HUDSON RIVER PCBS SUPERFUND SITE

Community Advisory Group Meeting

Wednesday, January 14, 2026

EPA

Hudson River PCBs SUPERFUND SITE

Upper Hudson River Update

EPA

Hudson River
PCBs SUPERFUND SITE

Hudson River Superfund Site

EPA Activities

(Conceptual - not to scale)

Remnant Deposits – OM&M

Upper Hudson River Floodplain - RI/FS and STRAS

Waterline Transfer to Municipalities

Hudson Falls
(GE Plant Site - DEC)

Fort Edward
(GE Plant Site - DEC)

Former Fort Edward Dam

Powerhouse and Allen Mill - Deconstruction

Upper Hudson River – Dredging Remedy OM&M and Special Studies (40 mi)

Troy (Dam)

Albany

Catskill

Poughkeepsie (salt front)

Tappan Zee

George Washington

NJ

NY Harbor

Lower Hudson River – Additional Investigations and Sampling (160mi)

PCB Sites (DEC)

- BASF
- Hastings
- BIC

New York City Battery

The items shown in this figure represent a subset of activities and do not encompass all operations conducted at the site.

Hudson River PCBs SUPERFUND SITE

3rd Five-Year Review (FYR) - Deferred Protectiveness

- EPA needs enough data to identify a (statistically reliable) trend in the fish before a protectiveness determination can be made
  - Not enough data at the time of the FYR to establish trends
  - Moving window analysis shows eight or more years of data are needed (2024)
  - The rates of decline need to be statistically reliable
- Overall, PCB levels in fish and water are declining and progress is being made towards the Remedial Action Objectives (RAOs)
- Uneven fish recovery in some species/locations

Why does the EPA need more fish data?

The EPA uses statistical analysis to evaluate water, fish and sediment sampling data to identify patterns and trends. EPA has good quality data, but we need at least eight years of fish data to see a trend.

As expected, some fish are recovering faster than others. A statistical analysis provides a better understanding of how the cleanup actions are working. This is important so that the EPA can tell if the project is on track to meet the goals of the original cleanup plan.

Path to Determination (Addendum)

2025

Moving Window Analysis
- 8 or more years of data needed
- High year-to-year variability
- Based on pre-dredge data

2024 fish data is 8th year

Test Moving Window Analysis (Underway)
- Compare pre-dredge variability to post-dredge variability

Calculate Trends
- Compare trends to model projections
- Consider various technical aspects (lipid ….)
- Consider trends various ways including by whole Upper Hudson River, river reach, river section, station, species …..

Evaluate Trends (Underway)
- Are the trends statically reliable?
- Multiple statistical approaches will be used
- Consideration of species weighted average

2026 – Data Collection and Evaluation
- Sediment collection (year 10) and evaluation
- 2025 special study data will be evaluated
- Special studies continue (including isotope study, additional pumpkin seed collection, supplemental fish, sediment in localized areas ….)

2026
Evaluate the 2025 (year 9) fish data, retest moving window analysis and the reliability of trends

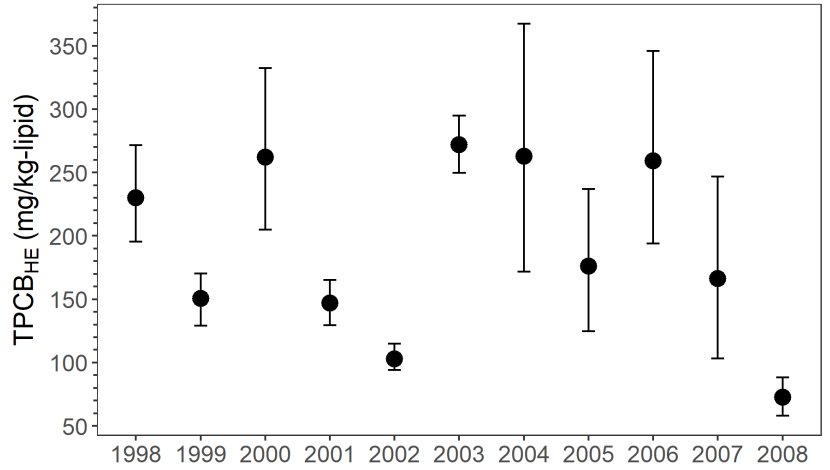
2027
Evaluate the 2026 (year 10) fish data, reliability of trends

Make Protectiveness Determination (3rd FYR Addendum)

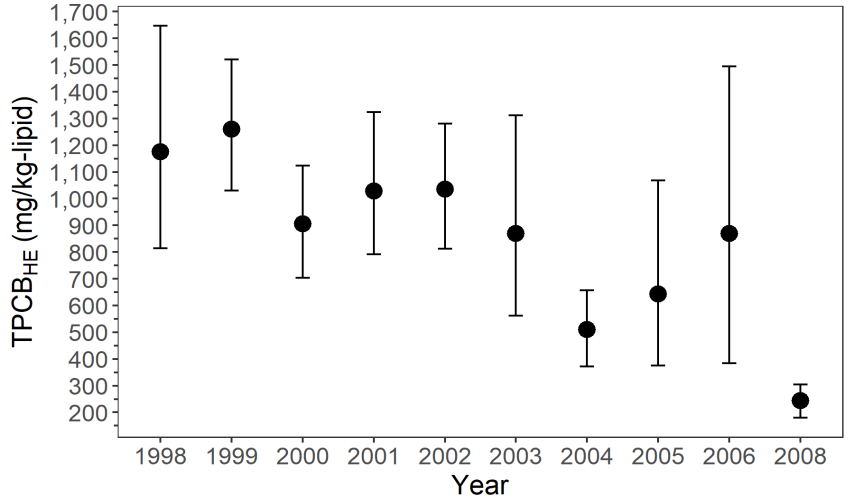
Eight or More Years of Data Needed

- Year-to-year variability in fish and water concentrations makes detecting a time trend difficult
  - Confounding factors include flow, temperature and food sources in a particular year
  - More samples per year does not reduce year-to-year variability
  - Higher variability requires more years of data to detect the “true” trend
  - Without enough years of data, the calculated trend may not reflect the “true” trend, even if the calculated trend has statistical significance
- EPA conducted a “moving window” analysis to determine how many years of data are necessary
  - Based on pre-dredge data
  - Eight or more years determined to be necessary
- EPA evaluating post dredge year-to-year variability
  - One test - if post-dredge data variability is less than pre-dredge data then eight years of data may be sufficient

Pumpkinseed in RS1



Largemouth Bass in RS1



Eight or More Years of Data - Update

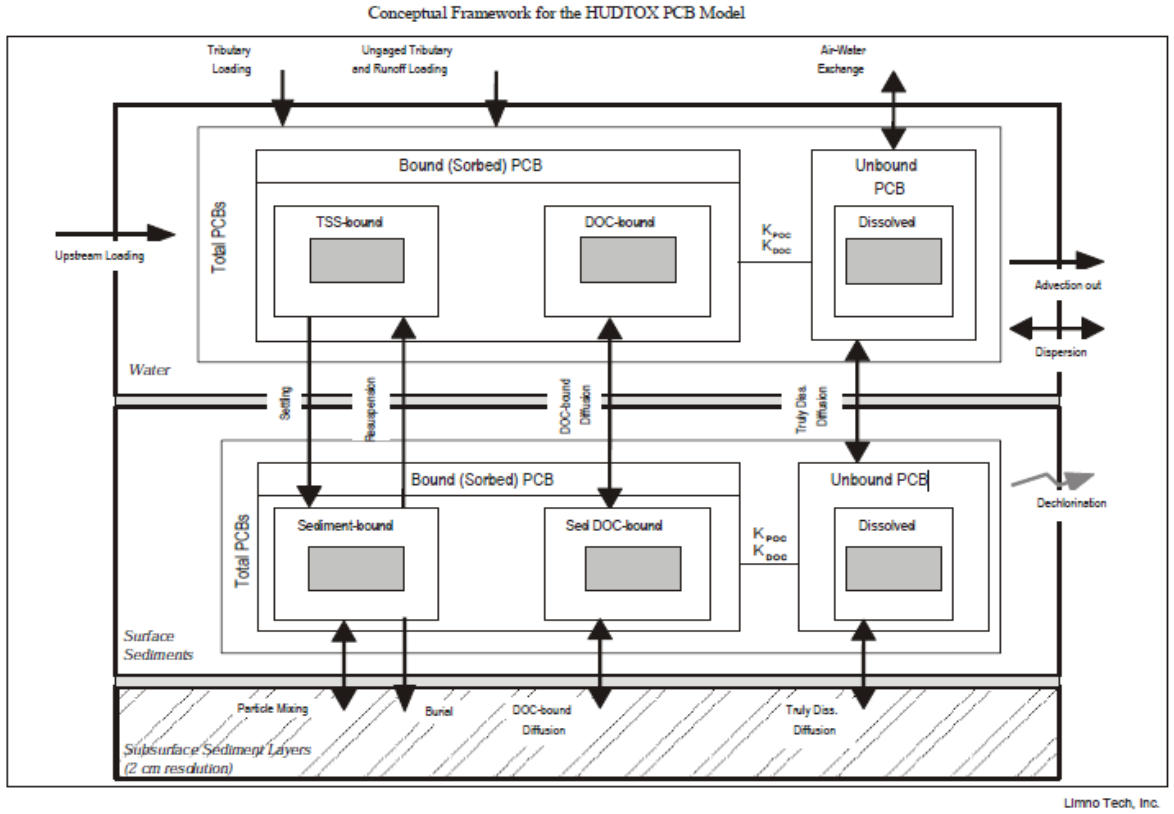
- On average, variance in the data after dredging is similar to pre-dredging - further evaluation still needed
  - Need to look closer at impacts of more variability - by species and locations
- Note: this is not an analysis of statistically relevant rates of decline

River Section (RS) - Species	2004-2008 Pre-Dredge Variance	2017-2024 Post-Dredge Variance	Change from Pre-Dredge to Post-Dredge Variance
RS1-Bass	0.02	0.01	less
RS1-BB	0.03	0.02	less
RS1-PKSD	0.11	0.11	same
RS1-YP	0.04	0.03	less
RS2-Bass	0.01	0.02	more
RS2-BB	0.05	0.04	less
RS2-PKSD	0.08	0.13	more
RS2-YP	0.02	0.01	less
RS3-Bass	0.1	0.04	less
RS3-BB	0.03	0.03	same
RS3-PKSD	0.02	0.03	more
RS3-YP	0.01	0.04	more
Average	0.04	0.04	Similar (4 more/6 less)

Note:
Between-year variance is calculated as the deviation between measured annual average log-transformed PCB and the regression line through all years of data for each period.

Modeling Purpose/Limitations

- Developed to compare cleanup alternatives for the Feasibility Study
  - Uncertainty in modeling – modeled vs. actual expected to be (and are) different
  - Actual conditions different than modeled (e.g., start year, dredging sequence, flows, resuspension etc.)
- Direct comparisons to model are extremely difficult
- Modeling results discussed in Section 11 of Record of Decision (ROD) are focused on the comparative analysis of alternatives
  - Discussion of why the alternative was selected (not the RAOs and specific time to meet goals)



Upper Hudson River Update: Data Evaluation & Analysis

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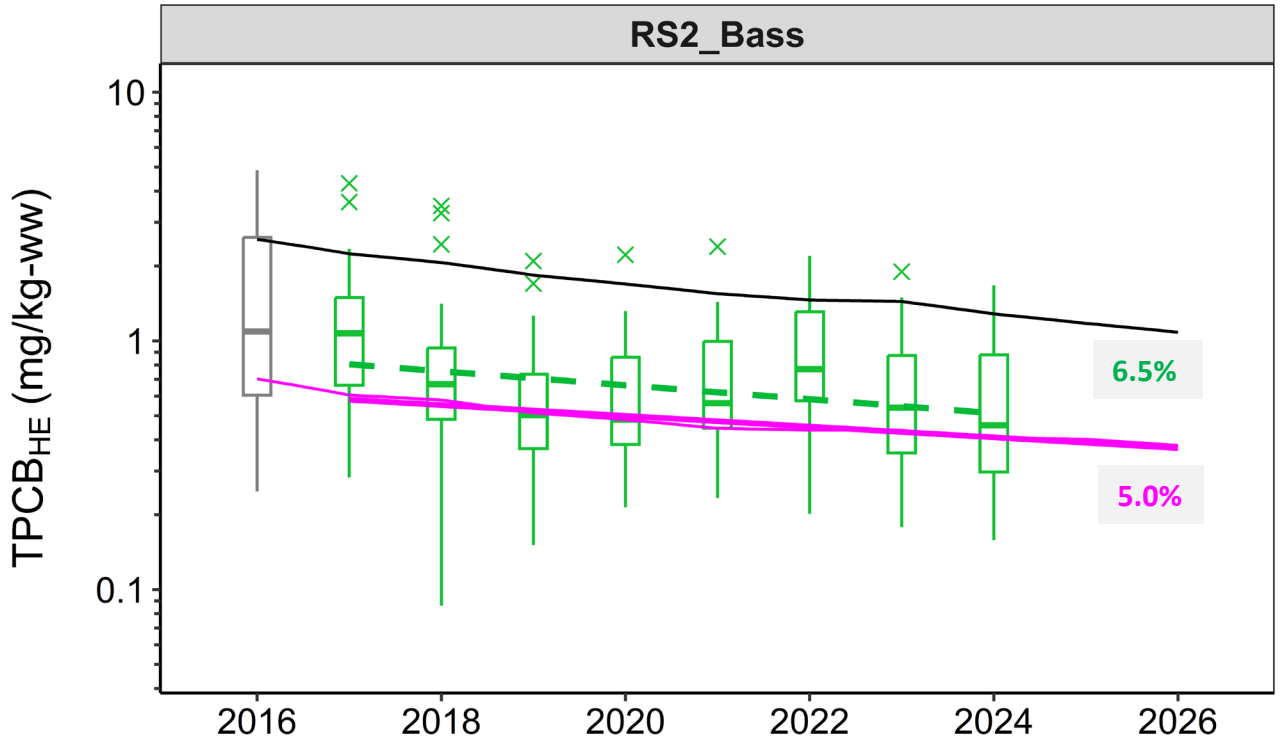
Intro Slide: Model to Data Comparison (Example)



Equilibrium Period (2016)
Post-Dredging (2017-2024)

ROD Model MNR

ROD Model Selected Remedy

Trend line using ROD-modeled concentrations from 2011 to 2020 for the selected remedy.

Post-dredging trend line

Outlier Sample

1.5*IQR or maximum of data excluding outliers, whichever is larger

75th Quantile

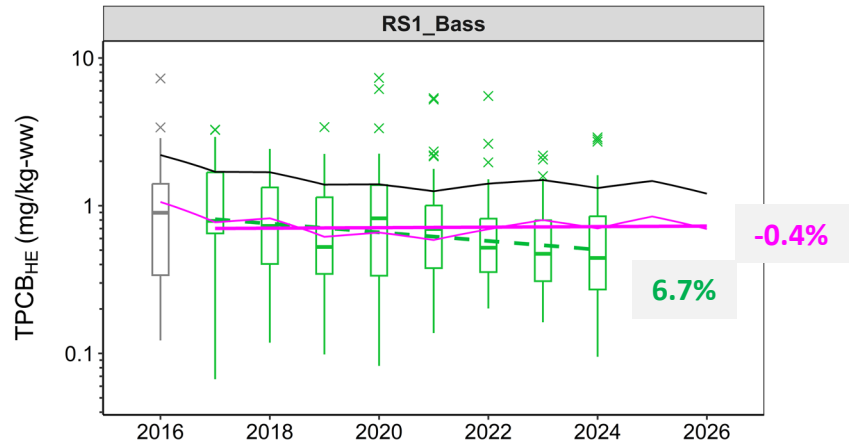
Median

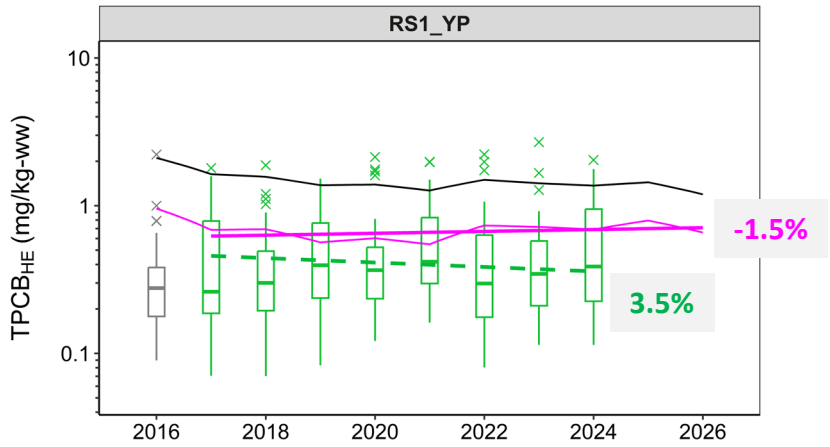
25th Quantile

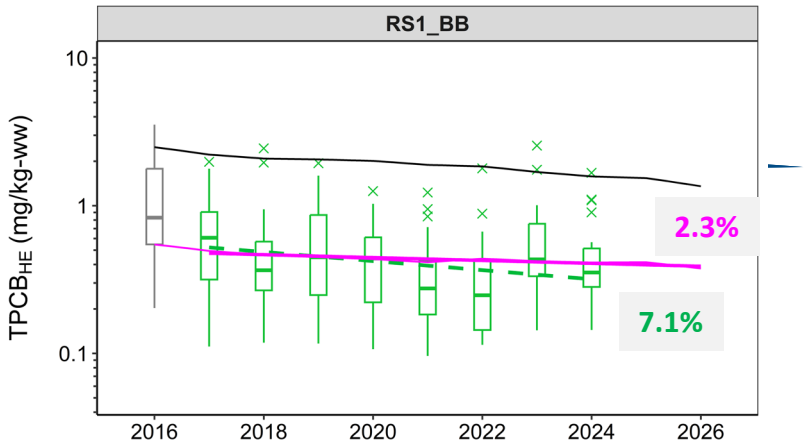
1.5*IQR or minimum of data excluding outliers, whichever is smaller

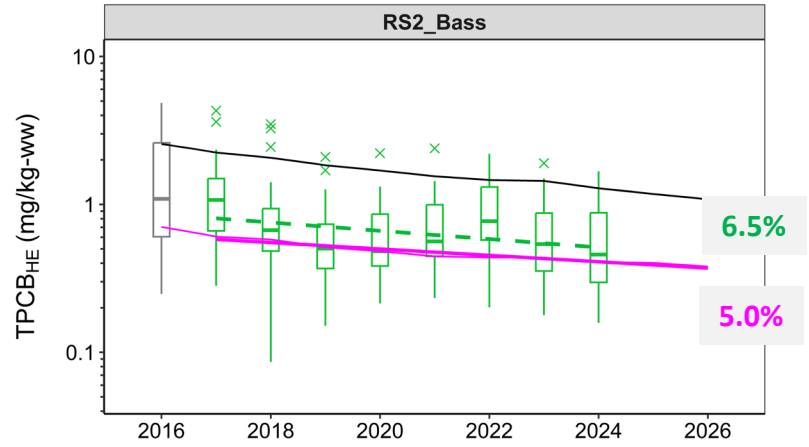
Notes:

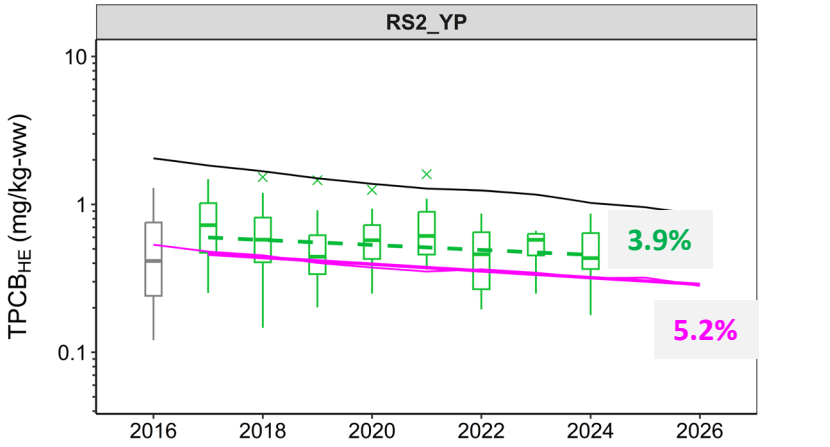
1. Modelling year was shifted forward for six years to match the actual dredging schedule. For example, model prediction for year 2010 was plotted at year 2016.

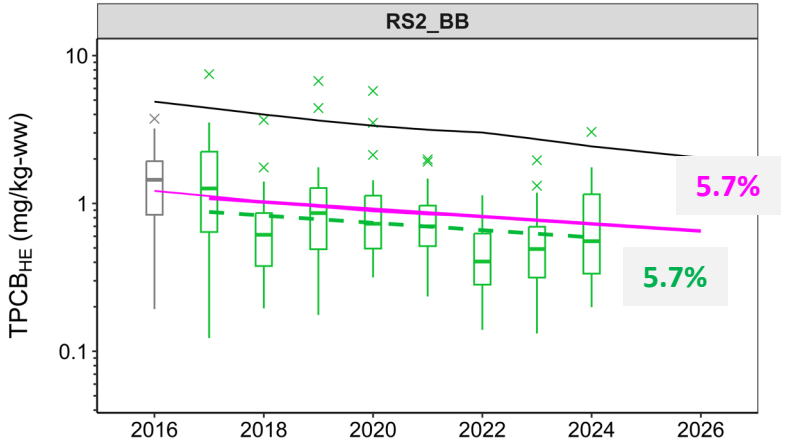

RS1_Bass
TPCB$_{HE}$ (mg/kg-ww)
10
1
0.1
2016
2018
2020
2022
2024
2026
-0.4%
6.7%

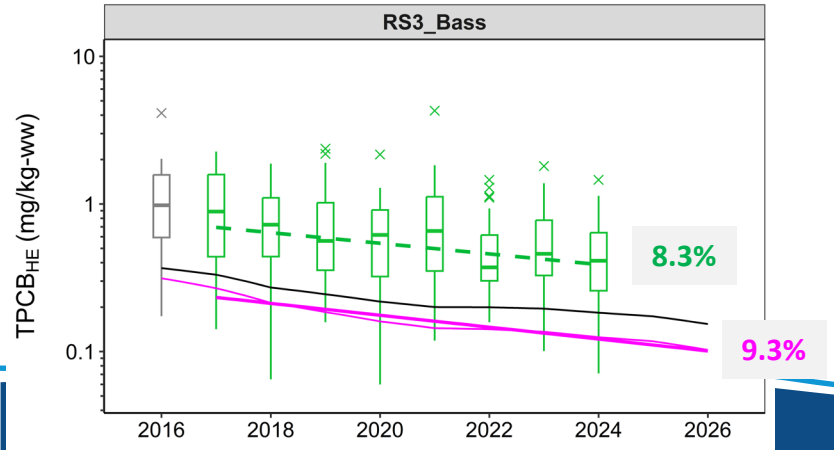

RS1_YP
TPCB$_{HE}$ (mg/kg-ww)
10
1
0.1
2016
2018
2020
2022
2024
2026
-1.5%
3.5%

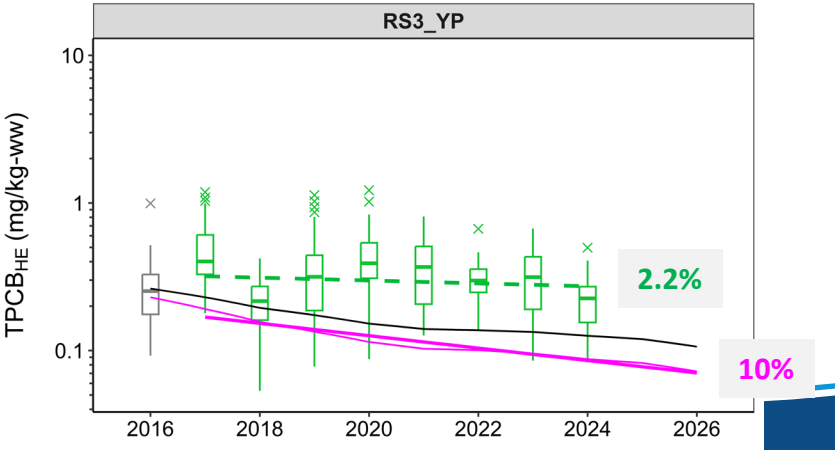

RS1_BB
TPCB$_{HE}$ (mg/kg-ww)
10
1
0.1
2016
2018
2020
2022
2024
2026
2.3%
7.1%

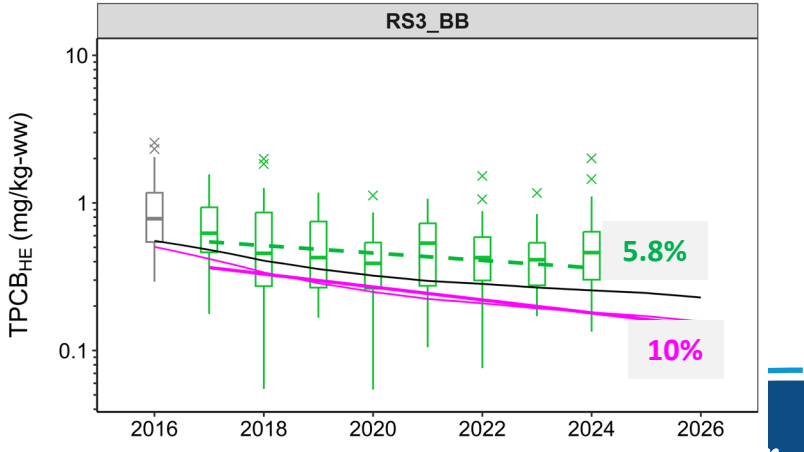

RS2_Bass
TPCB$_{HE}$ (mg/kg-ww)
10
1
0.1
2016
2018
2020
2022
2024
2026
6.5%
5.0%


RS2_YP
TPCB$_{HE}$ (mg/kg-ww)
10
1
0.1
2016
2018
2020
2022
2024
2026
3.9%
5.2%


RS2_BB
TPCB$_{HE}$ (mg/kg-ww)
10
1
0.1
2016
2018
2020
2022
2024
2026
5.7%
5.7%


RS3_Bass
TPCB$_{HE}$ (mg/kg-ww)
10
1
0.1
2016
2018
2020
2022
2024
2026
8.3%
9.3%

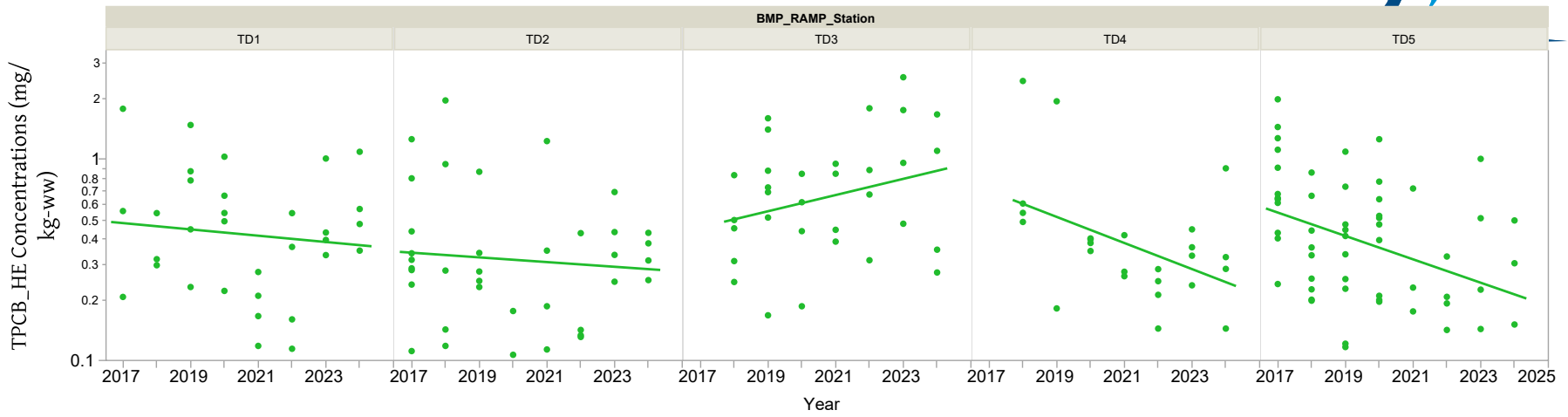

RS3_YP
TPCB$_{HE}$ (mg/kg-ww)
10
1
0.1
2016
2018
2020
2022
2024
2026
2.2%
10%


RS3_BB
TPCB$_{HE}$ (mg/kg-ww)
10
1
0.1
2016
2018
2020
2022
2024
2026
5.8%
10%

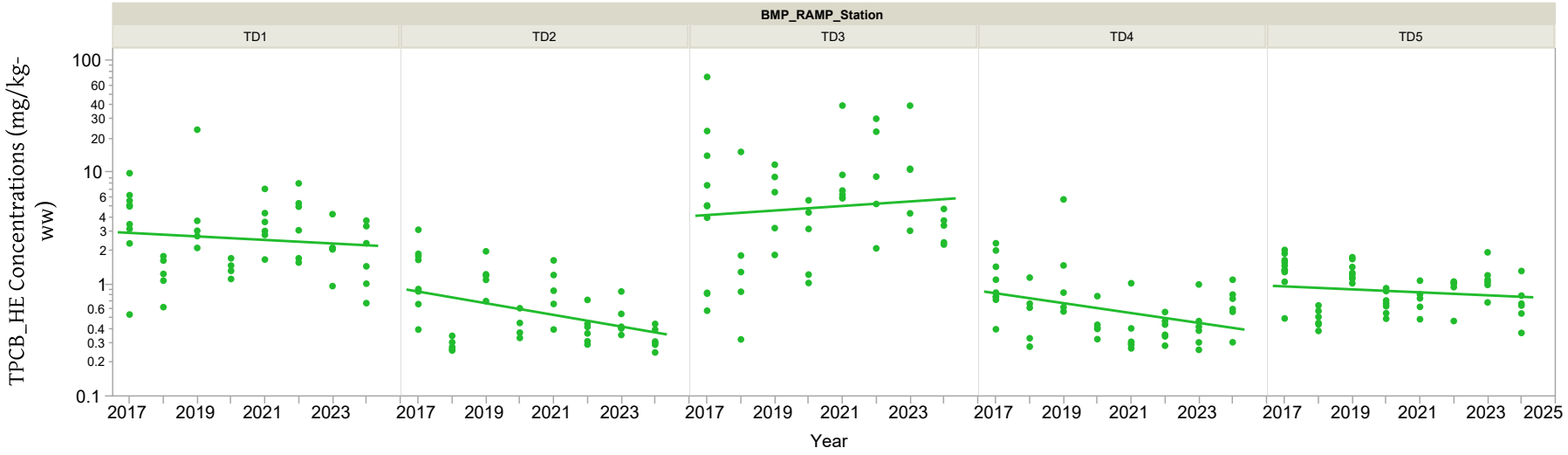
Station level variations in PCB concentrations and trends

- For the same species, the rates of recovery can vary within a River Section
- Some limited fish stations have consistently low or no rates of recovery for multiple species (e.g., TD3)

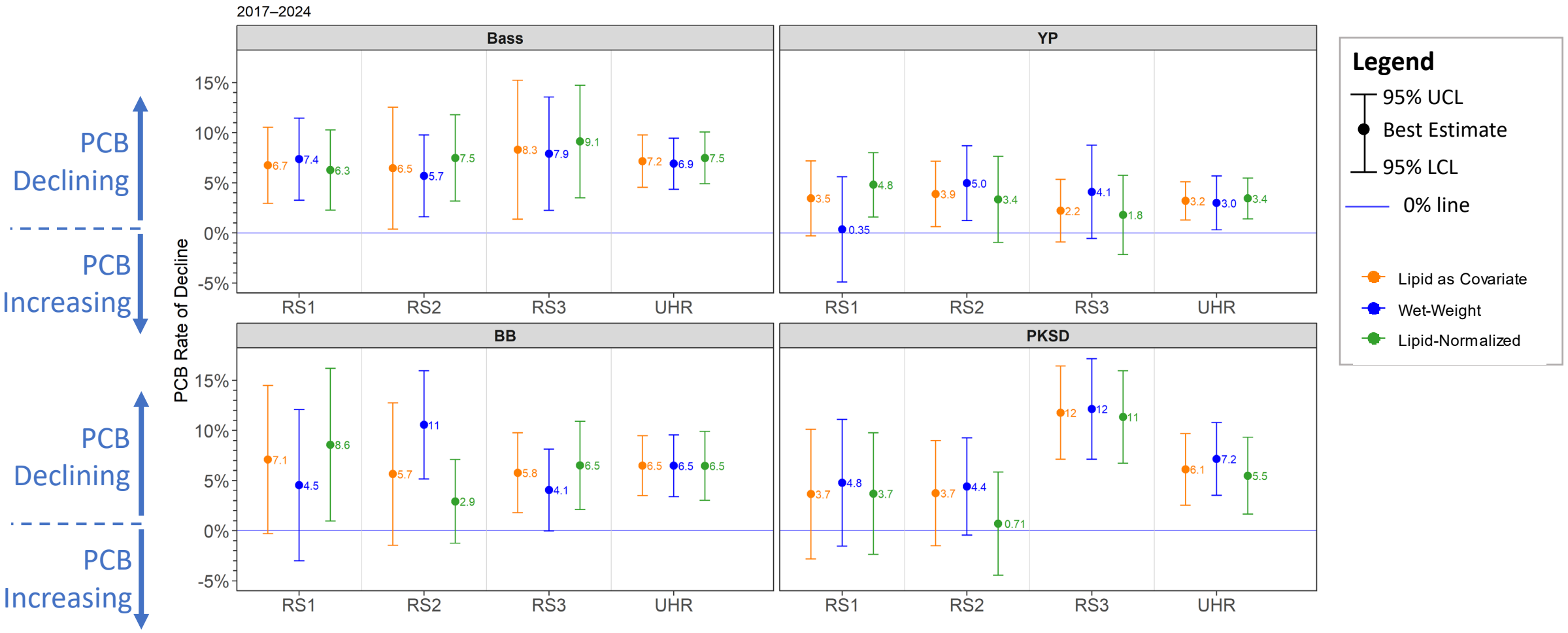
RS 1 Brown Bullhead (wet-weight) Post- Dredging Data



RS 1 Pumpkinseed (wet-weight) Post- Dredging Data



Fish PCB Rate of Decline by Species ($TPCB_{HE}$, Three Approaches)



Species-Weighted Average Calculation

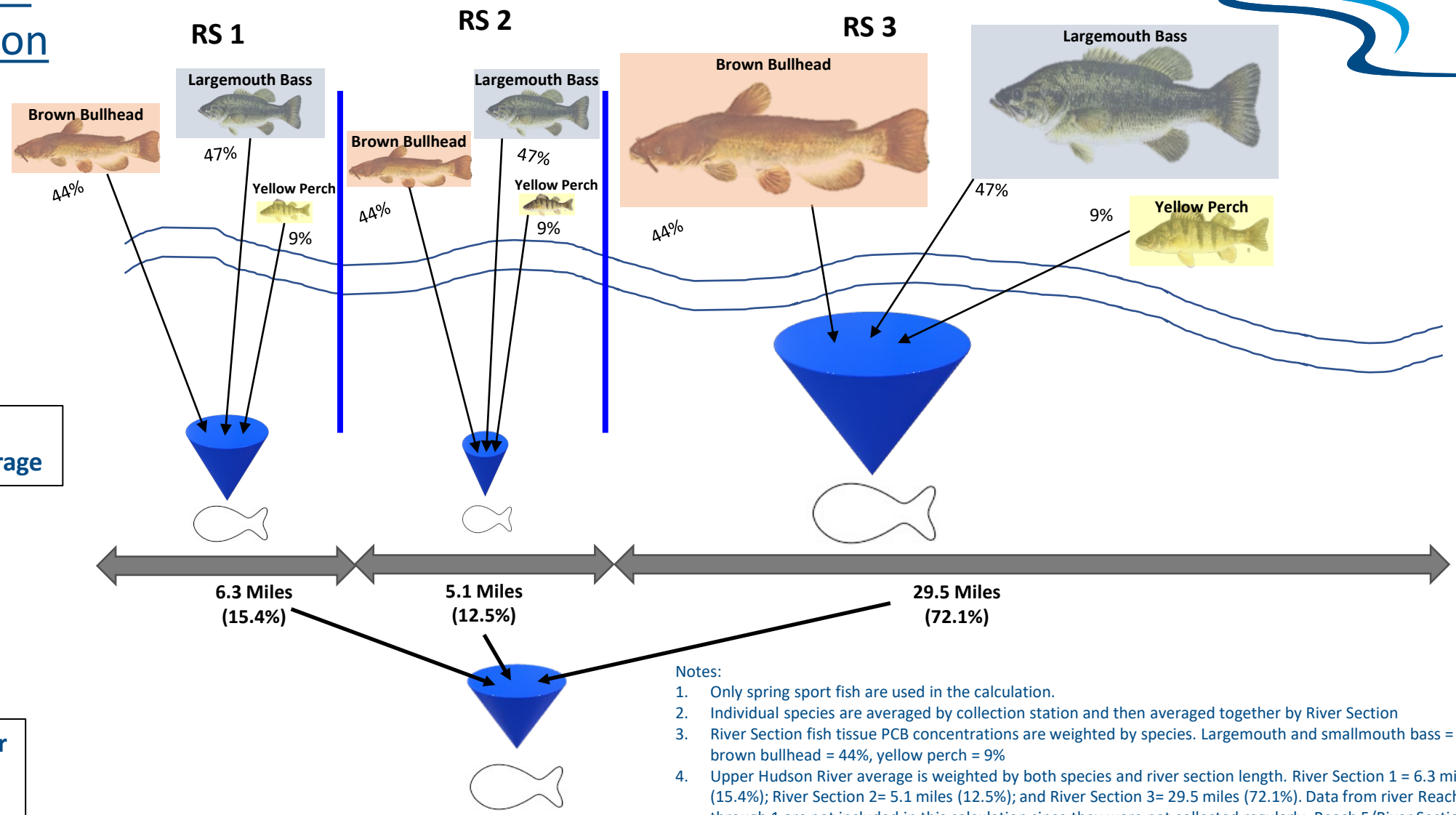
Average PCB concentration by species

Species weight based on likelihood of collection

River Section Species-Weighted Average

River Section weight based on length

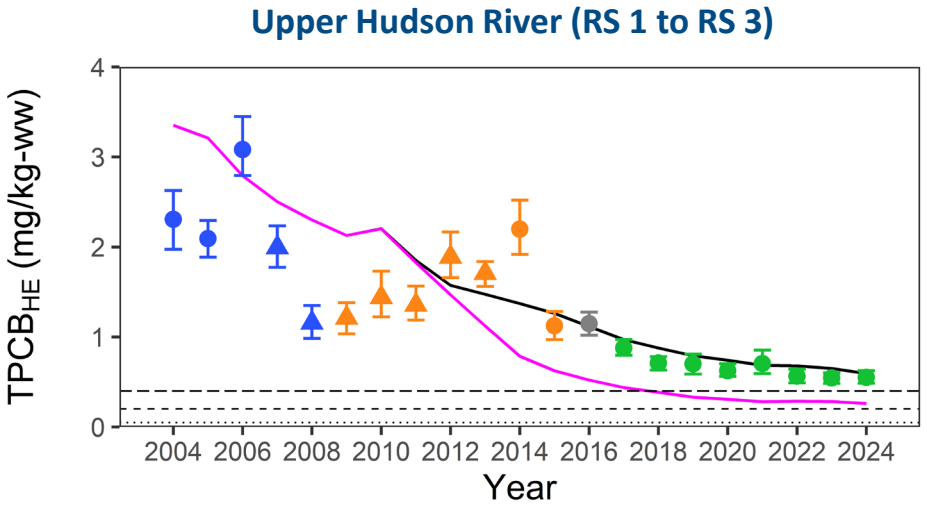
Upper Hudson River Species-Weighted Average

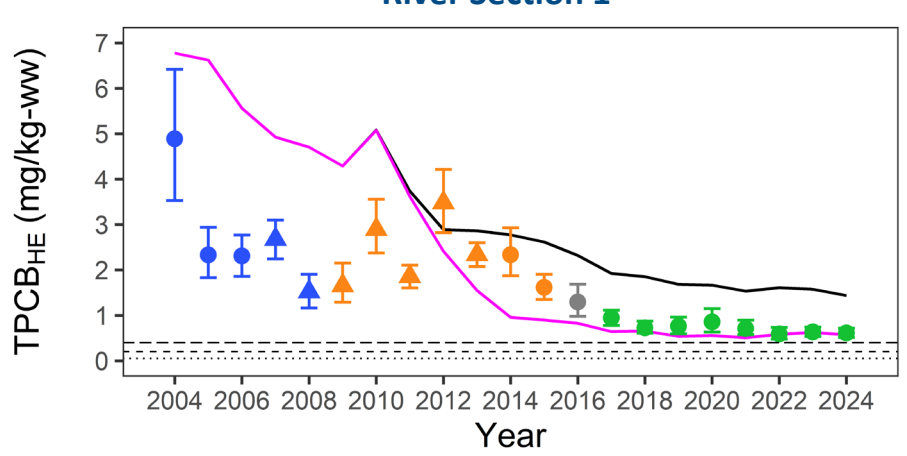


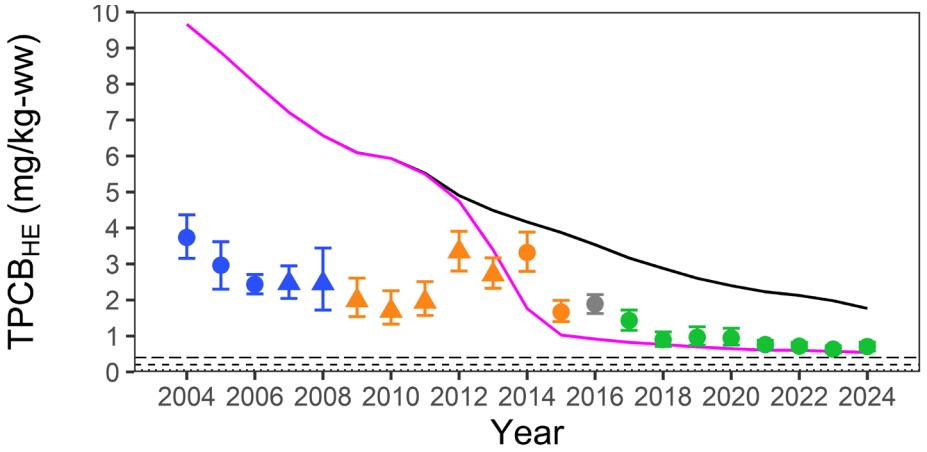
Notes:

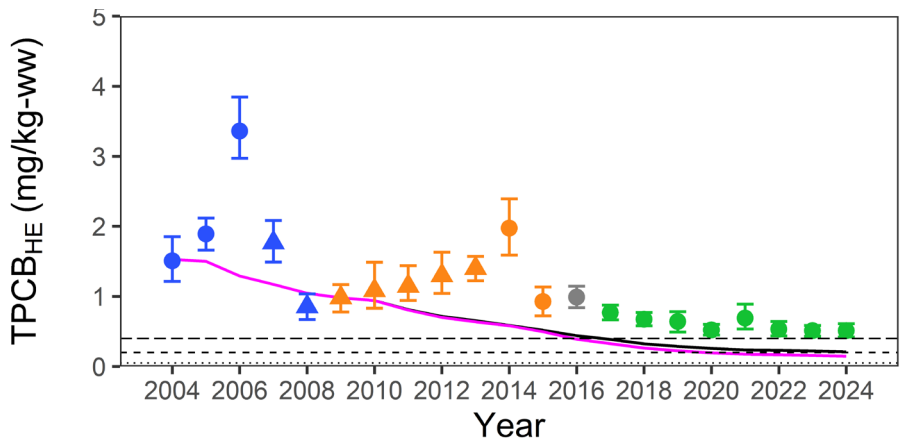
1. Only spring sport fish are used in the calculation.
2. Individual species are averaged by collection station and then averaged together by River Section
3. River Section fish tissue PCB concentrations are weighted by species. Largemouth and smallmouth bass = 47%, brown bullhead = 44%, yellow perch = 9%
4. Upper Hudson River average is weighted by both species and river section length. River Section 1 = 6.3 miles (15.4%); River Section 2= 5.1 miles (12.5%); and River Section 3= 29.5 miles (72.1%). Data from river Reaches 4 through 1 are not included in this calculation since they were not collected regularly. Reach 5/River Section 3 is weighted to reflect all 29.5 miles of River Section 3, while the fish monitoring stations representing River Section 3 are all located in Reach 5, which is 14 miles long).

Post-Dredging Species-Weighted Average Wet-Weight $TPCB_{HE}$









RAO Target PCB Concentration
- 0.4 mg/kg-ww
- 0.2 mg/kg-ww
- 0.05 mg/kg-ww

- Pre-Dredging (2004-2008)
- Dredging (2009-2015)
- Equilibrium Period (2016)
- Post-Dredging (2017-2024)

- 95% Upper Confidence Limit
- Mean
- 95% Lower Confidence Limit
- Rib-out samples
- ROD Model MNR
- ROD Model Selected Remedy

Notes

1. A single correction factor is used to convert the 2017-2024 data from Aroclor basis to Total PCB-homologue equivalent ($TPCB_{HE}$). The matched pairs used in the correction factor are from 2018, 2020, 2021, 2022 and 2024
2. Individual species are averaged by collection station and then averaged together by River Section
3. River Section fish tissue PCB concentrations are weighted by species. Largemouth and smallmouth bass = 47%, brown bullhead = 44%, yellow perch = 9%
4. Upper Hudson River average is weighted by both species and river section length. River Section 1 = 6.3 miles (15.4%); River Section 2= 5.1 miles (12.5%); and River Section 3= 29.5 miles (72.1%). Data from river Reaches 4 through 1 are not included in this calculation since they were not collected regularly. Reach 5/River Section 3 is weighted to reflect all 29.5 miles of River Section 3, while the fish monitoring stations representing River Section 3 are all located in Reach 5, which is 14 miles long
5. 95% confidence limits on the mean are calculated using a bias-corrected and accelerated (BCA) bootstrap method
6. The samples from 2007-2013 are rib-out fillets, all other data are NYSDEC standard fillet samples.
7. Modelling year was shifted forward for 6 years to match the actual dredging schedule. For example, model prediction for year 2010 was plotted at year 2016.

Modeling vs Actual – Time to Targets and Goals

Year After Dredging	ROD Model Year	Actual Year	Species Weighted Average Fish Fillet PCB (mg/kg)							
			Upper River Average		River Section 1		River Section 2		River Section 3	
			ROD Model	Actual	ROD Model	Actual	ROD Model	Actual	ROD Model	Actual
1	2010	2016	0.52	**1.1**	0.83	**1.3**	0.91	**1.9**	0.39	**0.99**
2	2011	2017	0.44	0.88	0.64	0.95	0.82	1.43	0.33	0.77
3	2012	2018	0.39	0.71	0.65	0.72	0.77	0.89	0.26	0.67
4	2013	2019	0.33	0.70	0.54	0.76	0.70	0.96	0.23	0.64
5	2014	2020	0.31	0.63	0.56	0.86	0.65	0.94	0.20	0.52
6	2015	2021	0.28	0.70	0.51	0.71	0.61	0.76	0.18	0.69
7	2016	2022	0.29	0.57	0.59	0.59	0.60	0.72	0.17	0.53
8	2017	2023	0.28	0.54	0.63	0.64	0.58	0.63	0.16	0.51
9	**2018**	**2024**	**0.26**	**0.55**	**0.57**	**0.61**	**0.54**	**0.71**	**0.15**	**0.51**
10	2019	2025	0.27	continued decline	0.65	continued decline	0.52	continued decline	0.14	continued decline
11	2020	2026	0.24		0.55		0.49		0.12	
12	2021	2027	0.21		0.45		0.45		0.12	
13	2022	2028	0.21		0.47		0.44		0.11	
14	2023	2029	0.21		0.51		0.42		0.11	
15	2024	2030	0.18		0.44		0.40		0.09	
16	2025	2031	0.17		0.40		0.37		0.09	
17	2026	2032	0.16		0.35		0.35		0.08	
18	2027	2033	0.18		0.48		0.36		0.08	
19	2028	2034	0.17		0.50		0.34		0.08	
20	2029	2035	0.15		0.40		0.32		0.07	
+22 years	2030 - 2051	2036 to 2056	Time gap							
42	2051	2057	(0.09 ~ 0.14)		70 + Years Uncertain		70 + Years Uncertain		0.05	

Notes (model uncertainty):

1. The ROD model results are shifted in time to reflect that the last year of dredging occurred in 2015.
2. Model assumptions including dredging sequence, duration of dredging, and rate of resuspension differed from actual implementation.

ROD Section 14 Statutory Determinations – 0.4 ppm will be attained within the entire upper Hudson River within 20 years of active remediation

- **Target - 0.4 mg/kg PCBs in fish fillet - 1/2 lb. meal per 2 months**
- **Target - 0.2 mg/kg PCBs in fish fillet - 1/2 lb. meal per month**
- **GOAL - 0.05 mg/kg PCBs in fish fillet - 1/2 lb. meal per week**

Criteria	Pre-Dredge Fish in UHR	2024 Data Fish in UHR
< 1 ppm	46%	84%
0.4 ppm	21%	50%
0.2 ppm	9%	16%

Upper Hudson River Update: Water Column

EPA

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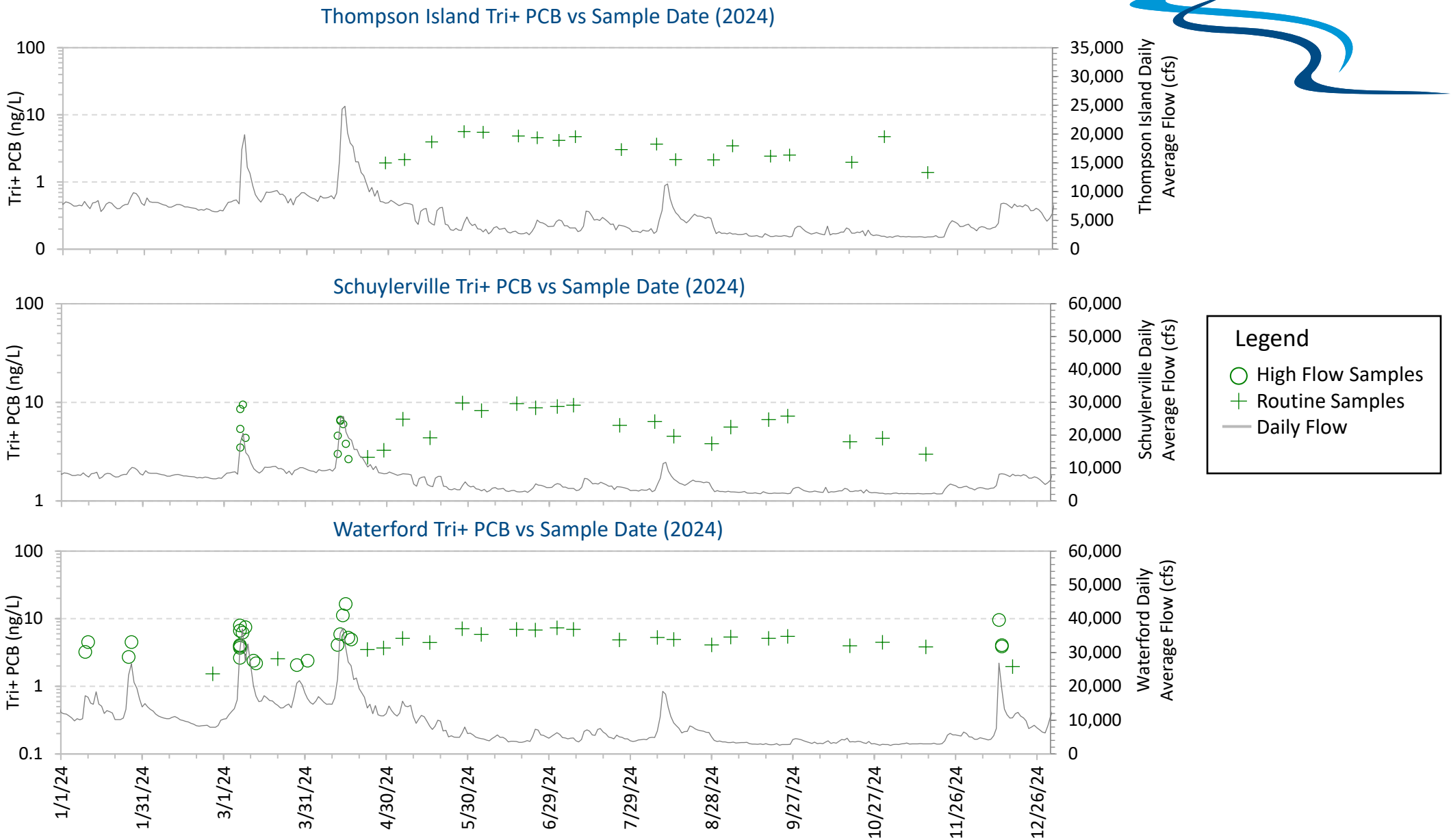
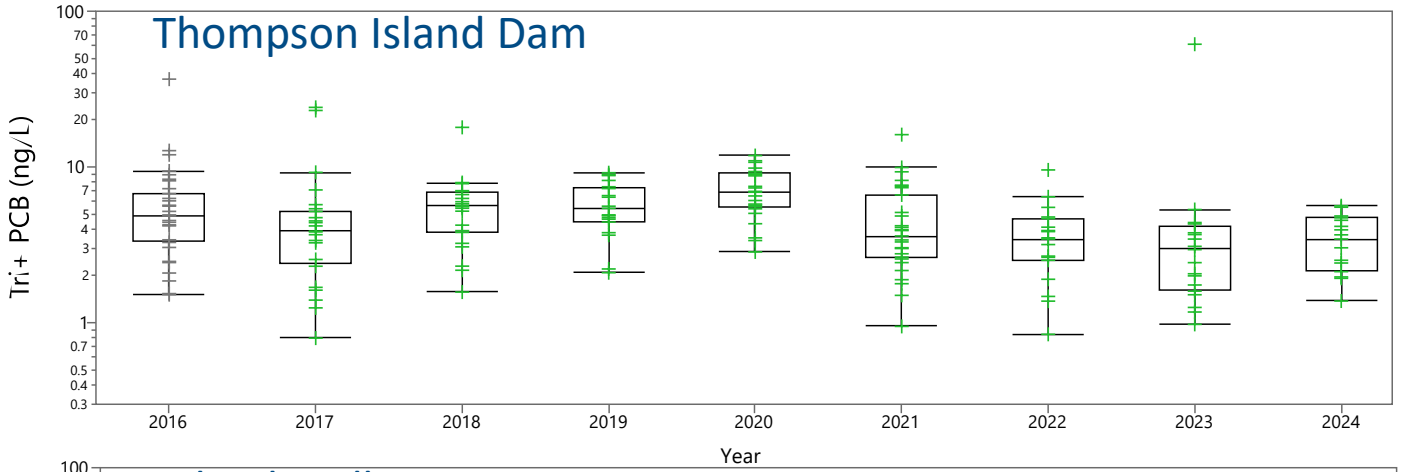
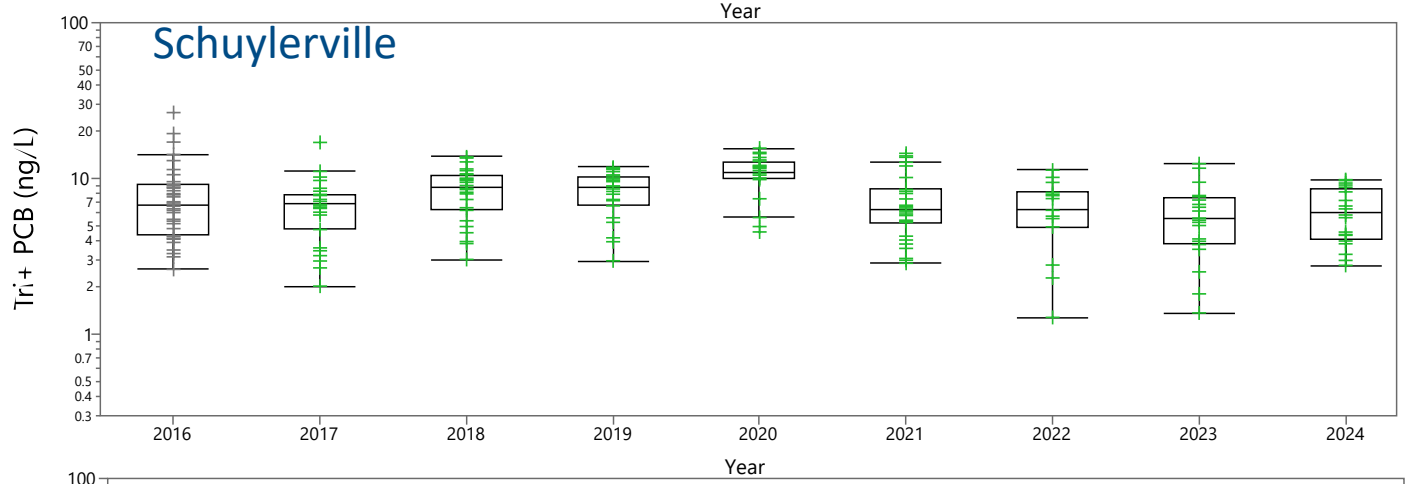
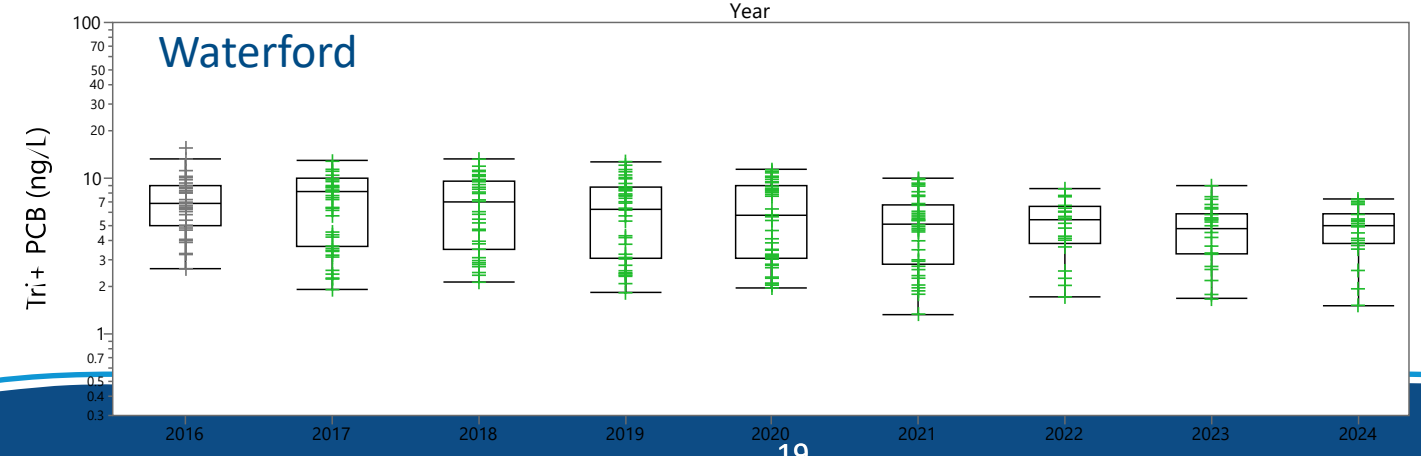
Water Column Routine and High-Flow Samples 2024



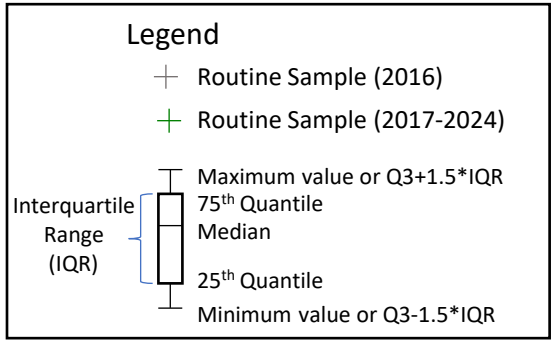
Water Column Routine Samples 2016-2024







Log-Scale

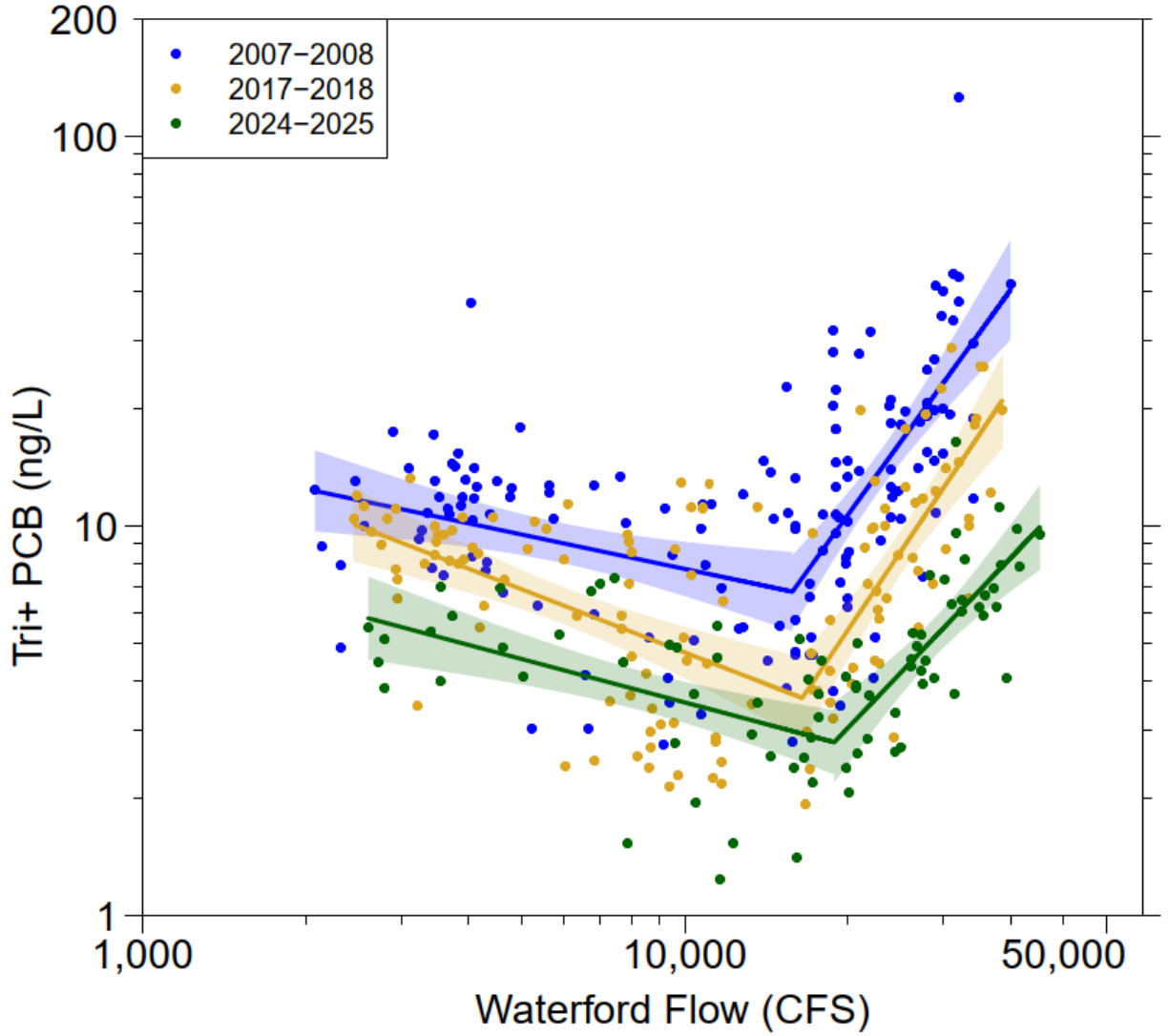


Flow vs. Tri+ PCB - Segmented Regression

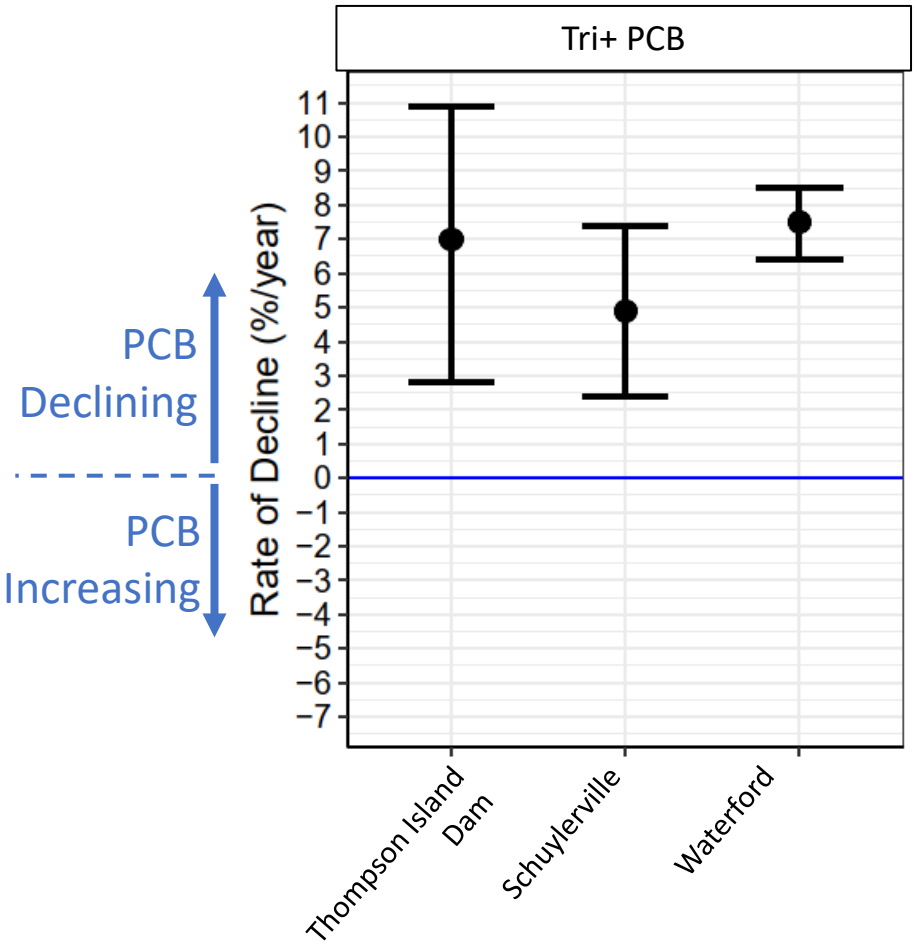
- Concentrations across all flows have decreased in post dredge years
- Water column directly related to sediment concentrations
- Take away - <u>water column decline likely indicating similar sediment decline</u>
  - Sediment data after five years post dredging was inconclusive (next sampling in 2026)

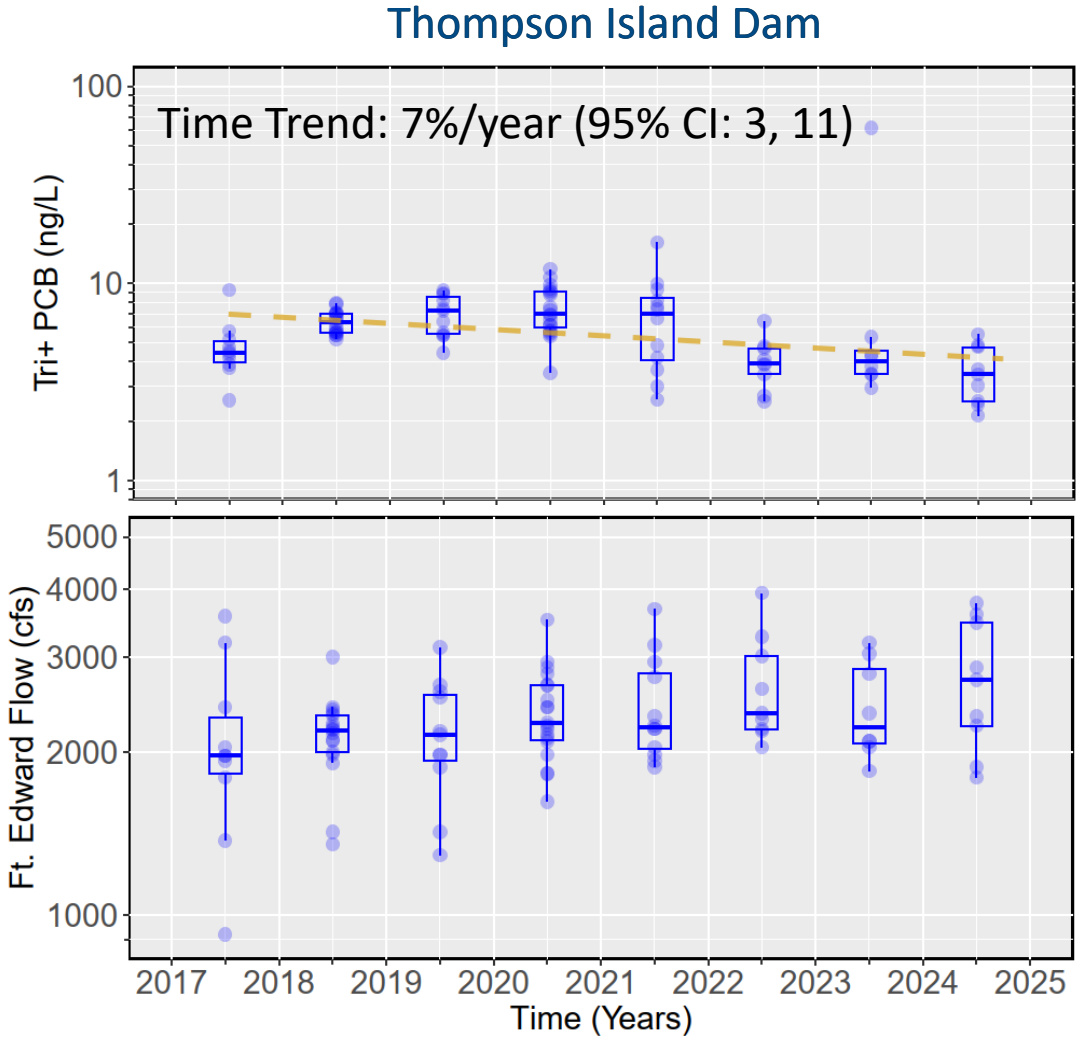
Note: Lines represents best-fit of the segmented regression model between concentration and flow. Shaded area represents the 95% confidence band about the fit.

Waterford Monitoring Station



2017 to 2024 Water PCB Rate of Decline – Summer Low Flow Data





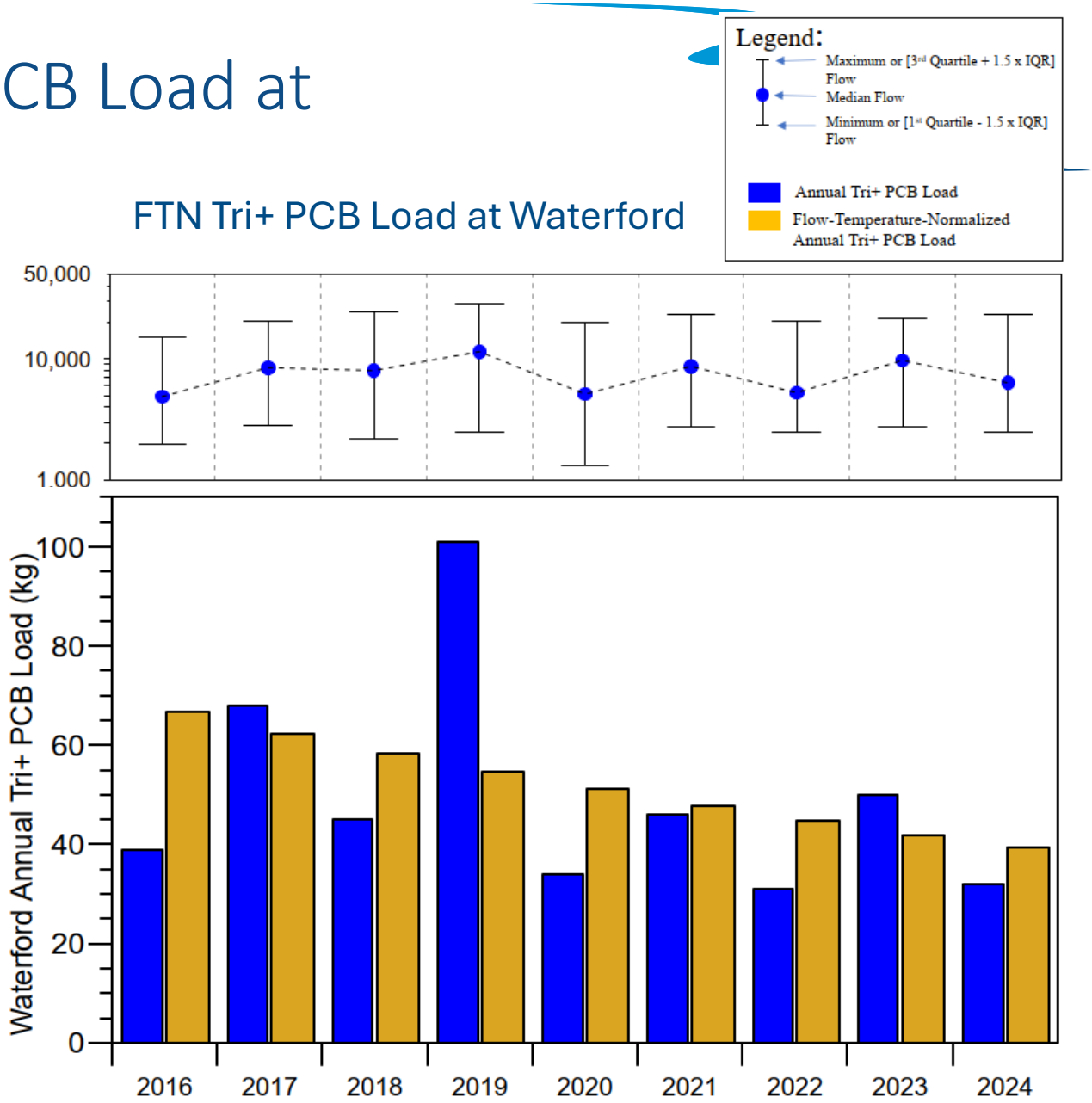
Notes:

- Thompson Island Dam and Schuylerville Low Flow: 4,000 cfs at Ft. Edward, May – Sept., TSS < 10mg/L. Waterford Low Flow: 10,000 cfs at Waterford, May – Sept., TSS < 10mg/L
- The Generalized Additive Model (GAM) use for rate of decline calculations include both flow and seasonality (day of the year) as covariates.
- Flows represent the daily mean flow at Ft. Edward (scaled by 1.03 to reflect increased drainage area at the TID station) on the day the sample was collected.

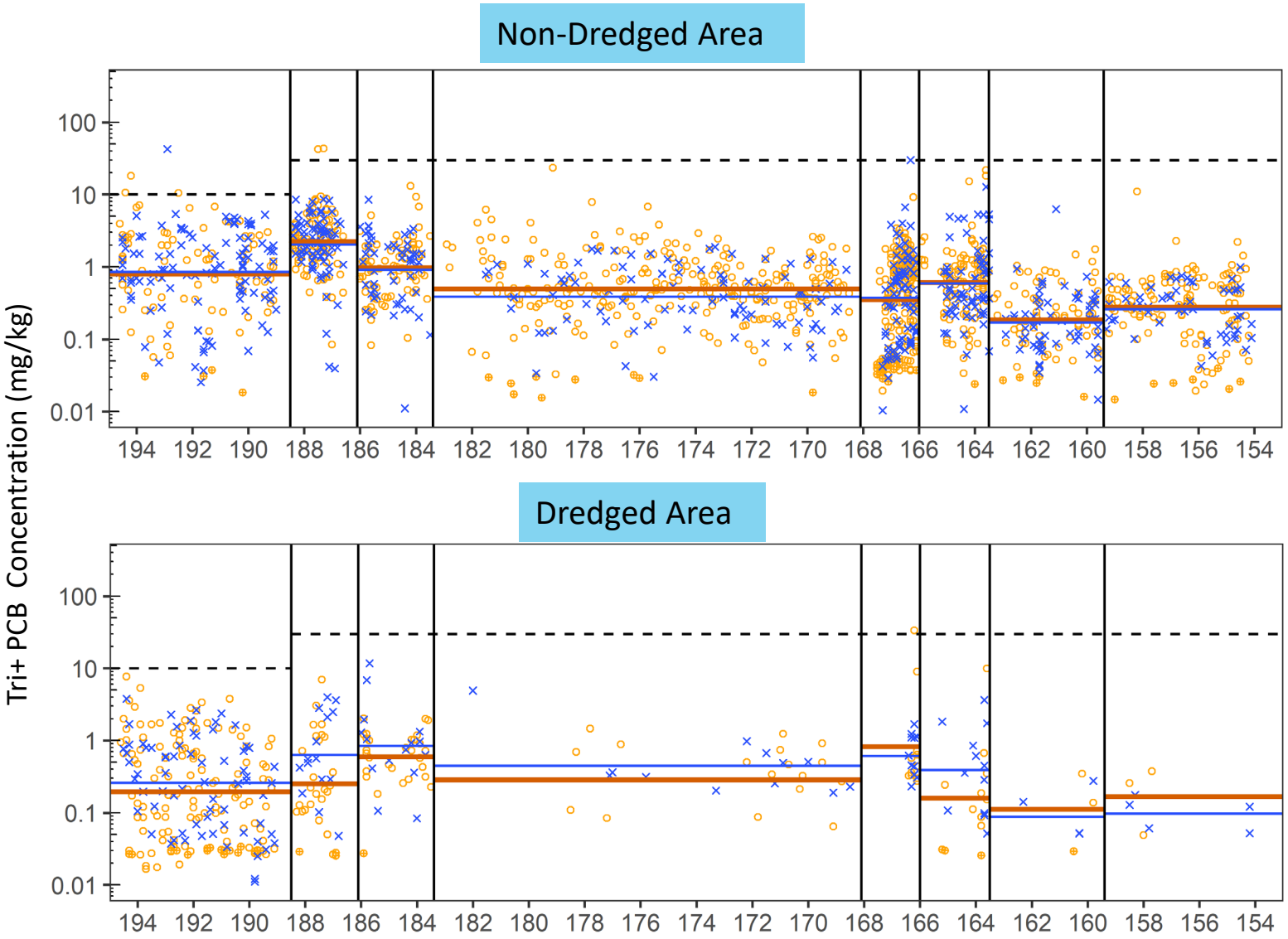
Update on Current Water Column PCB Load at Waterford

- Load at Waterford calculated accounting for flow and seasonality
- Flow temperature normalization load indicates a continued decline in Tri+ PCB load after accounting for flow and seasonality (temperature)

FTN Tri+ PCB Load at Waterford



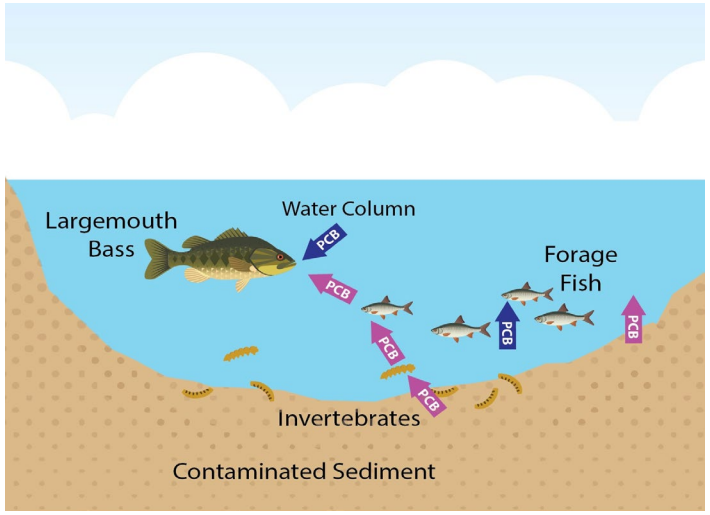
Post-Dredging Sediment Sampling Results

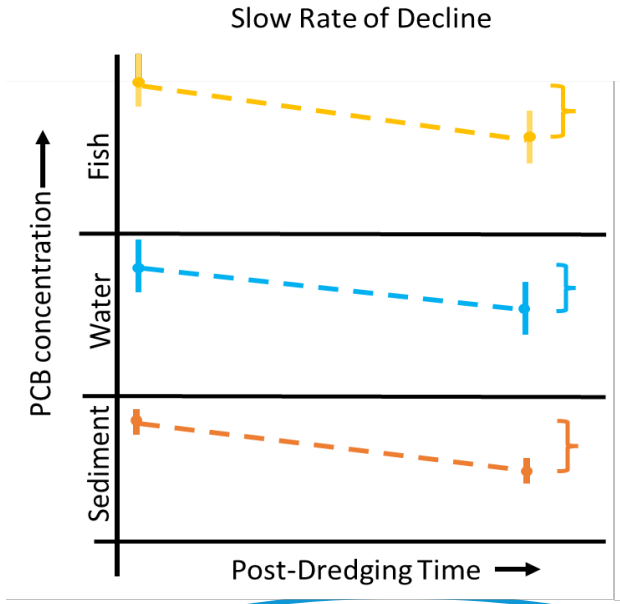


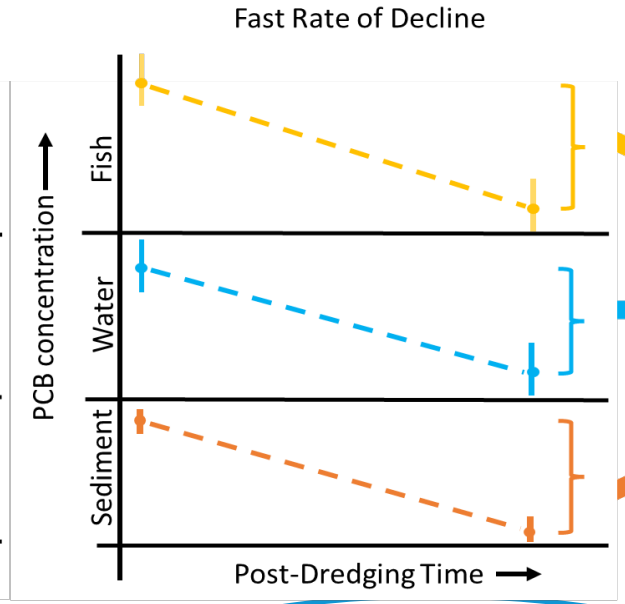
- Next sampling round in 2026 – several hundred samples will be collected following the program design
- Concentrations are highly variable
- No statistical difference in Tri+ PCB in non-dredge areas between 2016/17 and 2021
- Note: very few data points higher than dredge criteria (dashed line)

Sediment Site Principles

- Fish, water and sediment are linked
  - The remedy is based on the relationship between sediment, fish and water
  - All are expected to decline at similar rates
- For fish – the relative reduction in water and sediment determine their recovery







- PCBs concentrations in fish, water and sediment are related via bioaccumulation and fate and transport processes.
- Over the long-term, all media are expected to exhibit a comparable reduction in PCBs.

Next Steps

- Further evaluate moving window analysis
- Evaluate whether trends are statistically reliable
- Look into the uneven fish recovery at specific locations
  - Localized elevated sediment may not be impacting recovery
- Desktop evaluation of offsets and areas where there is potentially elevated sediment
  - EPA and DEC are collaborating on this effort – meeting soon to discuss
  - Areas of potentially elevated sediment would also need to be evaluated in terms of:
    - Is data used to evaluate the area representative of current conditions?
    - Are these areas contributing to potential impacts to water and fish recovery?
  - The evaluation will likely result in additional sediment and pumpkinseed sampling in 2026

Upper Hudson River Update: Special Studies

EPA

Hudson River
PCBs SUPERFUND SITE

Special Studies – Overview

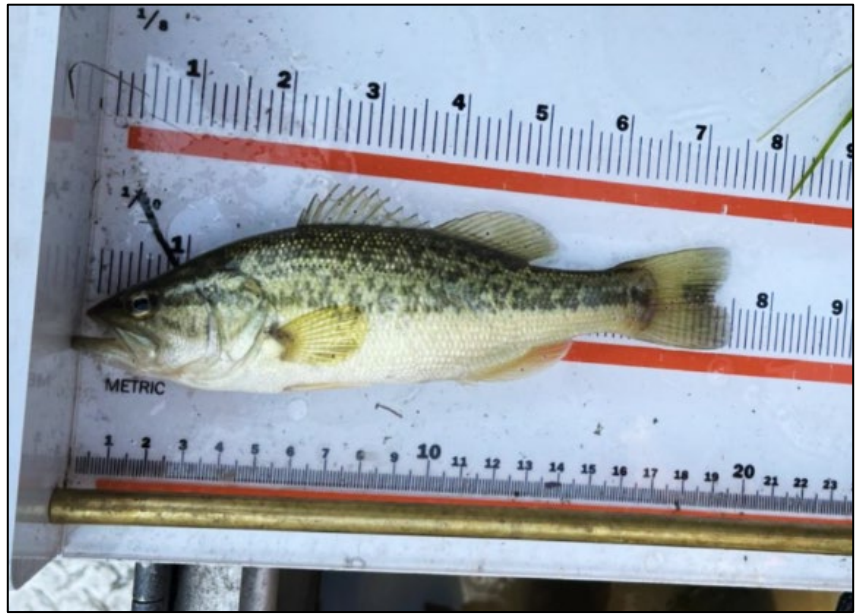
- Needed to further evaluate recovery and inform next steps
- Total of 10 special studies – water, sediment, soil and fish
  - Complete (3)
  - Field work complete – data analysis/evaluation ongoing (6)
  - Field work ongoing (1)

Special Studies

- Water column passive samplers (complete)
  - Understand how PCBs change from area to area
  - Collected in 2023 – over a seven-week period
  - Follow-up water column sampling in 2025
- Dissolved and particulate organic carbon evaluation (complete)
  - Understand how PCBs move in the water column
- Mohawk River PCB contribution (complete – possible future sampling)
  - Collected in 2022 (8 samples)
  - Potential future sampling (if needed)

Special Studies – Current Status

- Whole-body largemouth bass collection (fish collected)
  - Measure progress on reducing ecological risks
  - Smaller (3 to 8 inch) fish collected in spring 2025
  - Laboratory analysis underway
- Impacts of lipids on recovery (evaluation underway)
  - Includes review of literature, fish data, analytical methods, and trend evaluation methods
- Fish aging study (evaluation underway)
  - Understand role of age in how fish PCB concentrations change over time
  - Spines, otoliths (ear bone) and scales collected in 2025
  - Laboratory analysis underway



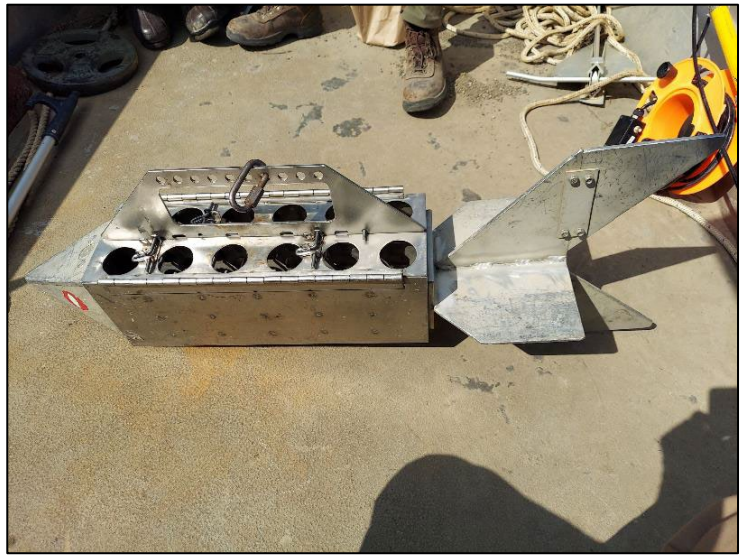
Juvenile Largemouth Bass Sample

Special Studies – Current Status (Cont'd)

- Pumpkinseed exposure evaluation (underway)
  - Sampling of nearshore sediment (2025)
  - Field sampling completed
  - Laboratory analysis ongoing
- Shoreline erosion study (underway)
  - Field sampling completed (2025)
  - Laboratory analysis ongoing

Special Studies – Current Status (Cont'd)

- Water loading evaluation (underway)
  - Field sampling and laboratory analysis completed
  - Data evaluation ongoing
- Rogers Island high flow (spring 2026)
  - To understand the amount of PCBs entering the project area under high flows



Water sampling apparatus

Upper Hudson River Next Steps

- Complete remaining special studies sampling and laboratory analysis in 2026
  - Follow up data collection as needed in 2026
- Water, fish and sediment sampling in 2026
- Cap isolation layer material sampling
  - Pilot study in 2026 to evaluate most appropriate sampling methods