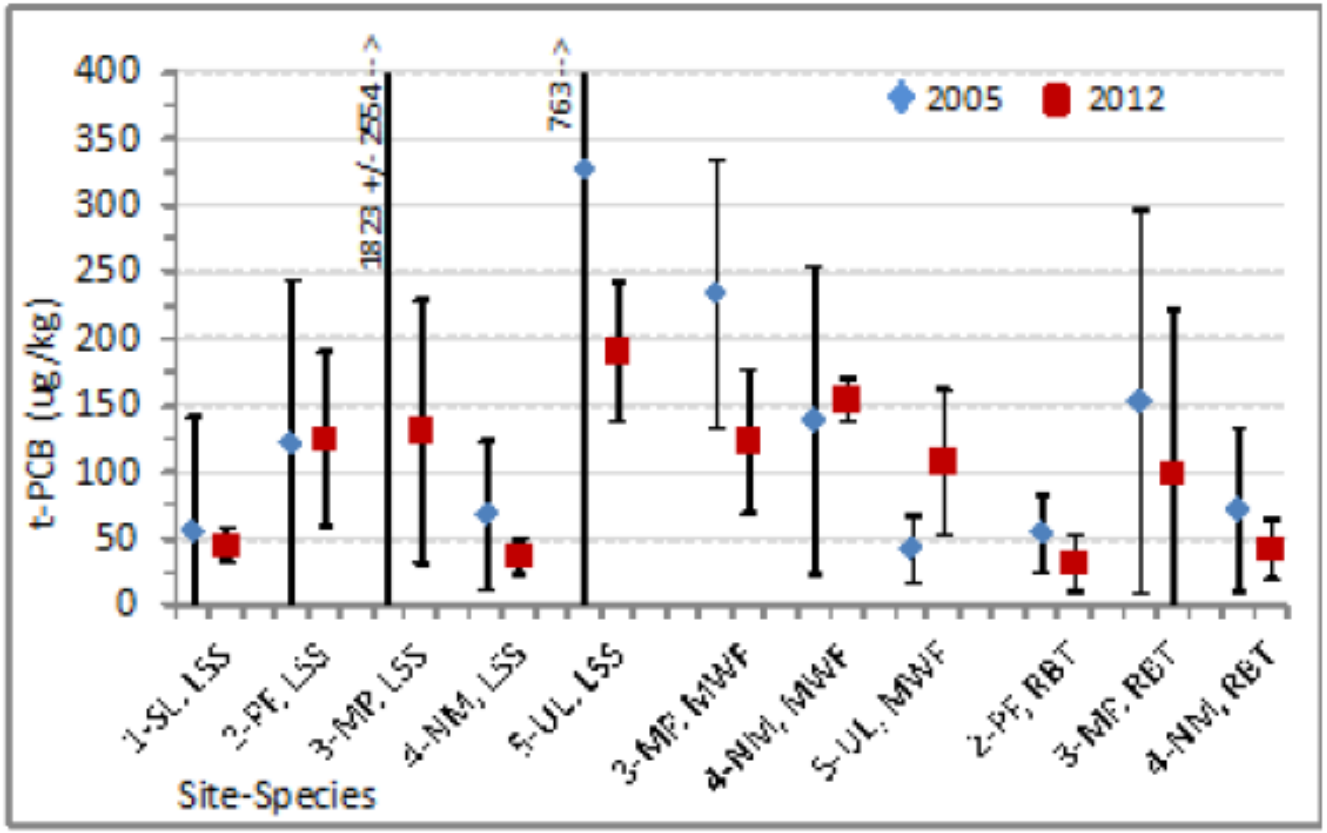
Sample Location	LSS	RBT	MWF	NPM
Spokane River				
Stateline (1-SL)	7			
Plante Ferry to Upriver Dam (2-PF)	7	3		1
Mission Park (3-MP)	7	3	5	
Ninemile Dam, upstream (4-NM)	7	3	7	

- 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