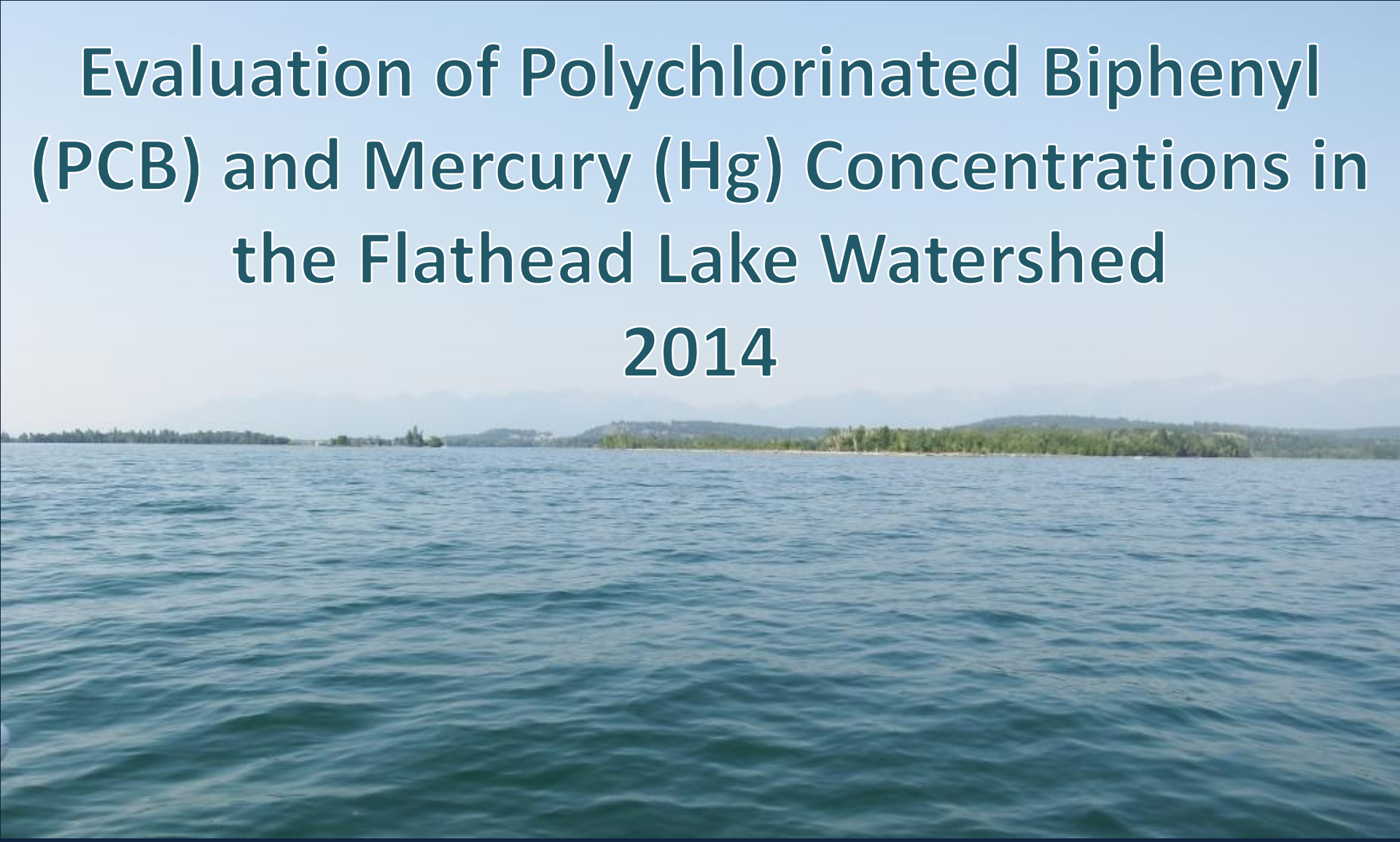
Evaluation of Polychlorinated Biphenyl (PCB) and Mercury (Hg) Concentrations in the Flathead Lake Watershed 2014



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June 4, 2015
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Existing Impairments

Whitefish Lake: PCBs and Mercury

fish consumption advisories from fish tissue collected in 1994 and 1995

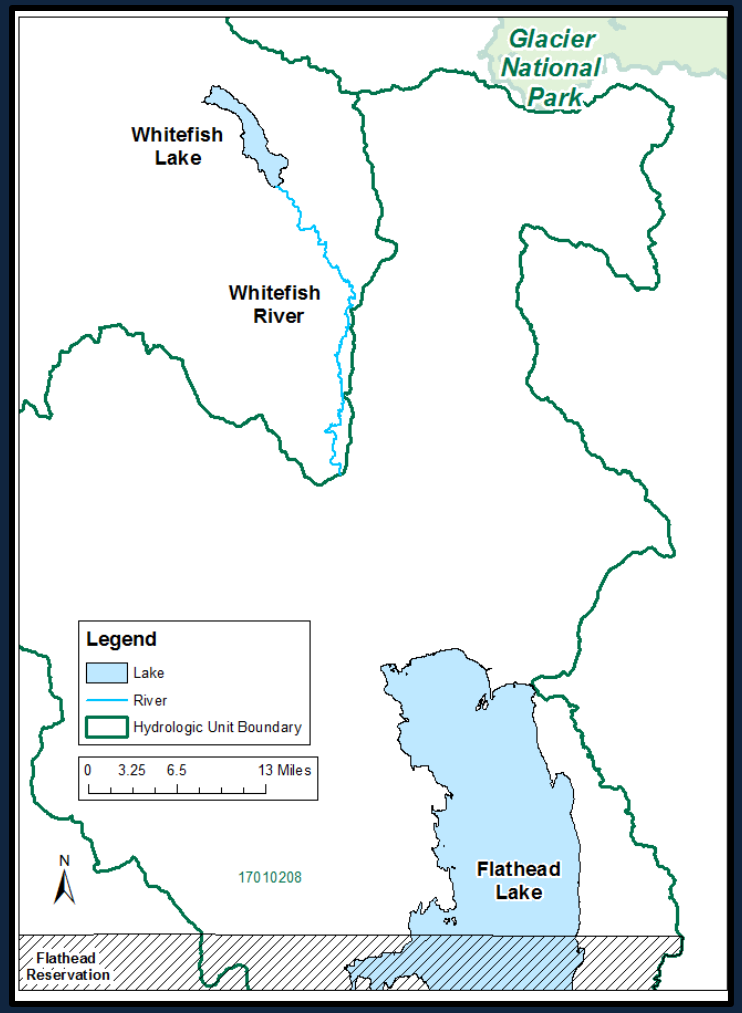
Whitefish River: PCBs

elevated PCBs in sediments found in 1998 near Burlington Northern Fueling Facility in Whitefish

The rail yard and adjacent areas (including the river) are a State Superfund Facility; PCBs one of several chemicals of potential concern

Flathead Lake: PCBs and Mercury

fish consumption advisories from fish tissue collected 1992 - 2000



All listed in 2000

Listings associated with Fish and Aquatic Life beneficial use

What are PCBs?

Synthetic organic chemicals

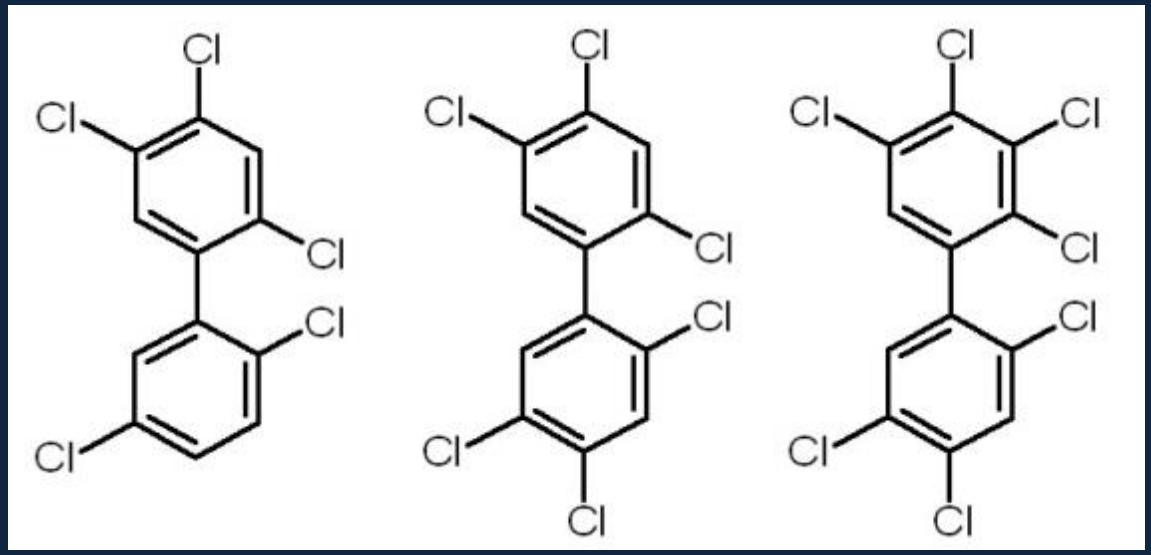
No natural sources

209 individual chlorinated compounds known as “congeners”

Commercial PCBs are mixtures of 50+ PCB congeners

Monsanto Corporation (major U.S. producer of PCBs from 1930 to 1977) marketed PCB mixtures under the trade name “Aroclor”

Aroclors identified by 4-digit codes showing the chlorine content by weight percent (e.g., Aroclor 1254 contains ~54% chlorine by weight)



In 1979, the manufacture of PCBs was banned in the United States under the Toxic Substances Control Act (TSCA)

Physical & Chemical Properties of PCBs
fire resistant
low electrical conductivity
resistant to thermal breakdown
chemical stability
high boiling point
resistant to oxidants and other chemicals
no smell or taste
vary in consistency
range in toxicity

Potential Sources of PCBs
dielectric fluids and transformers
capacitors
fluorescent light ballasts
electromagnets
heat transfer systems
hydraulic fluid
plasticizers
lubricants
paints
coatings
wood treatment
railroad transformers
landfills & junkyards
wastewater treatment plant sludge
used oil

How PCBs enter air, soil & water
accidental spills & leaks
hazardous waste sites
illegal or improper disposal
leaks from old electrical transformers
incineration of wastes
aerial deposition

Aquatic Life and Human Health Effects of PCBs

PCBs are persistent

- chemically stable = extremely persistent in environment
- long life of many products containing PCBs means substantial portion of the PCBs manufactured before the ban may still present risk of possible future discharge into the environment

PCBs bioaccumulate

- taken up by smaller organisms and other animals that eat these organisms, including humans
- magnify by a factor of 10 to 100 at each step
- lipophilic, accumulate in fatty tissues and skin
- can bioaccumulate at high concentrations in tissues from very low concentrations in water

PCBs are toxic to aquatic life

- Acutely toxic to fish, particularly for embryos and newly hatched fry
- Chronically toxic to fish and toxicity increases with increased duration of exposure
- toxicity similar for fish and invertebrates

PCBs are toxic to humans and other mammals

- human exposure primarily through consumption of contaminated food or inhalation
- skin rashes, itching and burning, eye irritation, skin and fingernail pigmentation changes, liver damage, immune system disruption, respiratory irritation, headaches, dizziness, depression, memory loss, nervousness, fatigue, and impotence, reproductive and developmental effects
- Probable carcinogen

Project Objectives

1. Conduct synoptic sediment monitoring in Flathead Lake, Whitefish Lake, and Whitefish River to characterize PCB and Hg concentrations

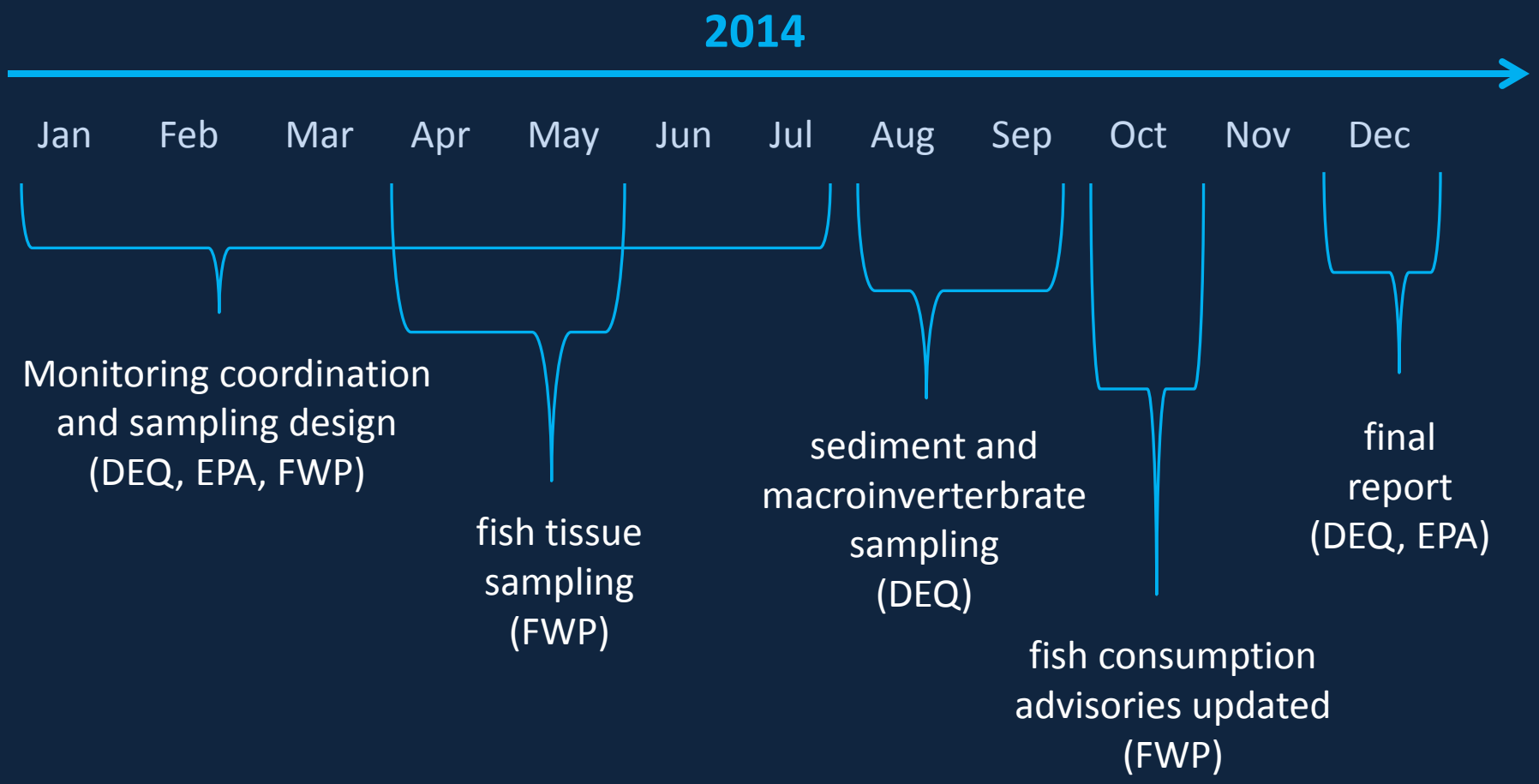
2. Conduct fish tissue monitoring in Flathead and Whitefish lakes to update sport fish consumption advisories and characterize PCB and Hg concentrations

3. Conduct targeted sediment and macroinvertebrate tissue monitoring in waters hydrologically linked to the waters of concerns to identify potential sources or “hot spots” of PCB or Hg contamination

4. Refine PCB monitoring and assessment protocols to inform future assessment activities

5. Report PCB and Hg concentrations in the Flathead Lake watershed to stakeholders

Project Timeline



Monitoring Design

Source Assessment & Watershed Characterization

1. Evaluate existing data

2. Research common uses and sources of PCBs

3. Compare source categories to remediation sites and permitted facilities in the project area to identify potential PCB source locations

4. Select sampling locations on the 3 waters of concern and other major waters

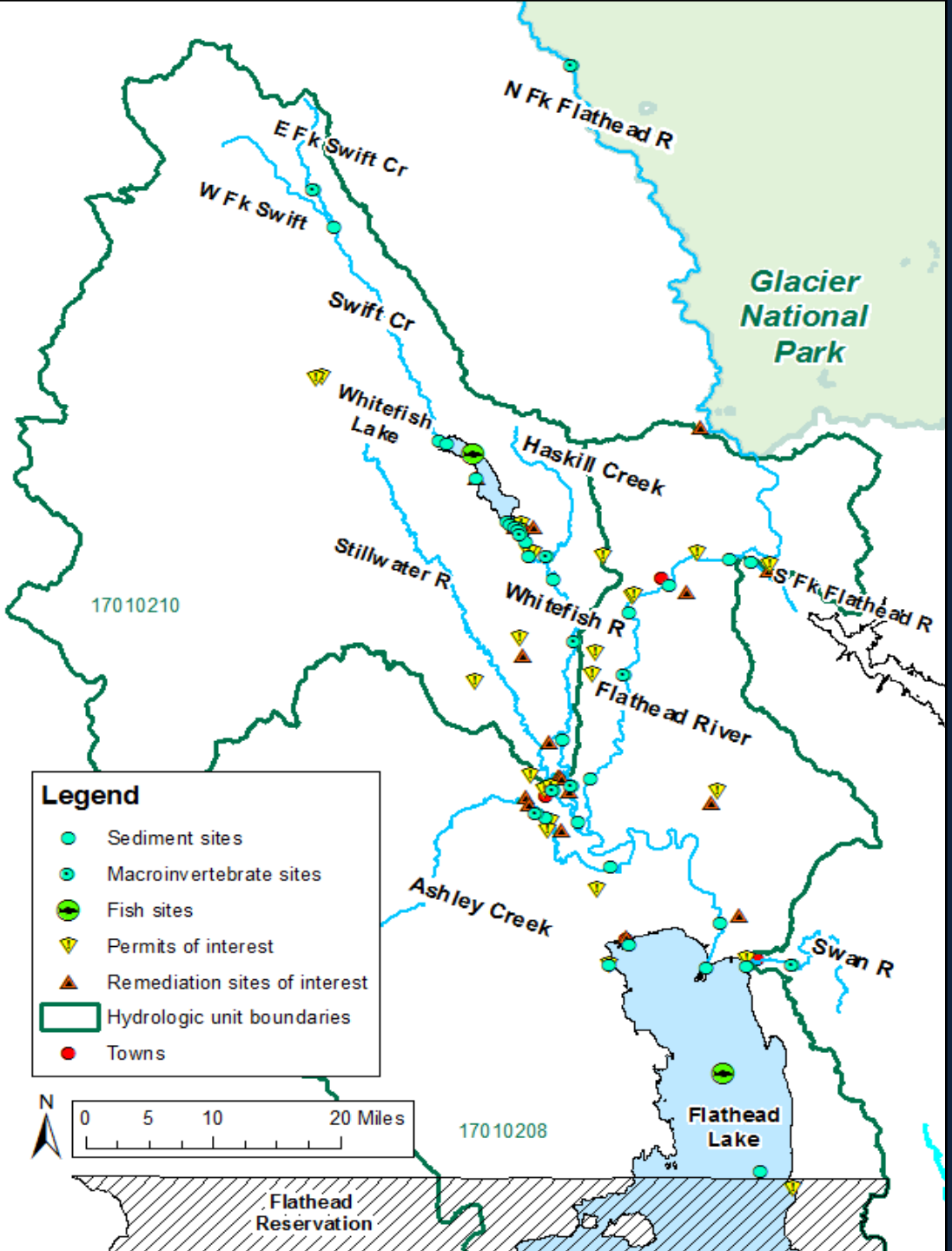
Sampling Locations

Lake sampling sites generally located:

- in bays with deposition zones from major tributaries
- in deepest region where settling has occurred
- near shoreline where PCBs were previously detected

River/stream sampling sites generally located:

- up- and downstream from potential PCB sources
- evenly spaced along reaches with no apparent PCB sources
- public access points
- potential reference sites upstream from potential PCB sources



Monitoring Sites & Potential Source Areas

Sample Media:

Bottom sediments (DEQ)

Macroinvertebrate tissue (DEQ)

Fish tissue (FWP)

Sample Parameters:

Total PCBs (9 most common PCB Aroclors: 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262 and 1268)

Total mercury

Lake Sampling Grids

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Collect and composite sediment from at least 5 sub-plots within sampling grid

River/Stream Sampling Frames

Collect and composite sediment from at least 5 depositional zones from within a relatively homogenous, ~100-m sampling reach

Waterbodies Sampled & Number of Samples Collected

Waterbody Name	Sediment	Macro	Fish
Ashley Creek	3	1	0
East Fork Swift Creek	1	1	0
Haskill Creek	1	1	0
Flathead Lake	5	0	26
Flathead River	6	1	0
North Fork Flathead River	1	1	0
South Fork Flathead River	1	0	0
Stillwater River	3	2	0
Stillwater Slough	1	1	0
Swan River	1	1	0
Swift Creek	1	0	0
West Fork Swift Creek	1	0	0
Whitefish Lake	4	0	27
Whitefish River	9	4	0
TOTAL # of SAMPLES	38	13	53

Montana's numeric water quality standards for PCBs (Circular DEQ-7)

Chronic Aquatic Life Standard = 0.014 ug/L

Human Health Standard for surface water = 0.0006 ug/L

Sediment Quality Guidelines (SQGs):

not standards; provide benchmarks for identifying potential contamination

Probable Effects Level (PEL)

concentration above which adverse effects are expected to occur *frequently*

(i.e., more than 50% adverse effects occur above)

Probable Effects Concentration (PEC)

effects-based

possible effect range within which adverse effects occur *occasionally*

consensus-based

Threshold Effects Level (TEL)

concentration below which adverse biological effects are expected to occur *rarely*

(i.e., fewer than 25% adverse effects occur below)

Threshold Effects Concentration (TEC)

Sediment Results

	Waterbody Name	n	Range of Concentrations	
			PCBs (mg/kg)	Mercury (mg/kg)
Whitefish Lake tributaries	West Fork Swift Creek	1	<0.023	0.082
	East Fork Swift Creek	1	<0.054	0.09
	Swift Creek	1	<0.022	<0.05
	Whitefish Lake	4	<0.027 to <0.055	<0.05 to 0.055
Flathead Lake tributaries	Whitefish River	9	<0.021 <0.038	<0.05 0.2
	Haskill Creek	1	<0.024	<0.05
	North Fork Flathead River	1	<0.021	<0.05
	South Fork Flathead River	1	<0.022	0.062
	Flathead River	6	<0.021 to <0.024	<0.05 to 0.075
	Swan River	1	<0.025	<0.05
	Ashley Creek	3	<0.025 to 0.044	<0.054 to 0.25
	Stillwater River	3	<0.022 to <0.024	<0.05 to <0.053
	Stillwater Slough	1	0.075	0.087
	Flathead Lake	5	<0.021 to <0.056	<0.05 to 0.075

PCBs

All PCB concentrations below Probable Effects Level (PEL) and Probable Effects Concentration (PEC)

2 sites with PCB detections:

Ashley Creek ~ 3 miles u/s of mouth (above TEL, below TEC, PEL and PEC)

Stillwater Slough lagoon at Woodland Park (above TEL and TEC, below PEL and PEC)

Several PCB detection limits above TEL (detection limits varied with moisture content)

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	Flathead Lake	5	<0.021 to <0.056	<0.05 to 0.075

Mercury

All mercury concentrations below PEL and PEC

2 sites with mercury concentrations above TEL and TEC:

Whitefish River at Canoe Park upstream Columbia Ave crossing

Ashley Creek about 3 miles upstream of mouth

Macroinvertebrate Results

PCBs

Detected in one macroinvertebrate sample at Stillwater Slough lagoon

- 0.13 mg/kg
- corresponds to elevated PCBs in sediment
- sample primarily mature crayfish (top of food chain, omnivorous, bottom-feeding scavengers)

Mercury

Detected in 3 sites

- Whitefish River above Baker Avenue
- Haskill Creek near mouth
- Swan River

Fish Tissue Results

Fish consumption advisories

- Issued by the Montana Department of Public Health and Human Services (DPHHS) in conjunction with Montana Fish, Wildlife and Parks.
- Designed to protect human health from potential adverse effects of PCB and mercury ingestion through the consumption of sport fish.

Fish consumption thresholds

Mercury[1]		
Women & children	Other Adults	meals/month
ug/g = ppm		
>1.18	>2.85	None
0.59 - 1.18	1.42 - 2.85	1
0.39 - 0.59	0.95 - 1.42	2
0.29 - 0.39	0.71 - 0.95	3
0.23 - 0.29	0.57 - 0.71	4
0.20 - 0.23	0.47 - 0.57	5
0.17 - 0.20	0.41 - 0.47	6
0.15 - 0.17	0.36 - 0.41	7
0.13 - 0.15	0.32 - 0.36	8
0.12 - 0.13	0.29 - 0.32	9
0.11 - 0.12	0.26 - 0.29	10
0.10 - 0.11	0.24 - 0.26	11
0.09 - 0.10	0.22 - 0.24	12
<0.09	<0.22	Unrestricted

PCBs[1]	
All people	meals/month
ug/g = ppm	
>0.47	None
0.11	1
0.025	4
<0.025	Unrestricted

[1] Based on 8-ounce serving (weight before cooking) for a 150-pound man, and a 6-ounce serving for women of childbearing age or for children age six and younger.

http://fwp.mt.gov/fishing/

Fish Consumption Advisories, 2014

Location	Species	Person	Size (*Length in inches*) 6-10	10-14	14-18	18-22	22-26	26-30	30+	Contaminant
Whitefish Lake	Lake trout	M					8			Hg
		WC		11	11	5	3			Hg
	Northern pike	M								Hg
		WC					10	10	9	Hg
	Lake whitefish	M								
		WC				6				Hg
	Cutthroat trout	M								
		WC								

= Fish are safe to eat
1 = Number of safe meals per month
= Fish should be avoided
= Fish have not been analyzed

Whitefish Lake

PCBs

2000: lake trout 22-26 inches restricted to 4 meals per month

2014: all tissue samples for all species & lengths were below detection; PCBs no longer indicated as a contaminant

Mercury

2014: lake trout, lake whitefish, and northern pike consumption advisories, esp. for women and children; mercury concentrations increase with fish size

2014 dataset is more comprehensive, and Hg concentrations are generally lower with less stringent fish consumption advisories than in 2000

Fish Consumption Advisories, 2014

Location	Species	Person	Size (*Length in inches*) 6-10	10-14	14-18	18-22	22-26	26-30	30+	Contaminant
Flathead Lake	Lake trout	M	12	12	7	6	4	2		Hg/PCBs
		WC	6	5	3	2	1			Hg/PCBs
	Lake whitefish	M				12				Hg
		WC	11	9	7	4				Hg

Flathead Lake

= Fish are safe to eat
1 = Number of safe meals per month
= Fish should be avoided
= Fish have not been analyzed

PCBs

2014: similar to 2000, PCBs were only detected in larger lake trout (>26 inches)

Mercury

2014: advisories for mercury in lake trout and lake whitefish; mercury concentrations increase with fish size

2014 advisory for lake trout is more stringent and the advisory for lake whitefish is less stringent than in 2000

Conclusions

Generally, recent data suggests minimal risk of PCBs in waters sampled for this project (all sediment PCBs below sediment screening values of concern)

Several waters indicate some degree of risk from PCBs:

- Flathead Lake - consumption advisory for large lake trout
- Stillwater Slough - slightly elevated sediment and macroinvertebrate tissue concentrations
- Ashley Creek – low, but detectable PCBs
- Whitefish River and Swan River - pending post-remediation data review

Mercury concentrations present in Whitefish Lake and Flathead Lake (fish tissue but not sediment)

Whitefish River and Ashley Creek have mercury between lower and upper sediment screening criteria (occasional effects may occur)


Thank you!