Hudson River PCBs Superfund Site Data Discussion

(follow up to May 14 CAG meeting)

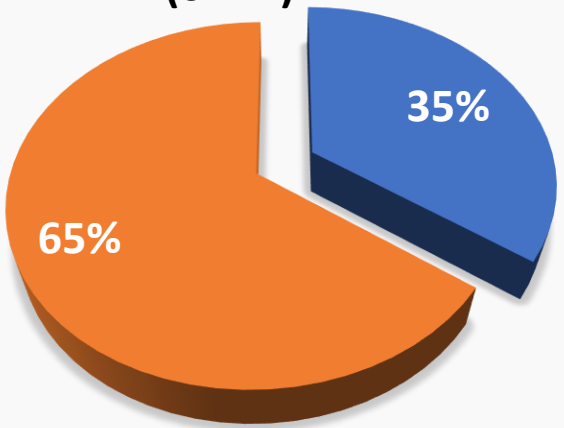
Community Advisory Group Meeting
Tuesday, June 25, 2019
Gideon Putnam Hotel

Presentation Outline

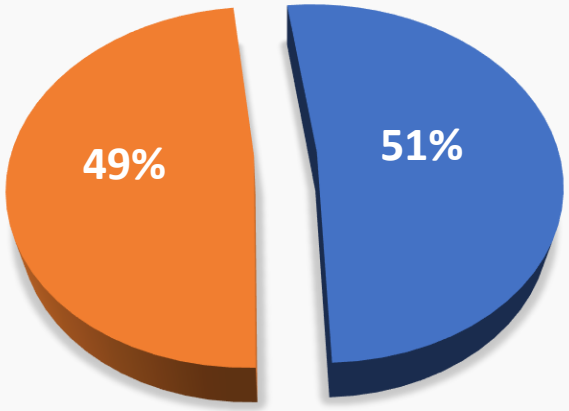
- Why does EPA focus on Tri+ PCB Concentrations?
- Water Column Results
- Fish Results
  - (including fall and spring fish – GE and DEC data)
  - Fish data available up to fall 2017
  - Spring and fall 2018 fish in process now
  - Spring 2019 fish collection underway
- Sediment Results
  - (follow up summary from last CAG meeting)
- Conclusions and Next Steps

Sediment

2017 NYSDEC Sediment (0-2in)



2002-2005 SSAP Sediment

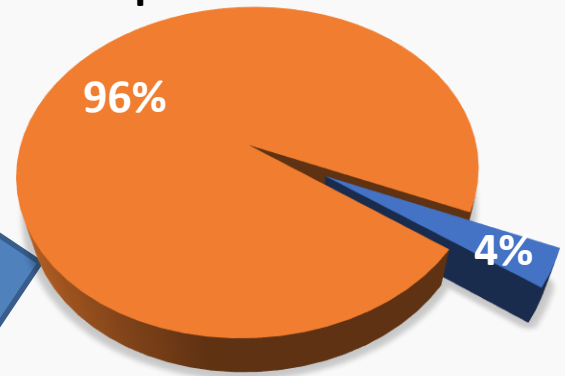


Why is the ROD based on Tri+ PCBs?

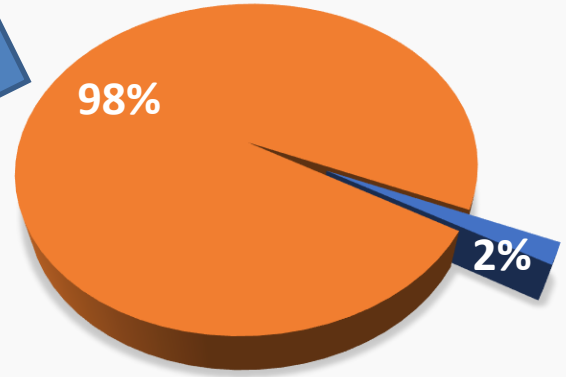
Tri+ PCBs represent 96+% of PCB mass in fish

Fish

2017 NYSDEC Pumpkinseed - Fall



1993 NYSDEC and NOAA Fish



Mono and Di PCB

Tri+ PCB

Hudson River PCBs SUPERFUND SITE

WSP Louis Berger

Hudson River PCB Monitoring Timeline:

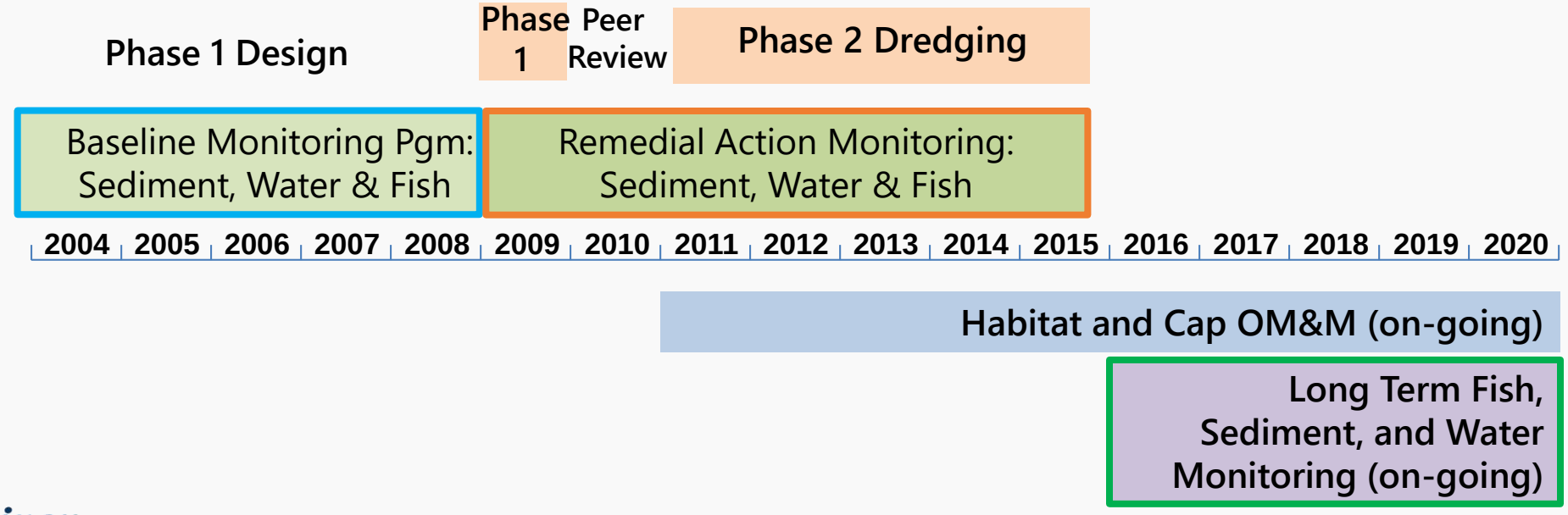
- **Historical Monitoring**

  Sediment: Sampling Events: 1976-1977, 1984, 1991, 1992, 1994, & 1998

  Water: Annual Collection from1976-2002, multiple stations

  Fish: Spring and Fall Events, 1976-2004

- **Design, Dredging and OM&M**

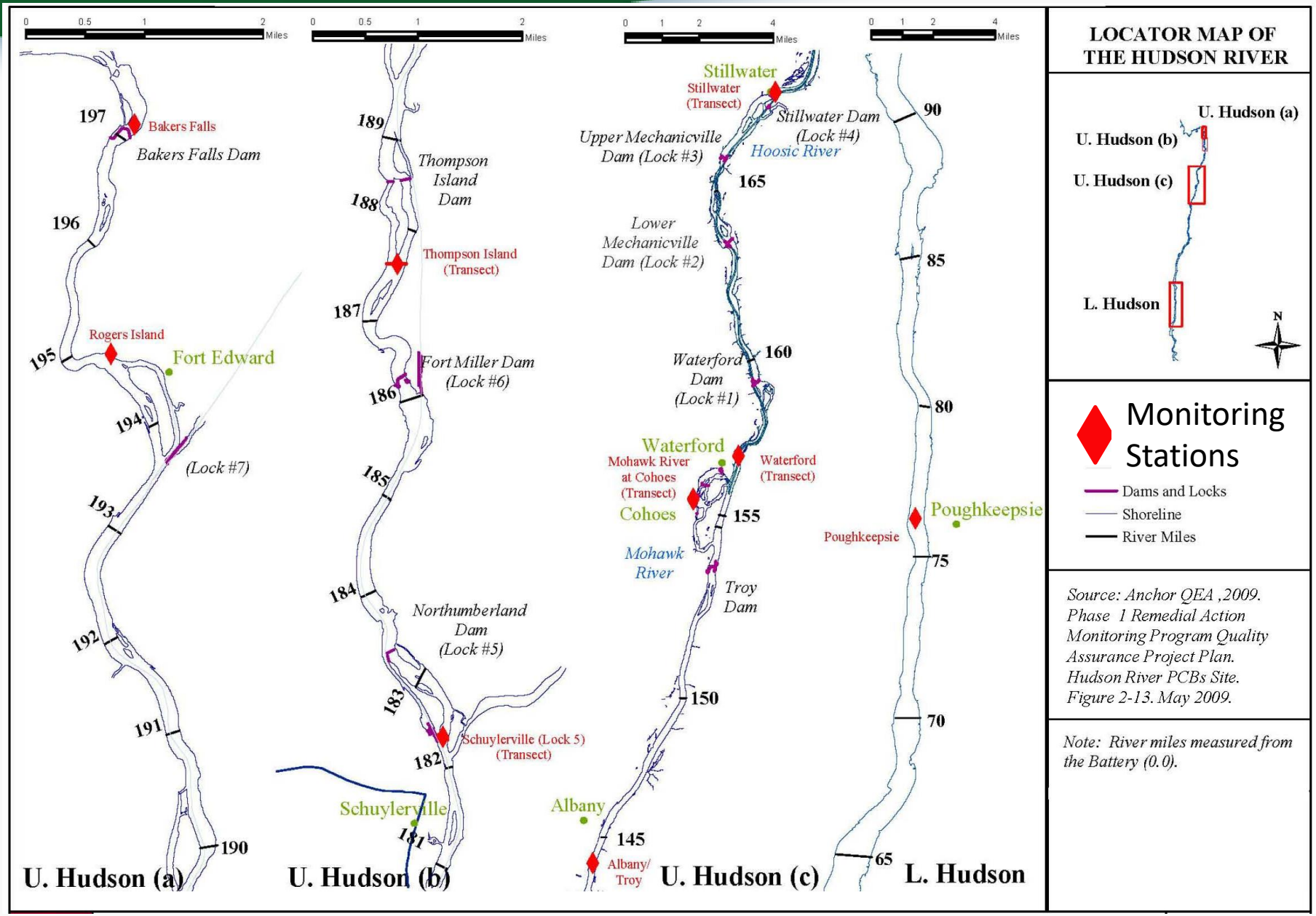


Hudson River PCBs SUPERFUND SITE

WSP Louis Berger

Water Column Results

Water Column Monitoring Stations



Source: Anchor QEA ,2009. Phase 1 Remedial Action Monitoring Program Quality Assurance Project Plan. Hudson River PCBs Site. Figure 2-13. May 2009.

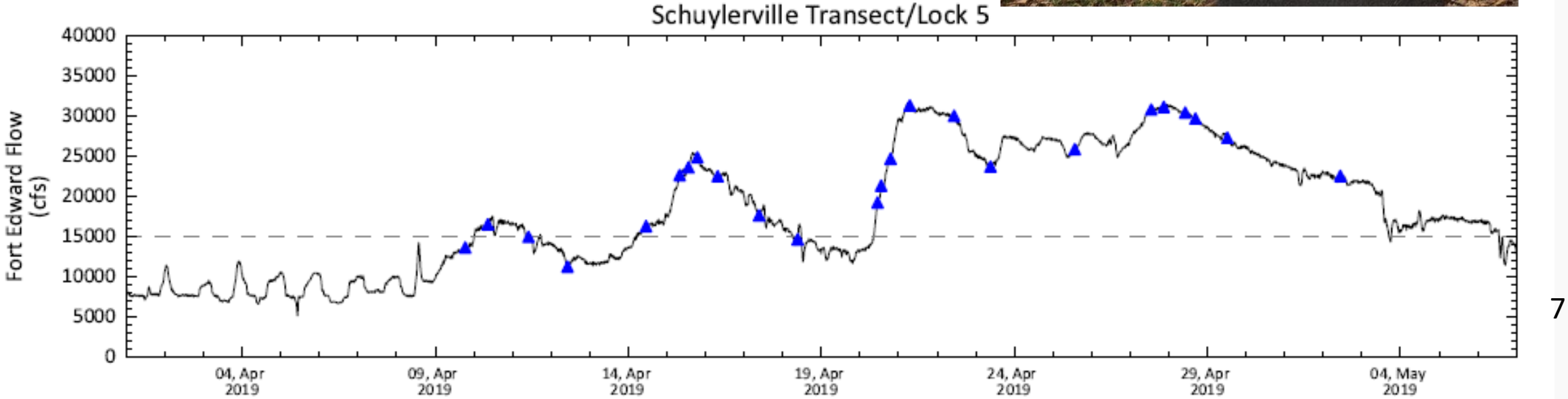
Note: River miles measured from the Battery (0.0).

Hudson River PCBs SUPERFUND SITE

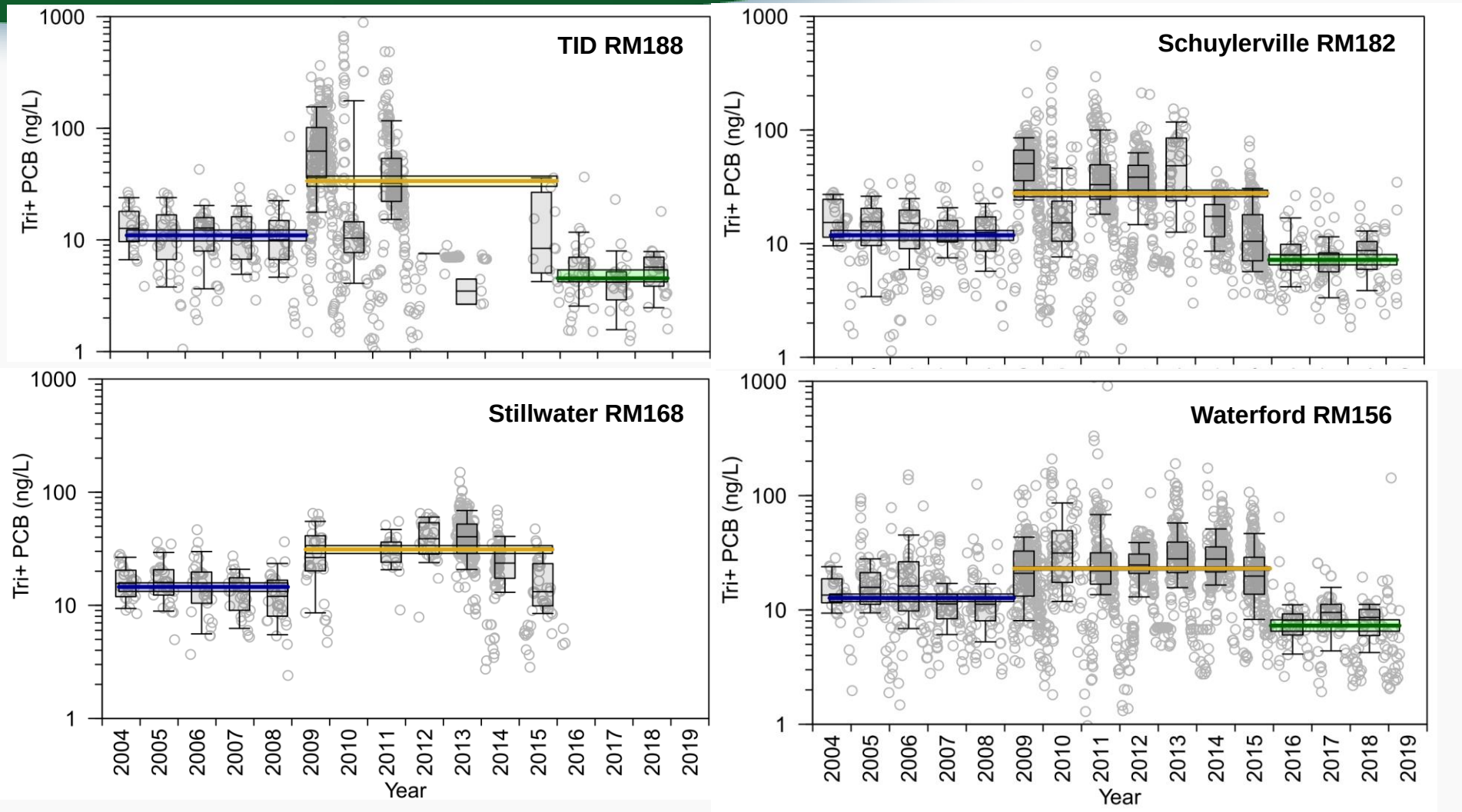
Louis Berger

High Flow Monitoring

- Samples collected when River has high flows (15,000 cubic feet per second at Fort Edward or 22,500 at Waterford)
- Samples collected at Waterford and Schuylerville
- Samples collected to capture the rising limb to the high flow event and falling limb
- 2019 events: January, April – May (see below)
- High flow sampling will be included in OM&M work plan
  - Details to be worked out include additional locations and frequency



Water Column Concentrations have Declined between 30 and 60%



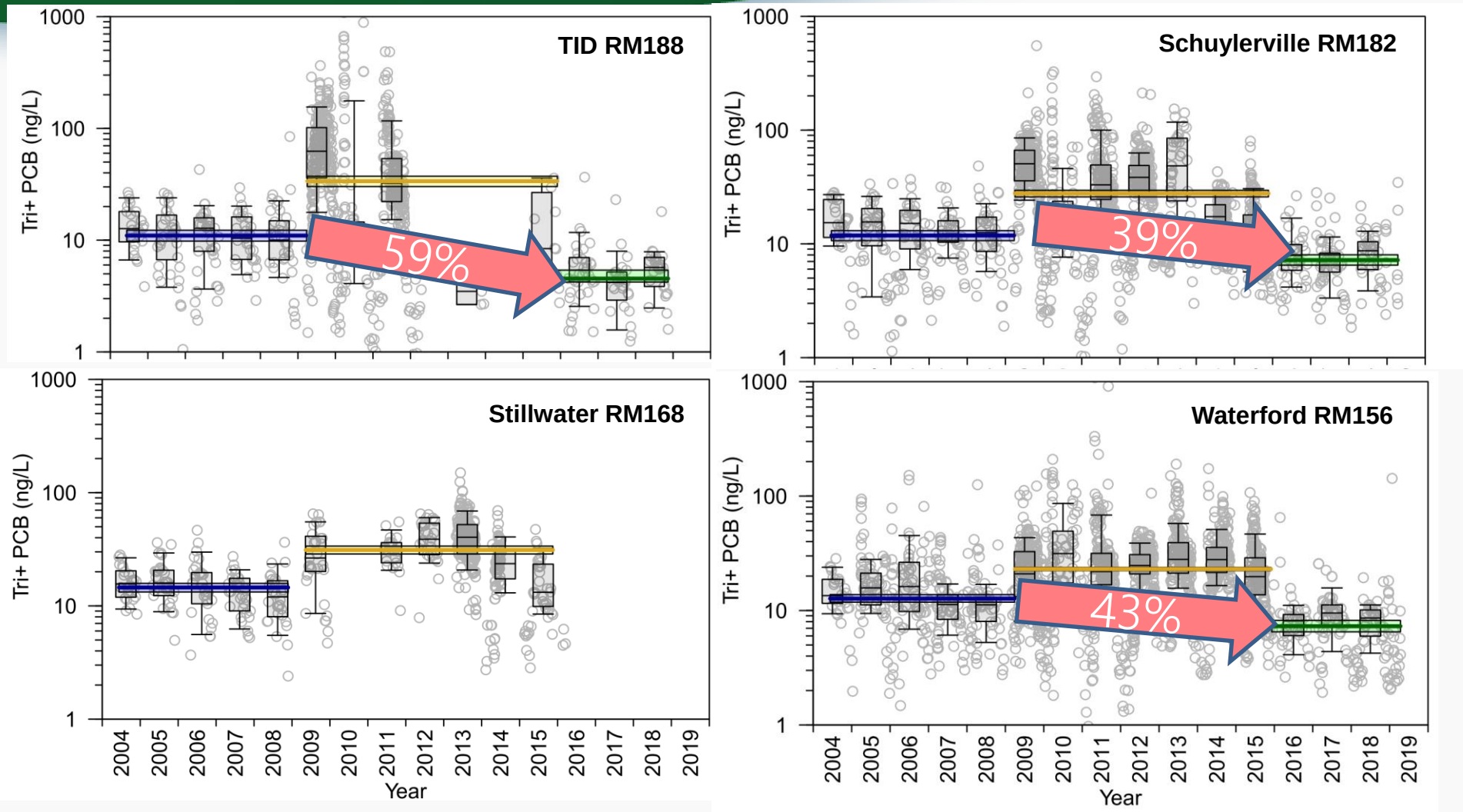
Water Column PCB Concentrations

Baseline (2004-2008)
Dredging (2009-2015)
Post-Dredging Period (2016-2017)

Hudson River PCBs SUPERFUND SITE

WSP Louis Berger

Water Column Concentrations have Declined between 30 and 60%



Water Column PCB Concentrations

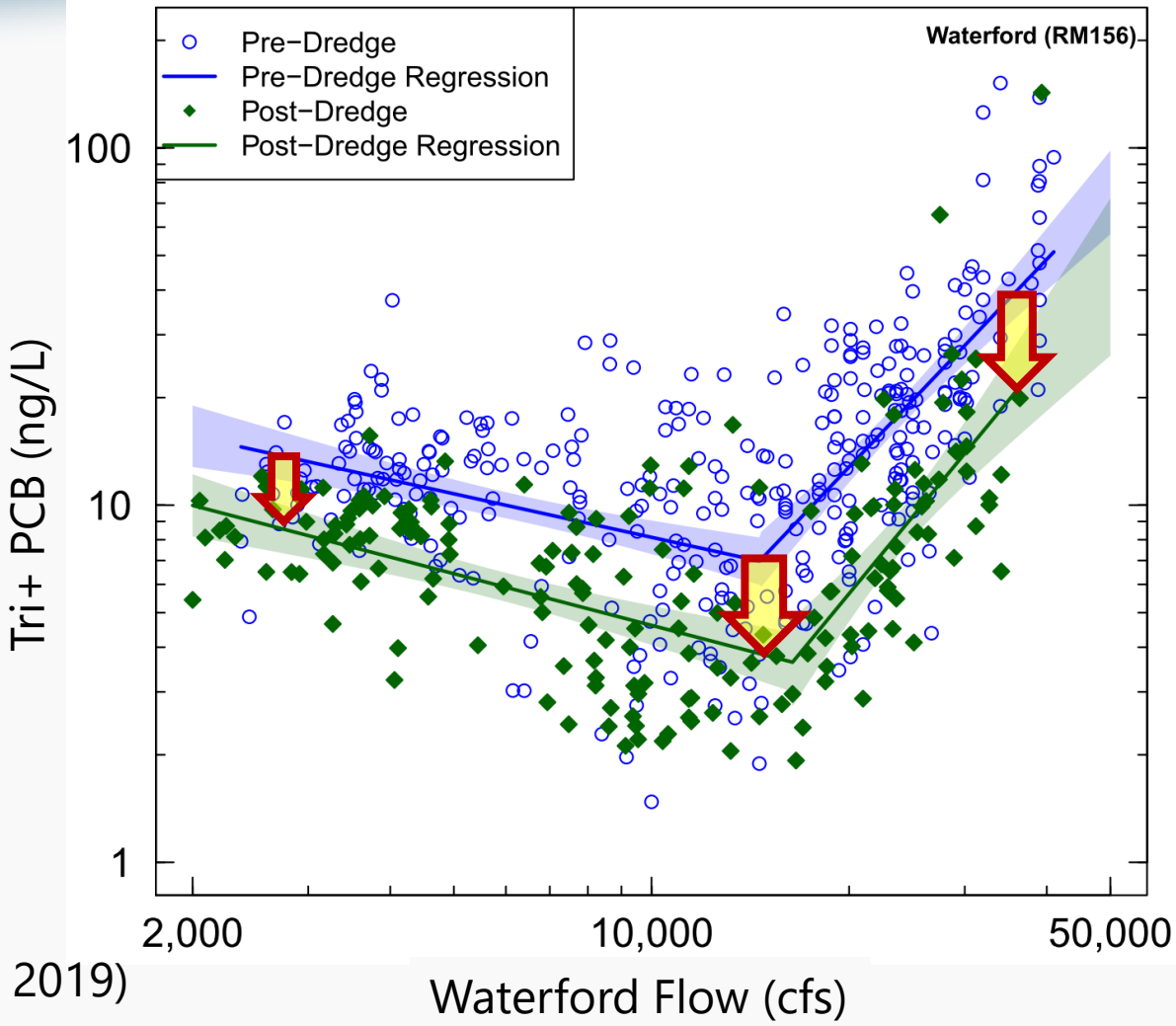
Baseline (2004-2008)
Dredging (2009-2015)
Post-Dredging Period (2016-2017)

Hudson River PCBs SUPERFUND SITE

WSP Louis Berger

Decline in Water Column PCB Loads to Lower Hudson

- Post-dredging PCB concentrations at Waterford have declined across all flow conditions.
- Within 3 years of completion of dredging, PCB loads to the Lower Hudson have decreased between 35 and 58% relative to baseline.



Shaded regions represent 95%CI band on regression line.

Baseline (2004-2008)
Post-Dredging Period (2016-Feb 2019)

Post-dredging PCB concentrations at Waterford have declined across all flow conditions

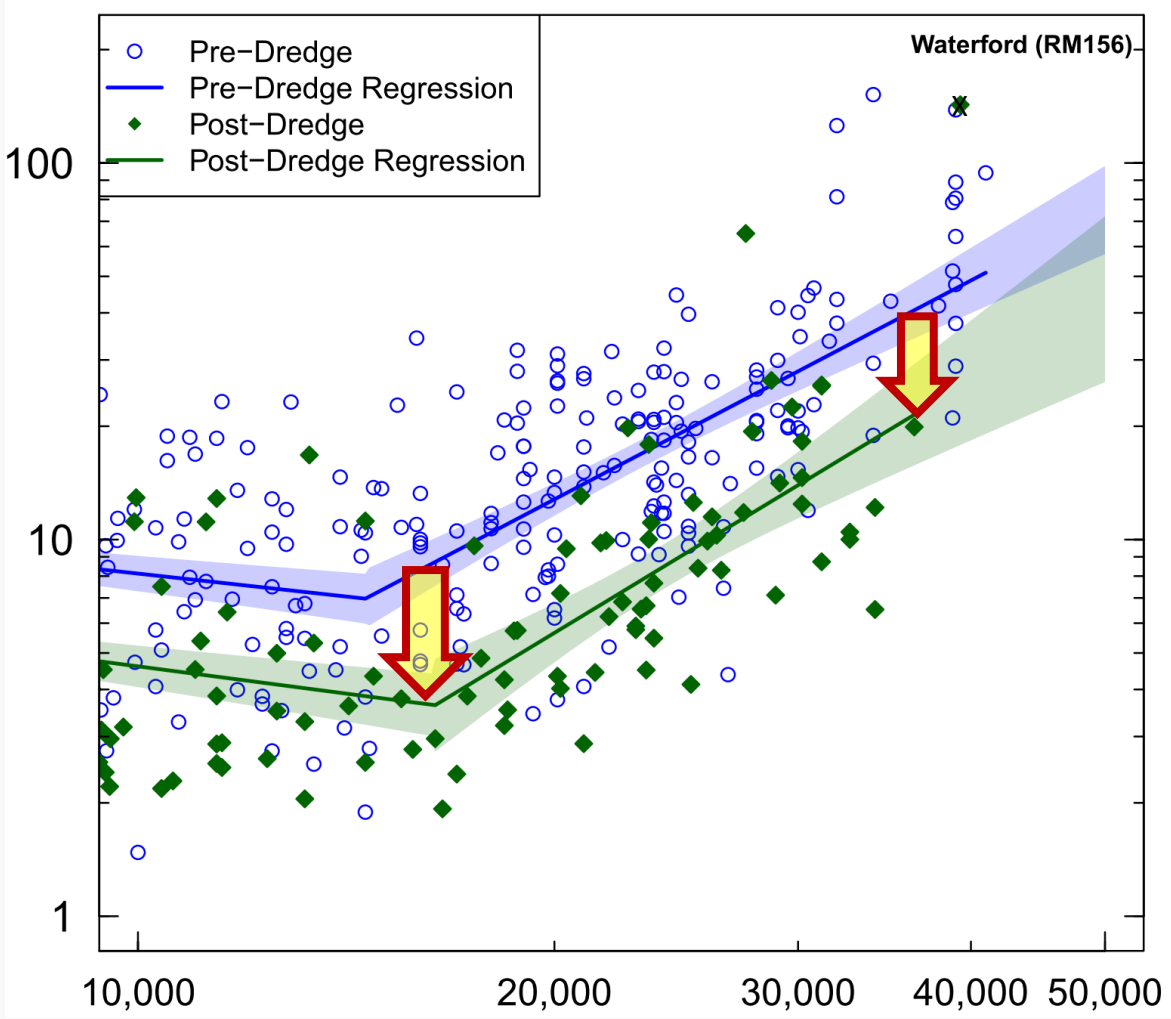
Hudson River PCBs SUPERFUND SITE

WSP Louis Berger

Water Column Concentrations and Loads have Declined Even at the Highest Flow Rates

Conditions for 10,000 to 45,000 cfs

- Concentrations are down between 47 and 58% across these flow conditions.
- This represents similarly reduced loads to Lower Hudson.

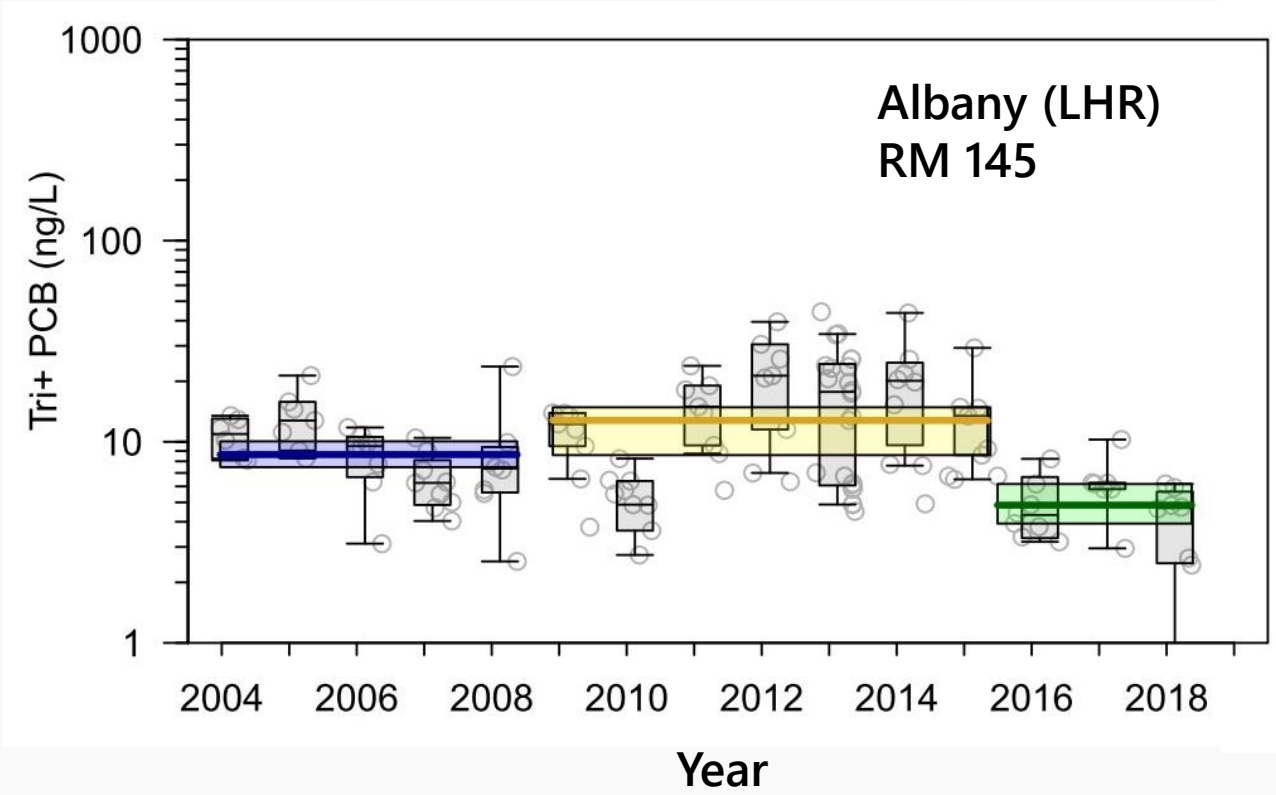


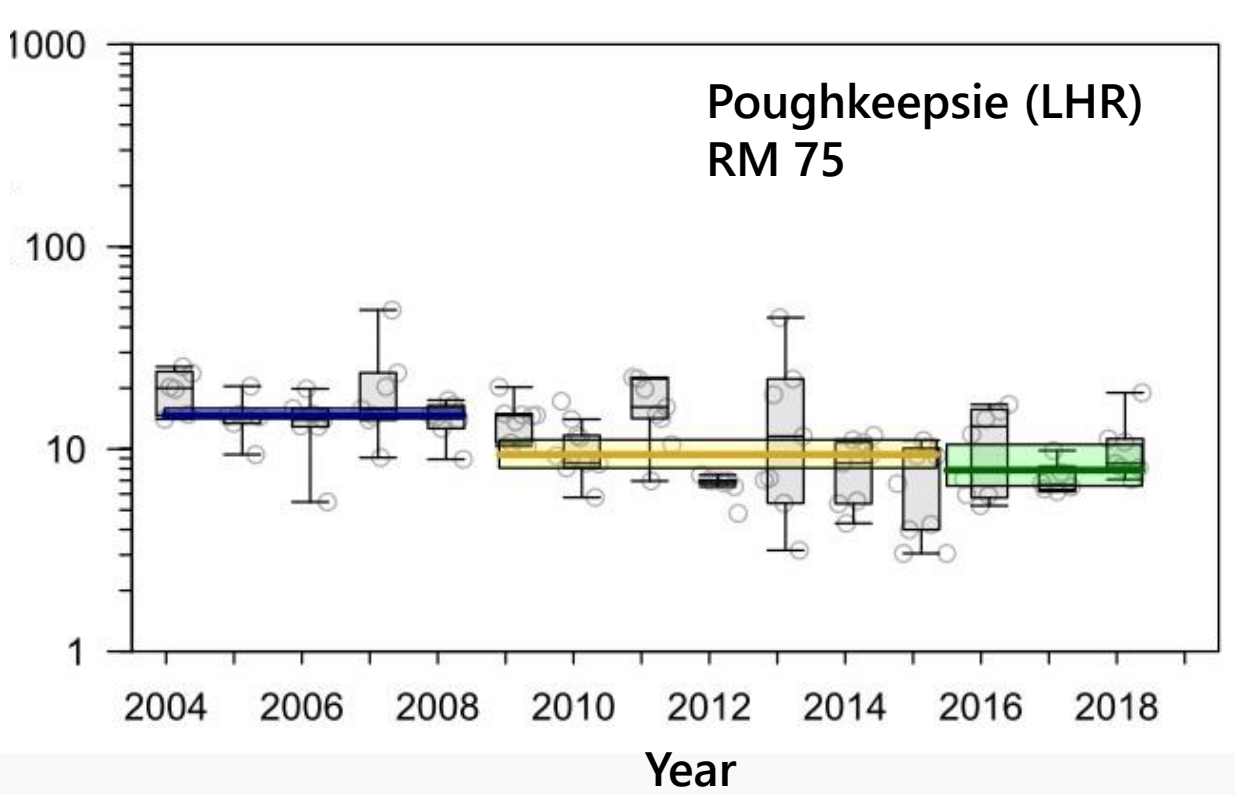
Baseline (2004-2008)
Post-Dredging Period (2016-Feb 2019)

Hudson River PCBs SUPERFUND SITE

WSP Louis Berger

Dredging-Related Water Column PCB Loads not Evident at Poughkeepsie

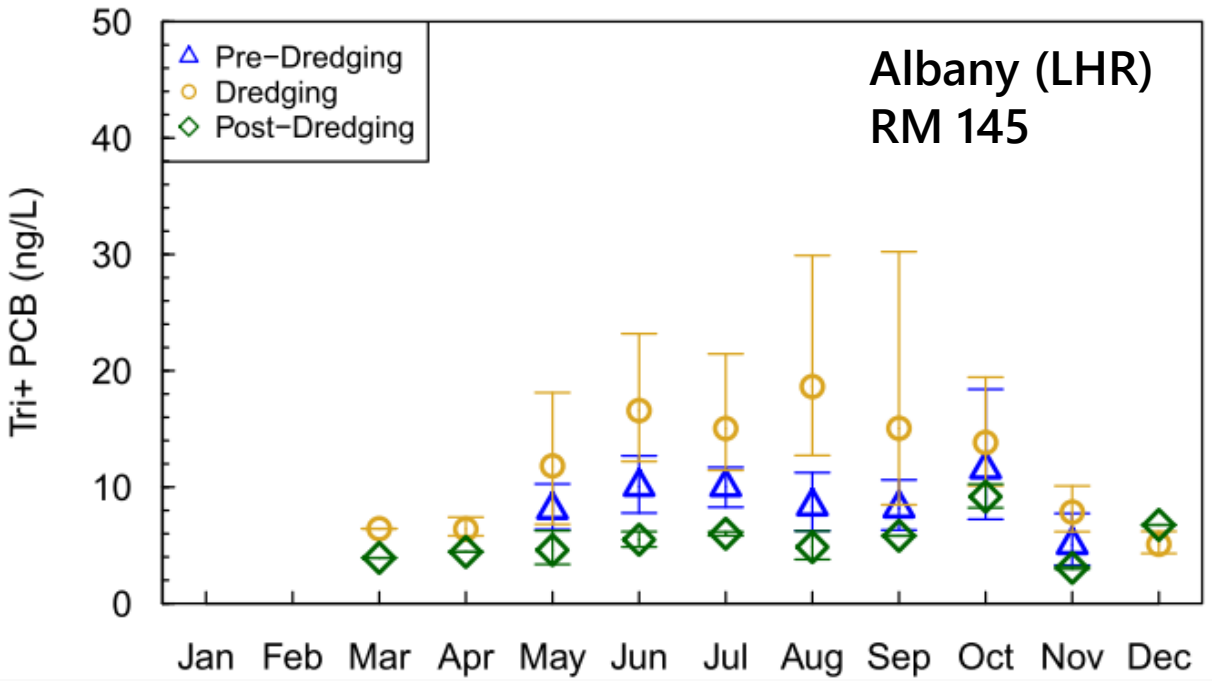


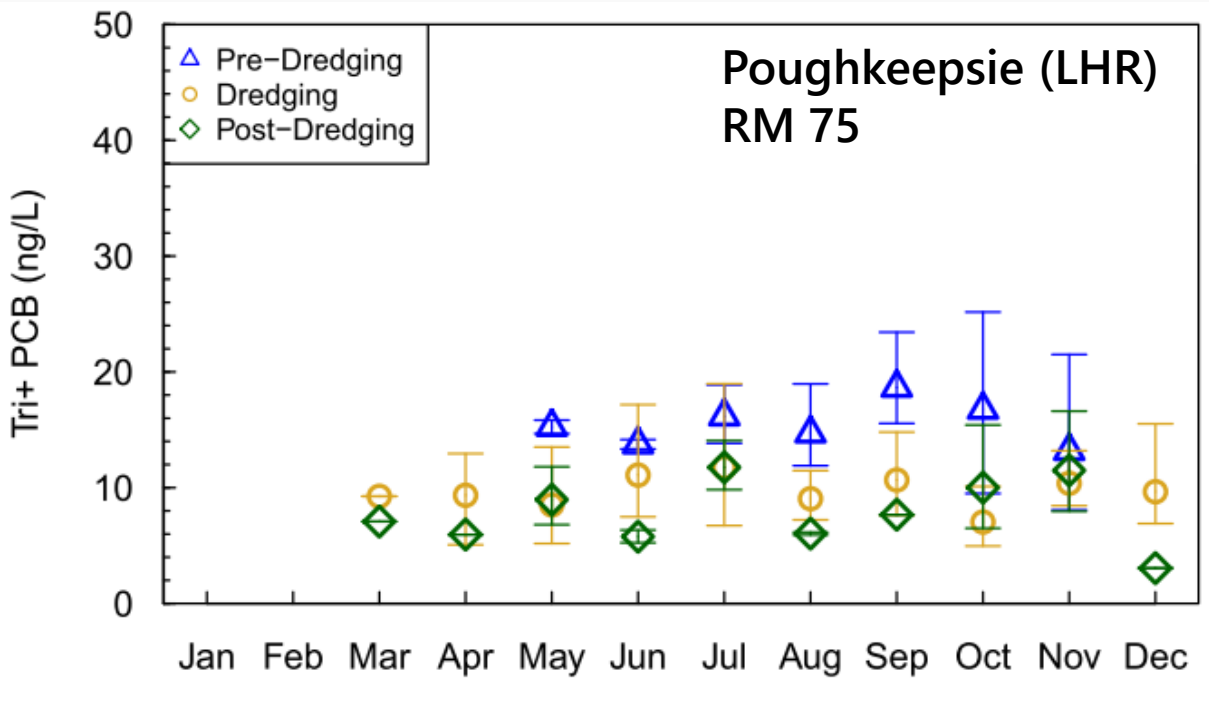


PCB concentrations at Albany increased as anticipated

PCB concentrations at Poughkeepsie did not respond to dredging-related loads to Lower Hudson

Dredging-Related Water Column PCB Loads not Evident at Poughkeepsie





PCB concentrations at Poughkeepsie did not respond even when viewed monthly

Hudson River PCBs SUPERFUND SITE

WSP Louis Berger

Fish Results

Upper Hudson River Fish Collection

Spring Collection (Fillet):

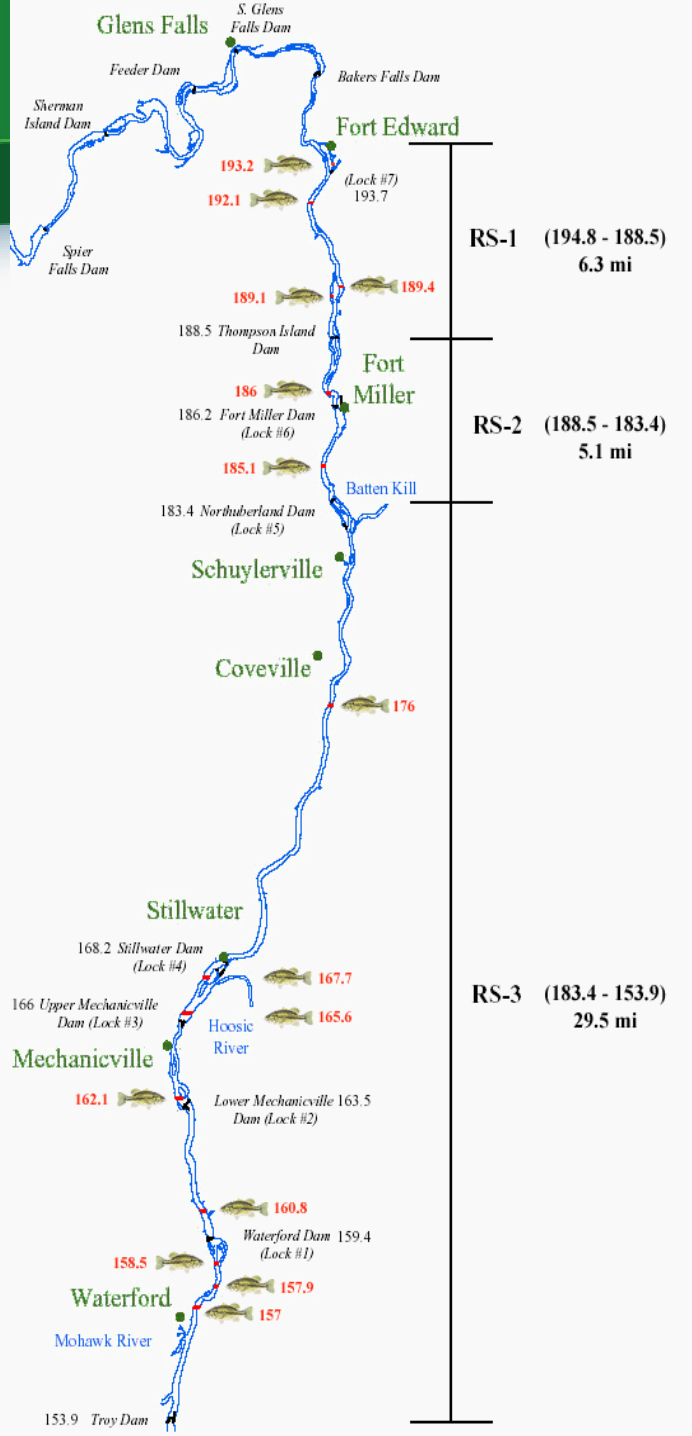
Largemouth Bass
(*Micropterus salmoides*)

Smallmouth Bass
(*Micropterus dolomieui*)

Brown Bullhead
(*Ictalurus nebulosus*)

Yellow Perch
(*Perca flavescens*)

- 420 individuals from the 4 species groups collected annually
- Additional 150 individuals are now being collected from Reaches 1 through 4 (same species groups)
- Sport fish species represent multiple food web niches and levels, reflect longer-term body burdens



Fall Collected (Whole Body):

Pumpkinseed
(*Lepomis gibbosus*)

Spottail Shiner
(*Notropis hudsonius*)

- 125 individual pumpkinseed and 50 composite forage species samples collected annually
- NYSDEC collected forage fish in 2017 and GE/EPA will also collect these data in fall 2019
- Young of Year "Rapid integrator" fish, more likely to reflect recent changes in water column PCB concentrations

Hudson River PCBs SUPERFUND SITE

Lower Hudson River Fish Collection

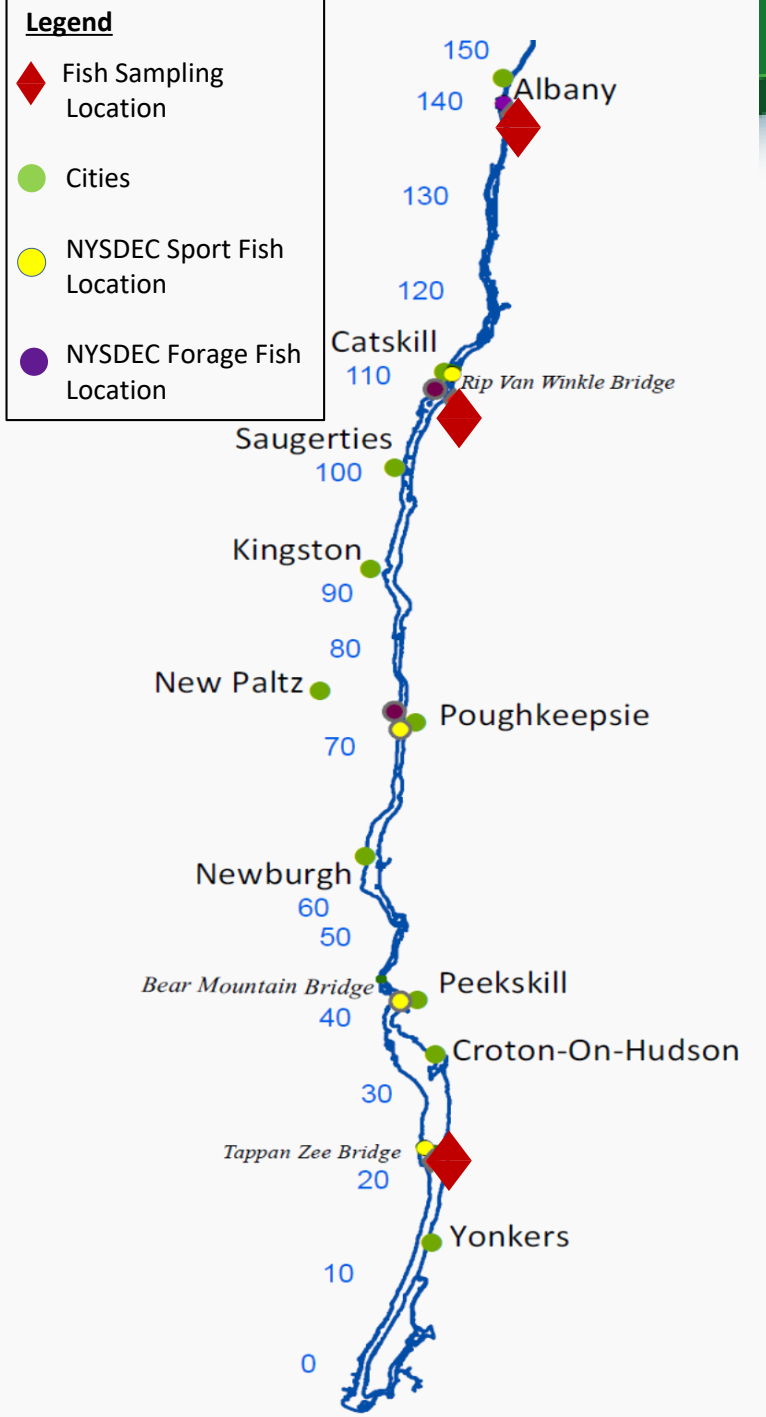
Spring Collection (Fillet):

Striped Bass (*Morone saxatilis*)

White Perch (*Morone americana*)

Smallmouth Bass (*Micropterus dolomieui*)

White Catfish (*Ictalurus catus*)



Fall Collected (Whole Body):

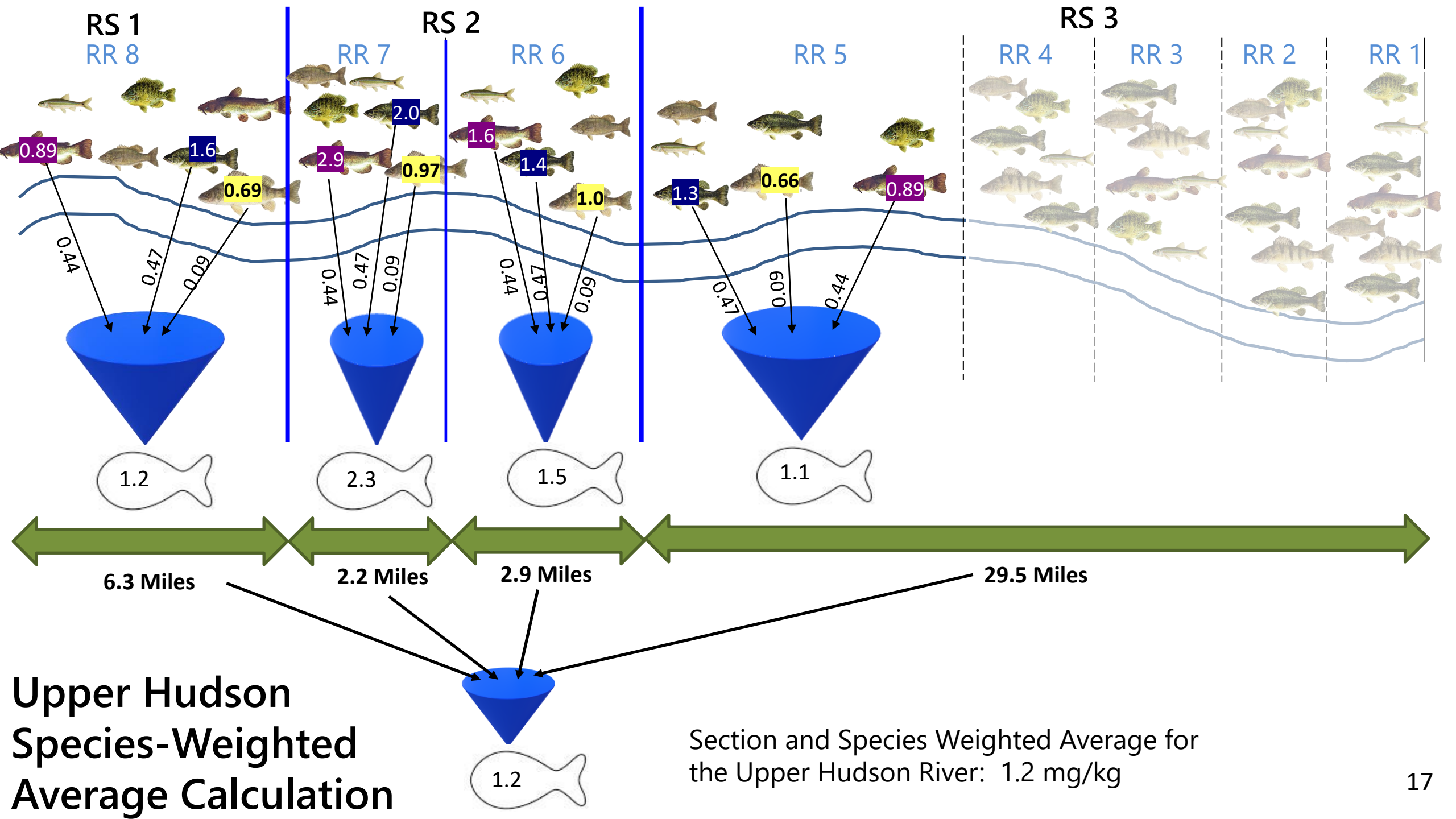
Pumpkinseed (*Lepomis gibbosus*)

Spottail Shiner (*Notropis hudsonius*)

- 180 individuals from the 4 species groups collected annually
- Supplemental fish collection effort to be implemented in 2020
- Sport fish species represent multiple food web niches and levels, reflect longer-term body burdens

- 20 individual pumpkinseed and 10 composite forage species samples collected annually from Albany/Troy station
- Additional forage fish collection at Catskill and Poughkeepsie being considered by EPA
- Young of Year "Rapid integrator" fish, more likely to reflect recent changes in water column PCB concentrations

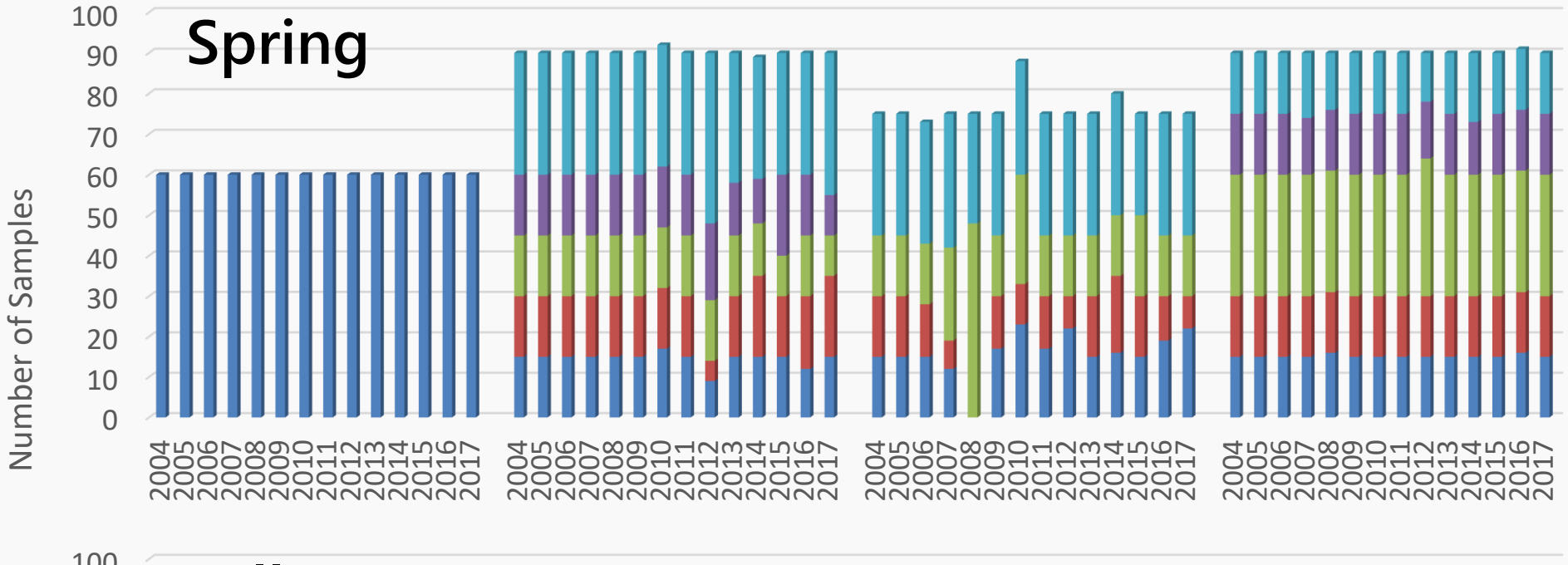
Hudson River PCBs SUPERFUND SITE

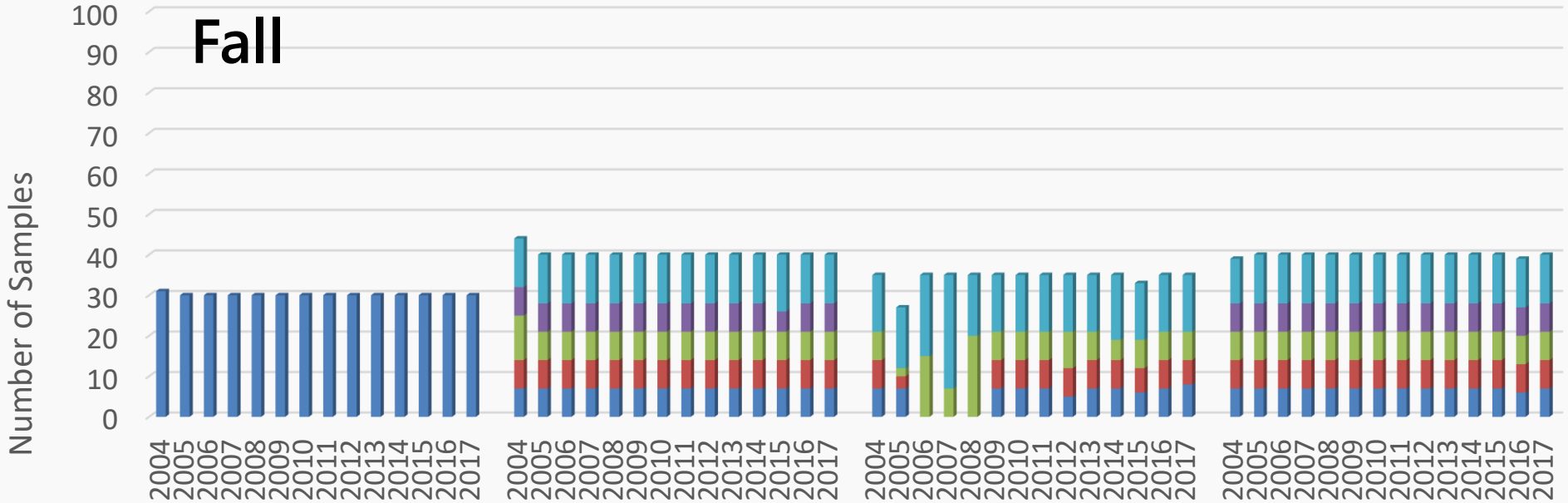


Upper Hudson Species-Weighted Average Calculation

Section and Species Weighted Average for the Upper Hudson River: 1.2 mg/kg

Upper Hudson Fish Data 2004-2017





Station
- 5
- 4
- 3
- 2
- 1

Reference Area (RM 205.5-201)

Thompson Isl. Dam (RM 194.2-189)

Northumberland Dam (RM 187.5-183.6)

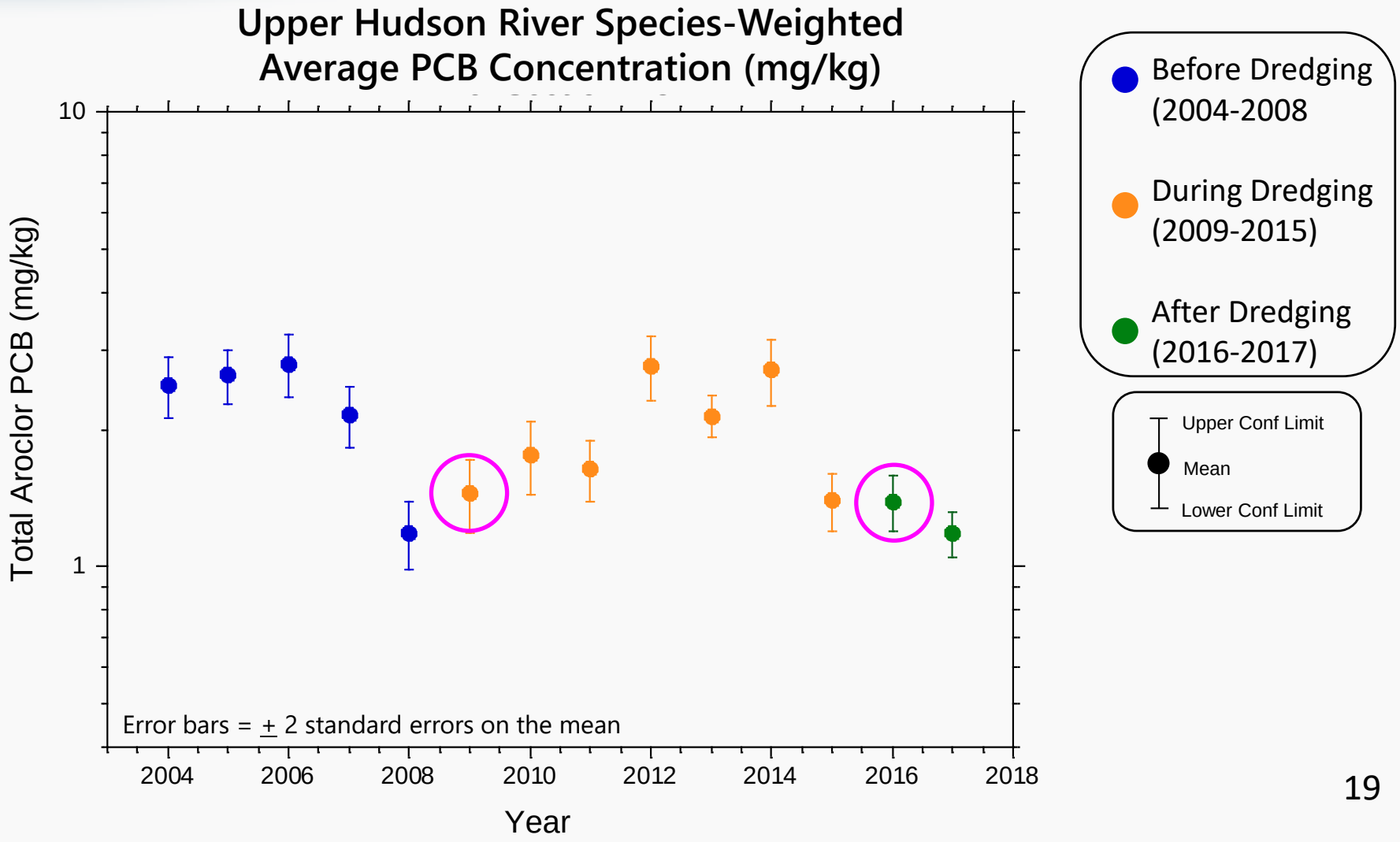
Stillwater Dam (RM 182-168)

Hudson PCBs SUPERFU

Louis Berger

Trend in the Species-Weighted Average over Time

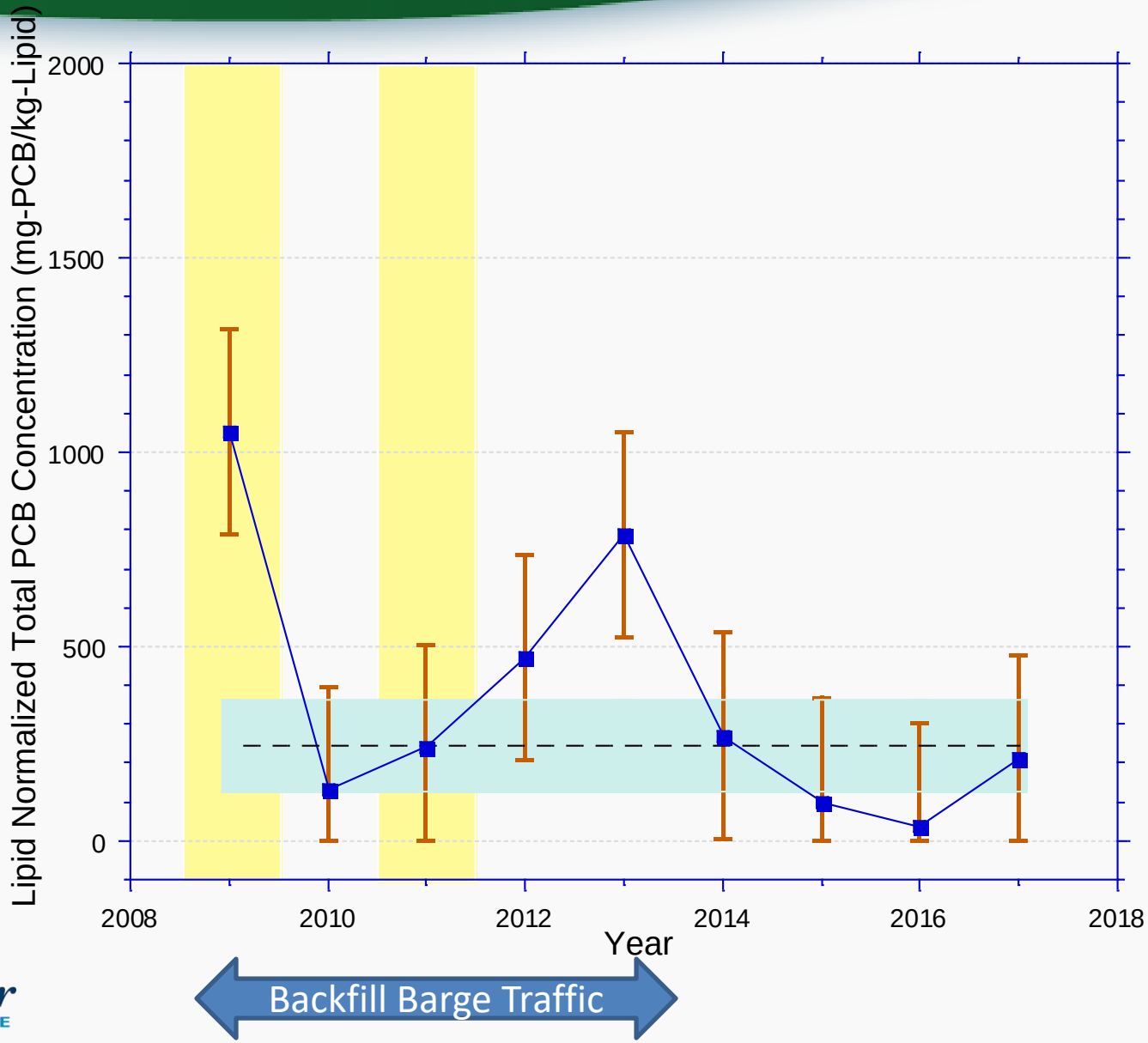
- Weighting Factors by reach or section
  - Large mouth bass = 47%
  - Brown bullhead = 44%
  - Yellow perch = 9%
- Upper Hudson River average factors
  - Reach 8= 15.4% (6.3 miles)
  - Reach 7 = 5.4% (2.2 miles)
  - Reach 6 = 7.1% (2.9 miles)
  - Reach 5 = 72.1% (29.5 miles)
- No current data for reaches 1 to 4
- All samples are spring fish



Hudson River PCBs SUPERFUND SITE

WSP Louis Berger

No Fish Station to Date has More Than 6 Years of Post-Dredging Data



Station mean with 95% Confidence Interval

Dredging Year

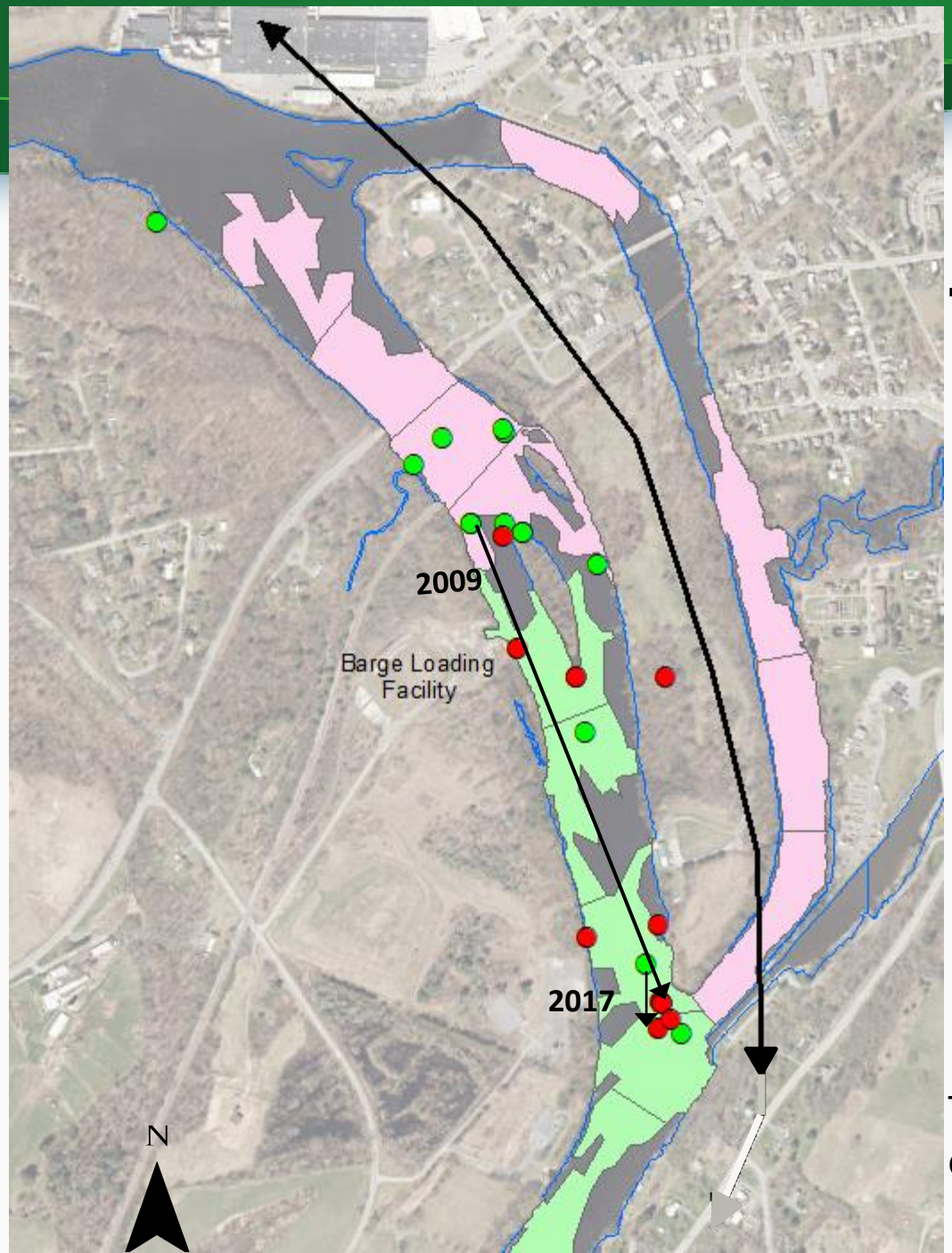
Mean station pre-dredge baseline (2004-2008) with 95% CI

Pumpkinseed at Sampling Station TD1 - Lipid Normalized

Hudson River PCBs SUPERFUND SITE

WSP Louis Berger

Fall Sampling Station - TD1 (pumpkinseed)



- Fish Transect Start Location
- Fish Transect End Location

Year of Dredging

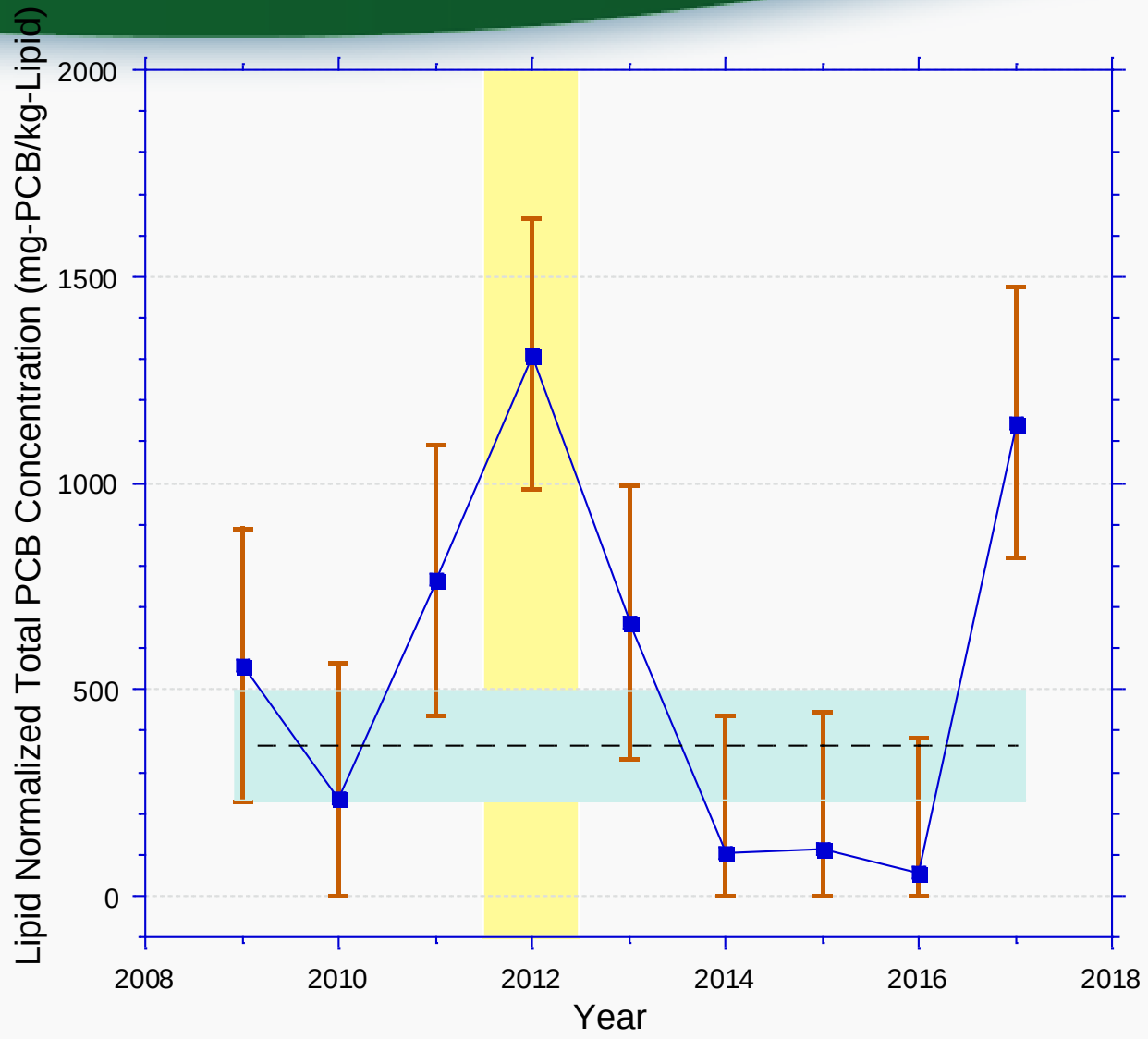
- 2009
- 2011
- 2012
- 2013
- 2015

TD-1 subject to extensive boat traffic due to barge operations until at least 2013

Hudson River PCBs SUPERFUND SITE

WSP Louis Berger

No Fish Station to Date has More Than 6 Years of Post-Dredging Data



Station mean with 95% Confidence Interval

Dredging Year

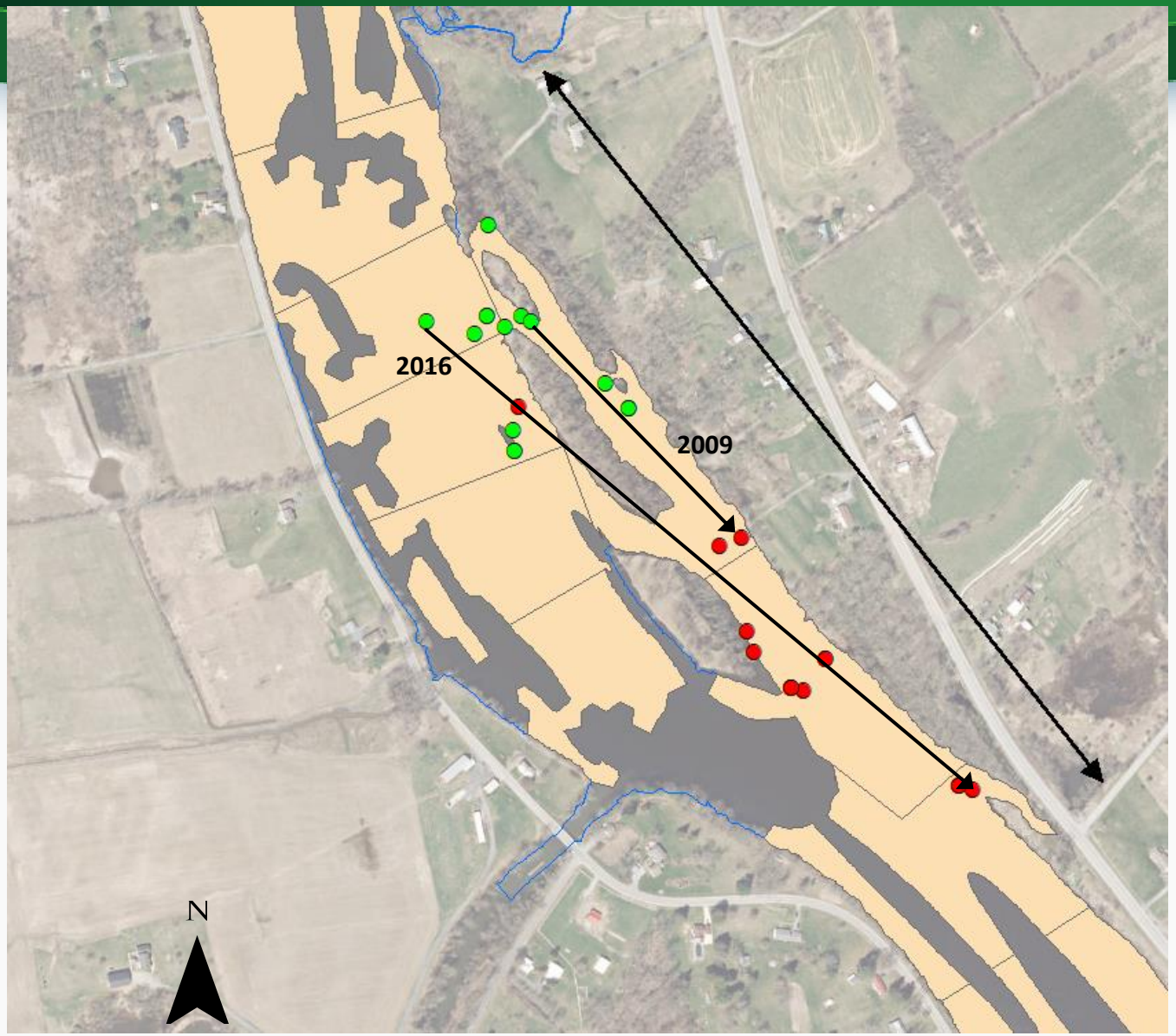
Mean station pre-dredge baseline (2004-2008) with 95% CI

Pumpkinseed at Sampling Station TD3 - Lipid Normalized

Hudson River PCBs SUPERFUND SITE

WSP Louis Berger

Fall Sampling Station - TD3 (pumpkinseed)



- Fish Transect Start Location
- Fish Transect End Location

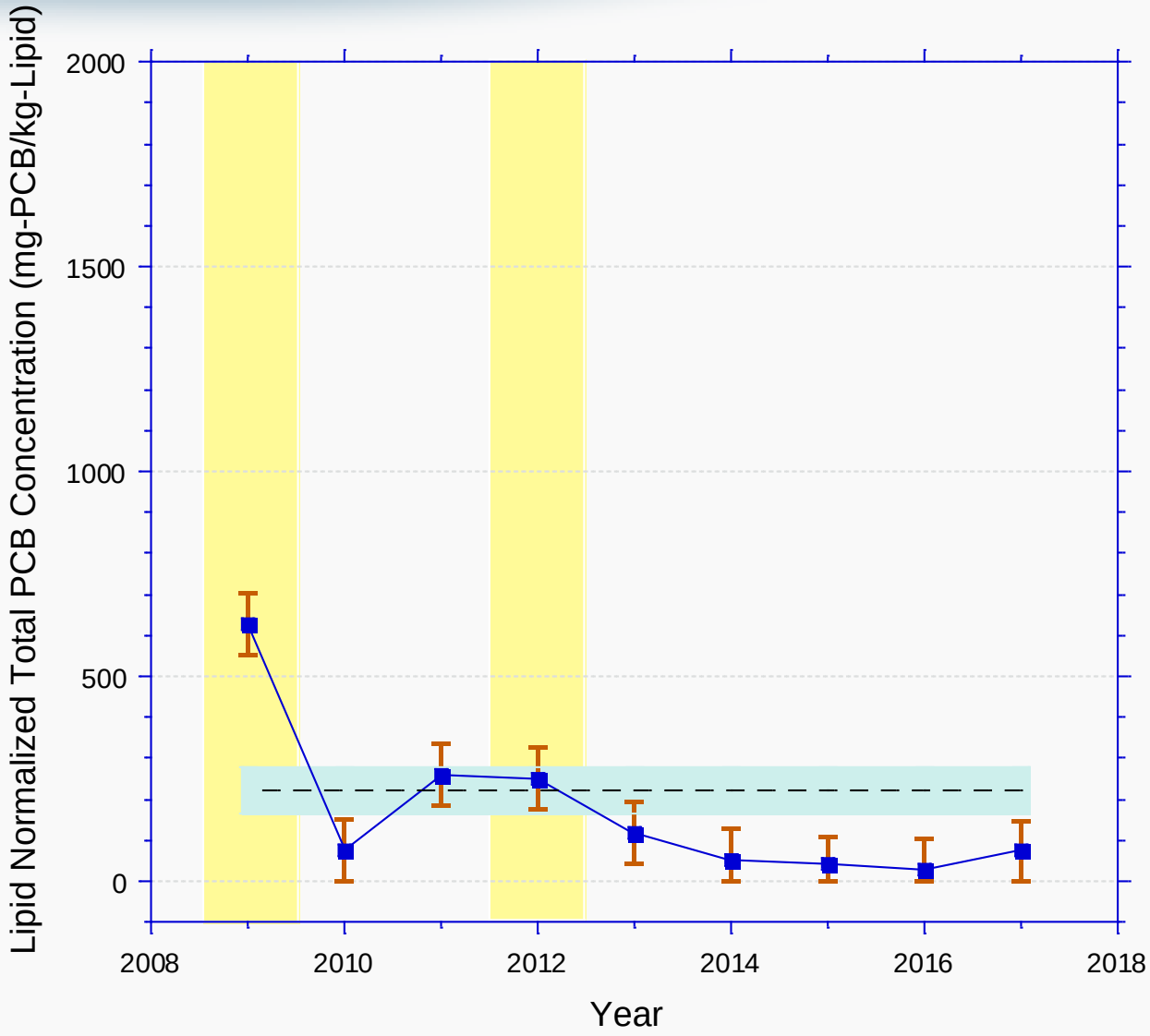
Year of Dredging

- 2009
- 2011
- 2012
- 2013
- 2015

Hudson River PCBs SUPERFUND SITE

WSP Louis Berger

No Fish Station to Date has More Than 6 Years of Post-Dredging Data



Station mean with 95% Confidence Interval

Dredging Year

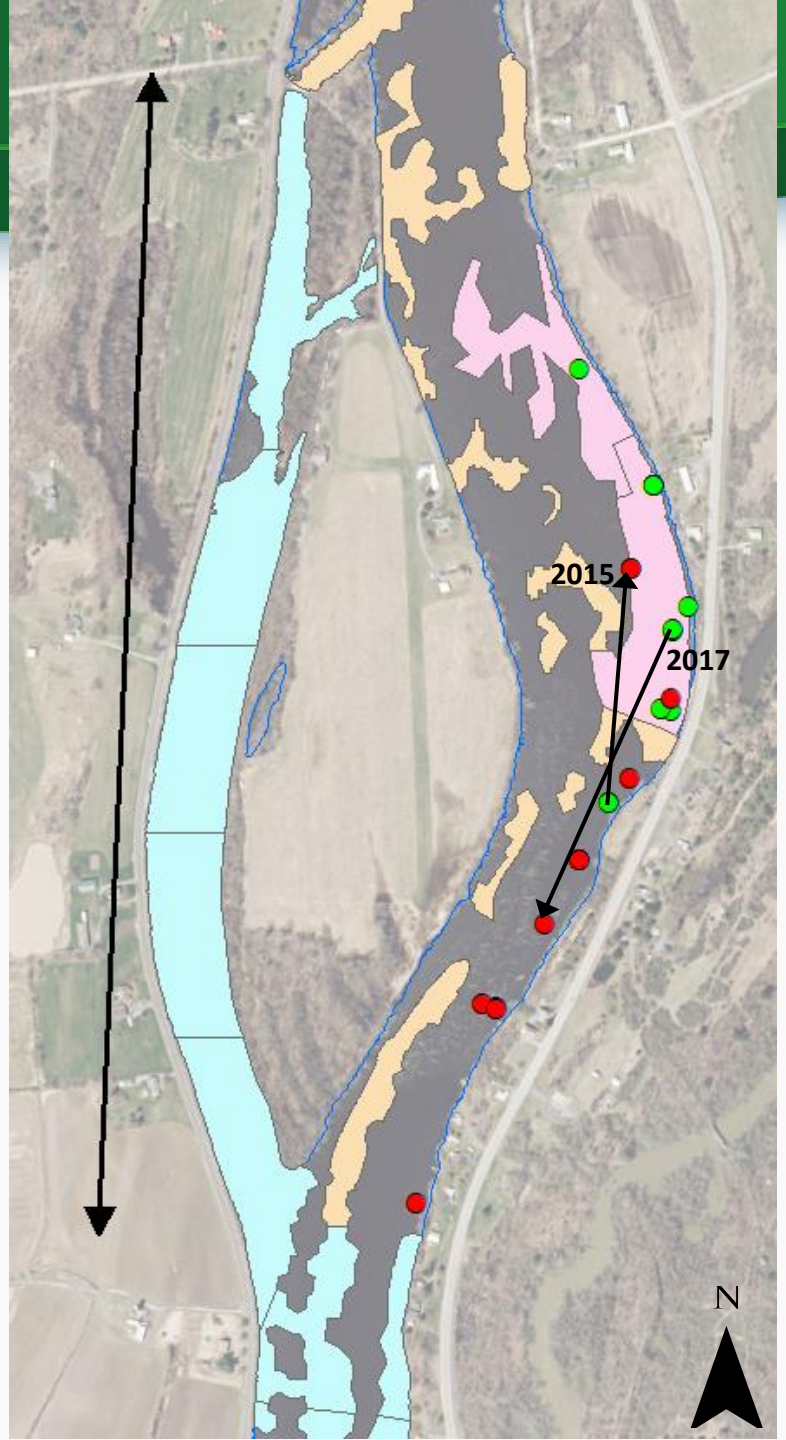
Mean station pre-dredge baseline (2004-2008) with 95% CI

Pumpkinseed at Sampling Station TD5 - Lipid Normalized

Hudson River PCBs SUPERFUND SITE

WSP Louis Berger

Fall Sampling Station - TD5 (pumpkinseed)



- Fish Transect Start Location
- Fish Transect End Location

Year of Dredging

- 2009
- 2011
- 2012
- 2013
- 2015

Hudson River PCBs SUPERFUND SITE

WSP Louis Berger

Fish Trends 2004-2017

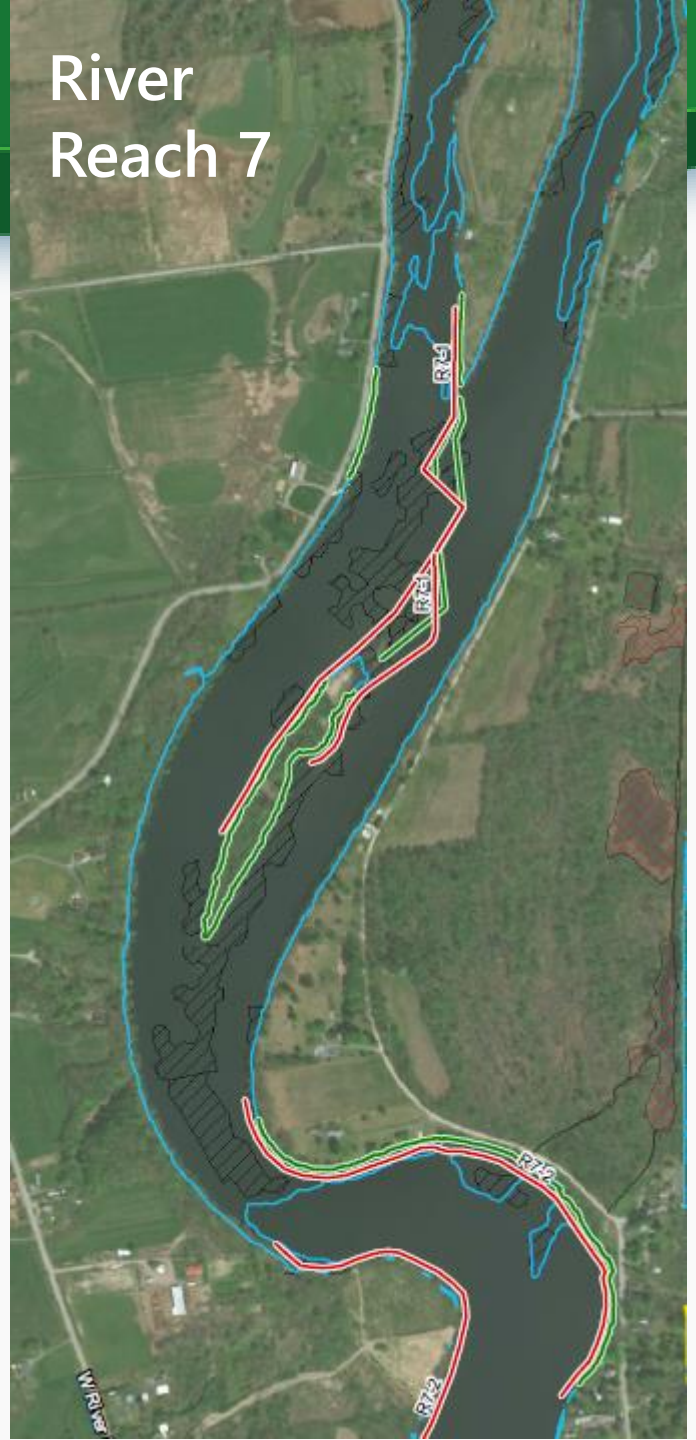
Variations in Fish Collection Locations

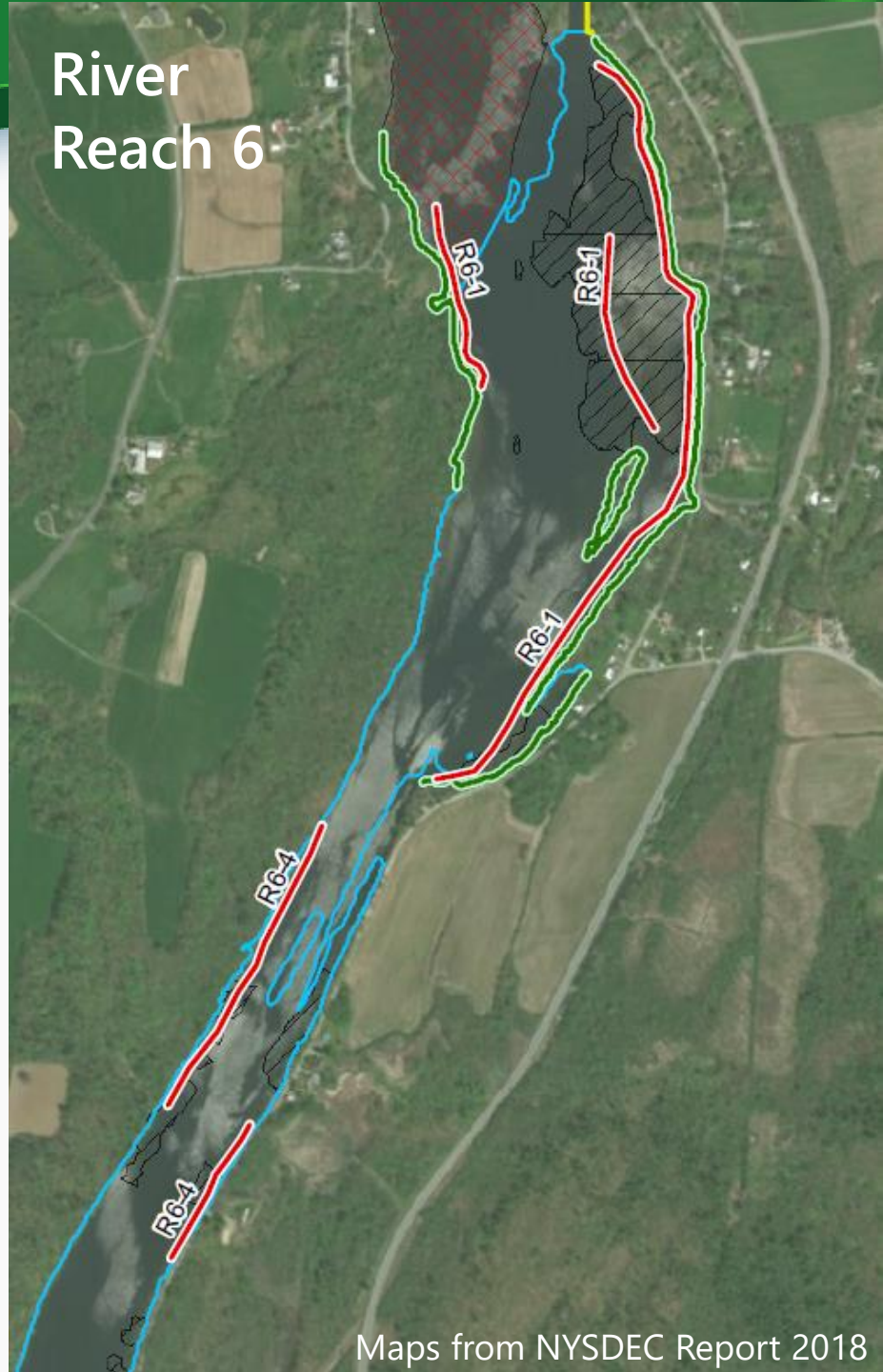
- Variations in fish collection stations are inevitable due to fish availability and annual variations in habitat
- This yields year-to-year differences in fish exposure (and thus fish PCB levels) simply due to variation in locale

Fall 2017 Fish Sampling Transects

- GE
- NYSDEC

Hudson River PCBs SUPERFUND SITE

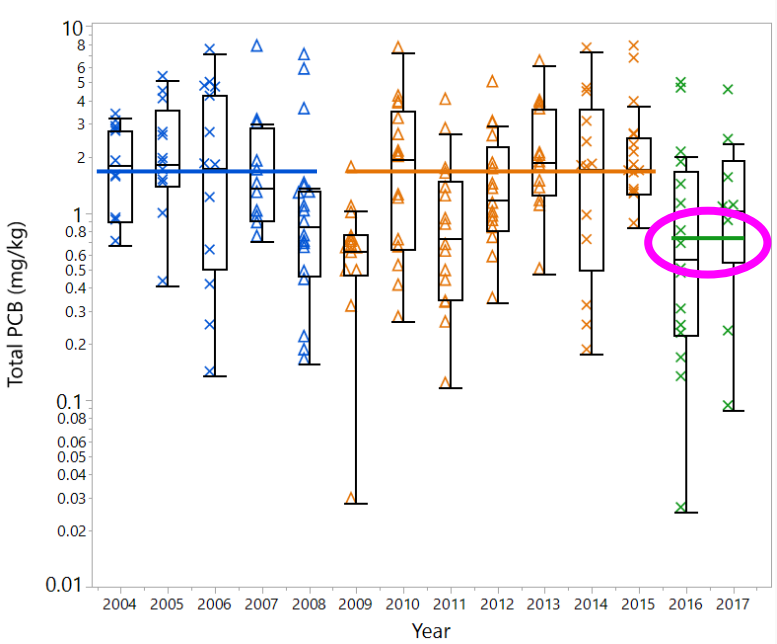




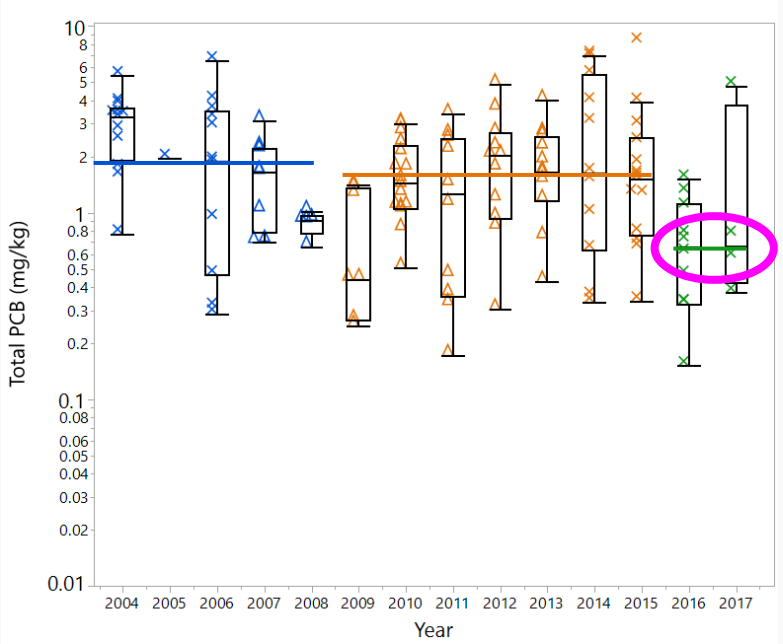
Maps from NYSDEC Report 2018

Upper Hudson Large Mouth Bass –Wet Weight

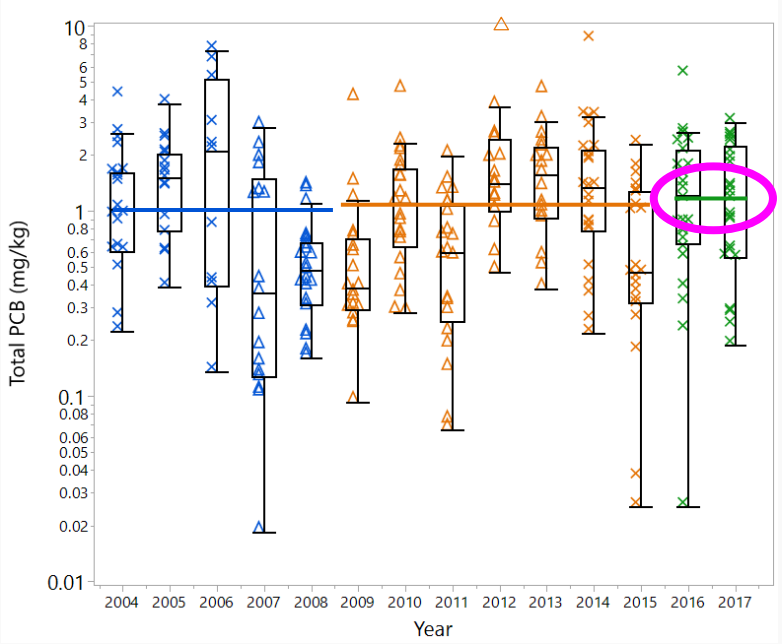
River Section 1



River Section 2



River Section 3



Before Dredging (2004-2008)

During Dredging (2009-2015)

After Dredging (2016-2017)

Standard Fillet

Rib-out Fillet

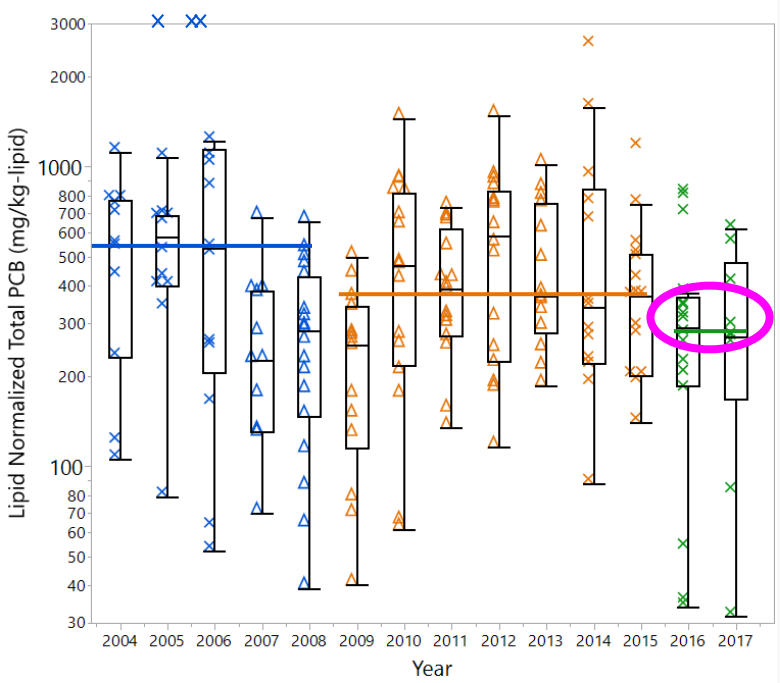
- PCB concentrations in fish have largely recovered from dredging impacts and are now at or below baseline conditions

Hudson River PCBs SUPERFUND SITE

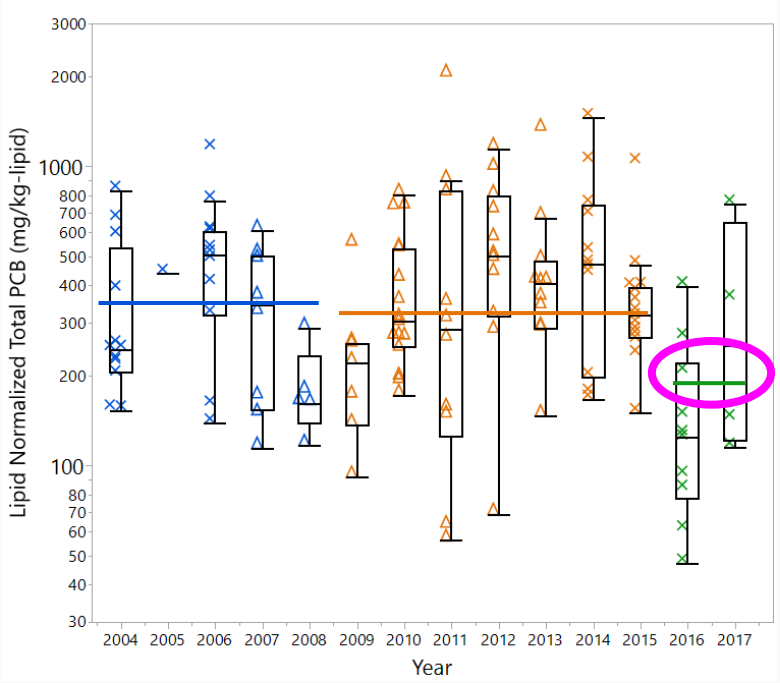
WSP Louis Berger

Upper Hudson Large Mouth Bass –Lipid-Normalized

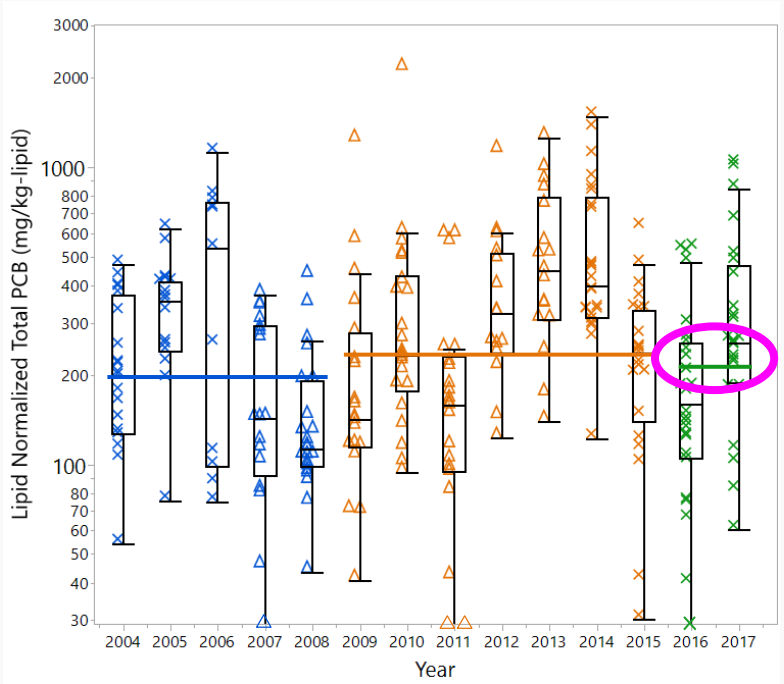
River Section 1



River Section 2



River Section 3



Before Dredging (2004-2008)

During Dredging (2009-2015)

After Dredging (2016-2017)

Standard Fillet

Rib-out Fillet

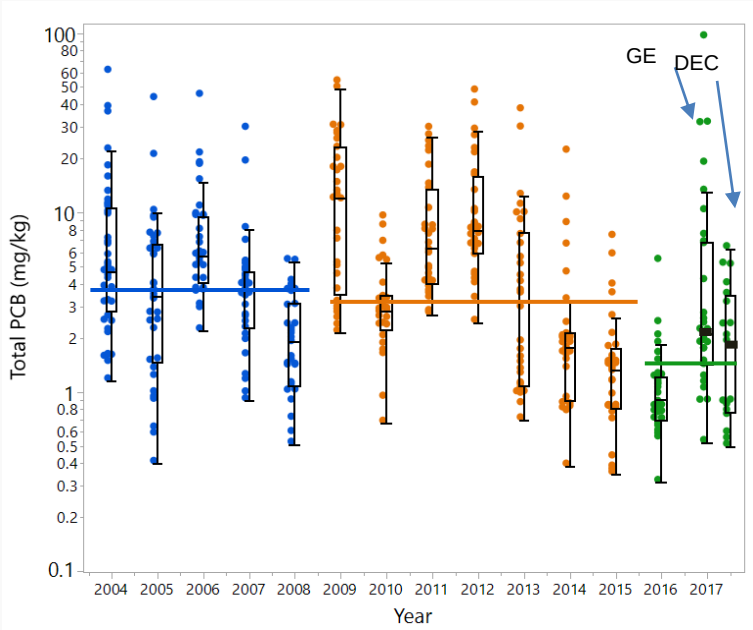
PCB concentrations in fish have largely recovered from dredging impacts and are now at or below baseline conditions.

Hudson River PCBs SUPERFUND SITE

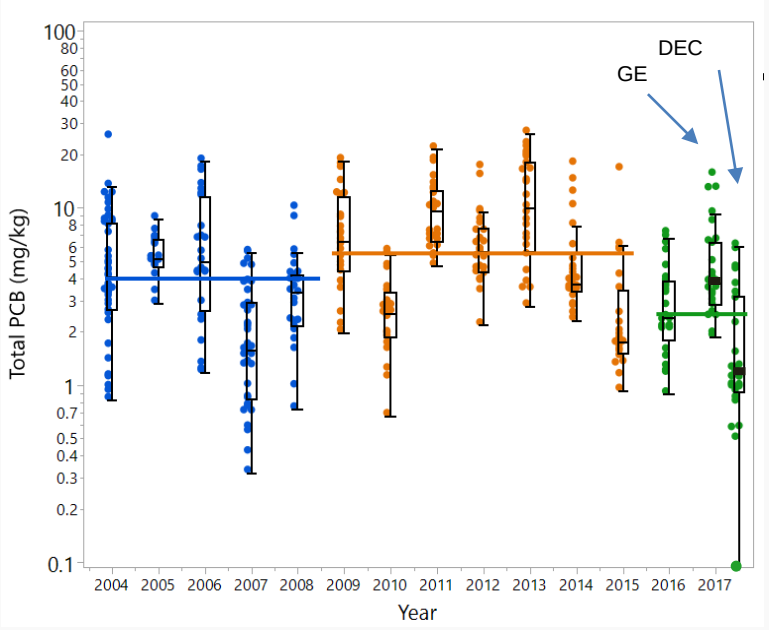
WSP Louis Berger

Upper Hudson Pumpkinseed (Young-of-the-year) – Wet Weight

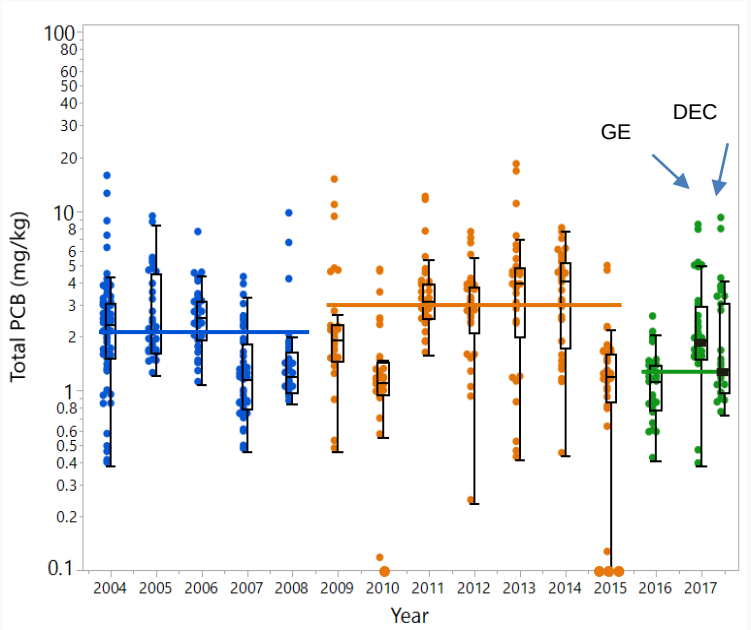
River Section 1



River Section 2



River Section 3



Before Dredging (2004-2008)

During Dredging (2009-2015)

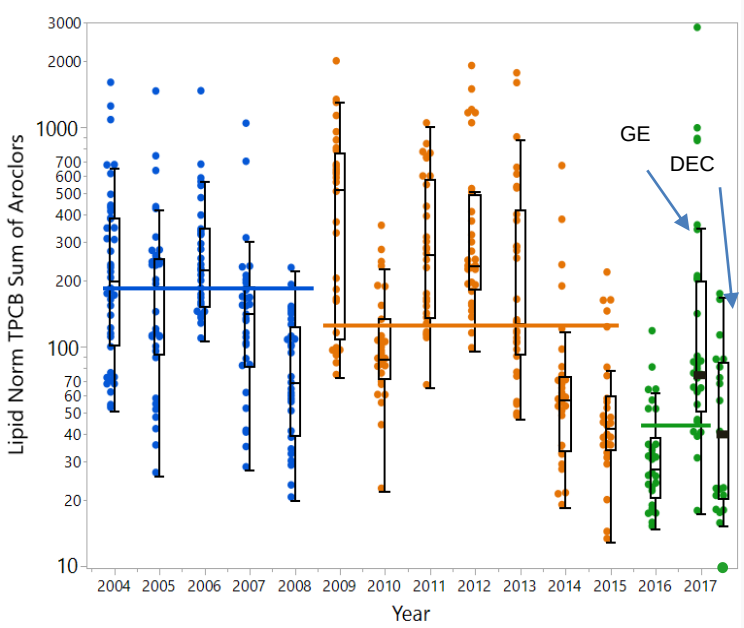
After Dredging (2016-2017)

- All Pumpkinseed samples are whole body composites
- Excluded data R1(1-4), R2(1-4), R3(1-3), R4(1-3),R6-4, R6-3, R8-6

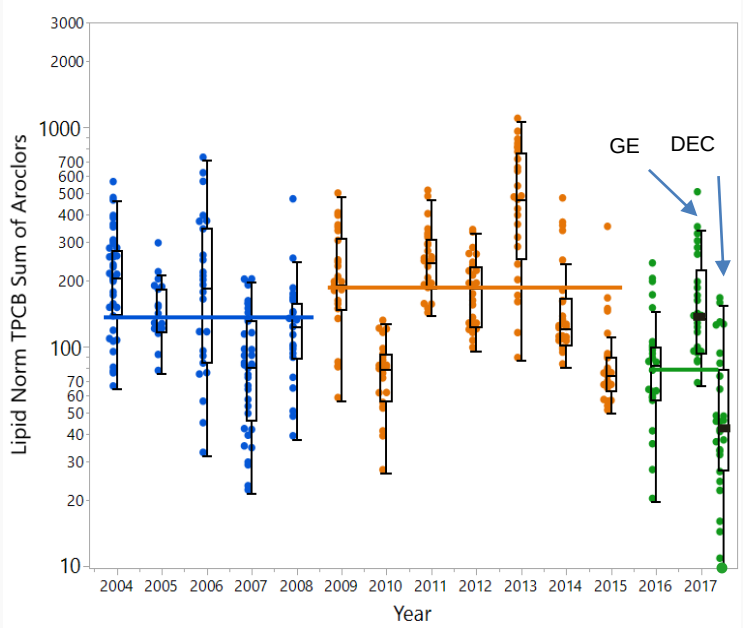
PCB levels have declined overall.

Upper Hudson Pumpkinseed (Young-of-the-year) – Lipid-Normalized

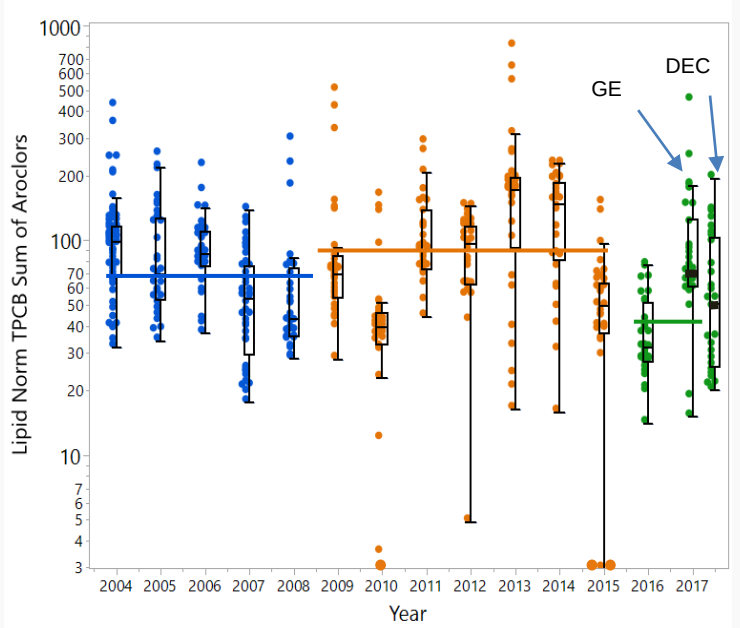
River Section 1



River Section 2



River Section 3

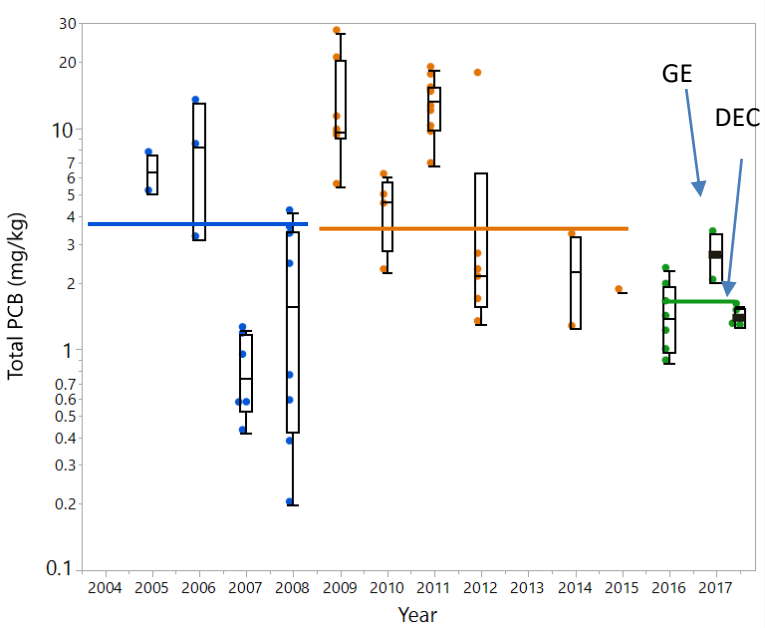


- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2017)

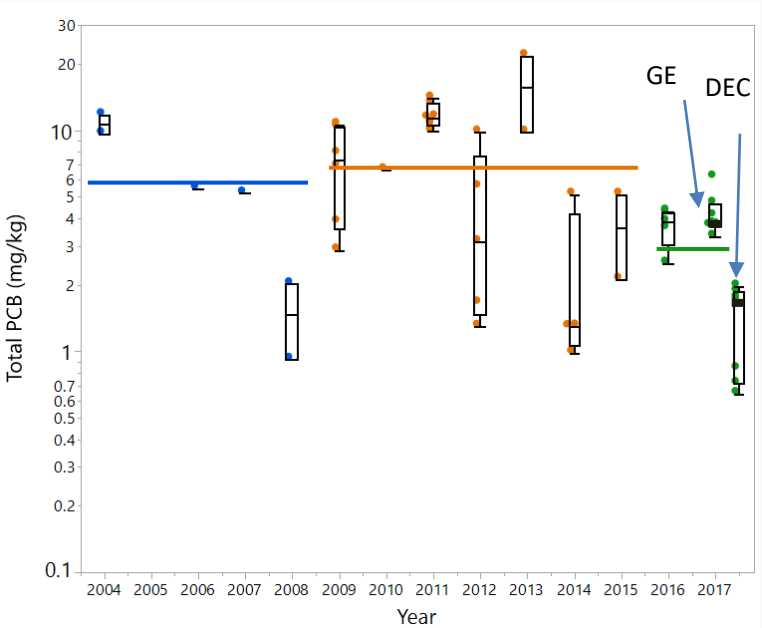
EPA estimates that as many as 8 years or more of post-dredging fish data will be needed to discern the new rate of recovery

Upper Hudson Spot-Tailed Shiner (Forage) – Wet Weight

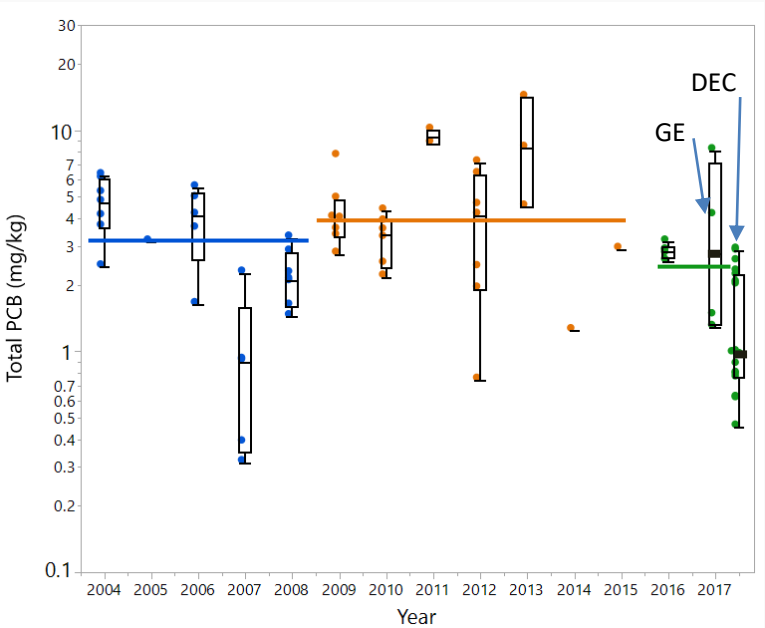
River Section 1



River Section 2



River Section 3



Before Dredging (2004-2008)

During Dredging (2009-2015)

After Dredging (2016-2017)

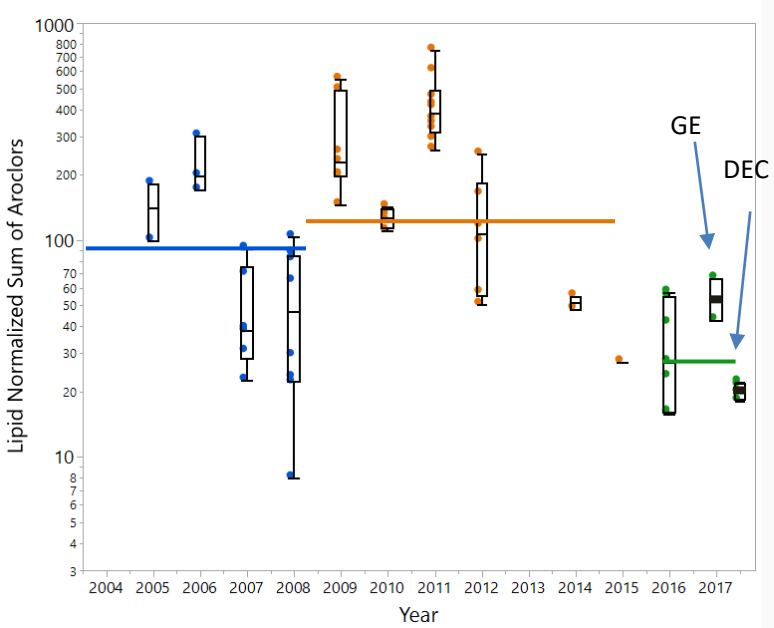
- Excluded data R1(1-4), R2(1-4), R3(1-3), R4(1-3),R6-4, R6-3, R8-6

Hudson River PCBs SUPERFUND SITE

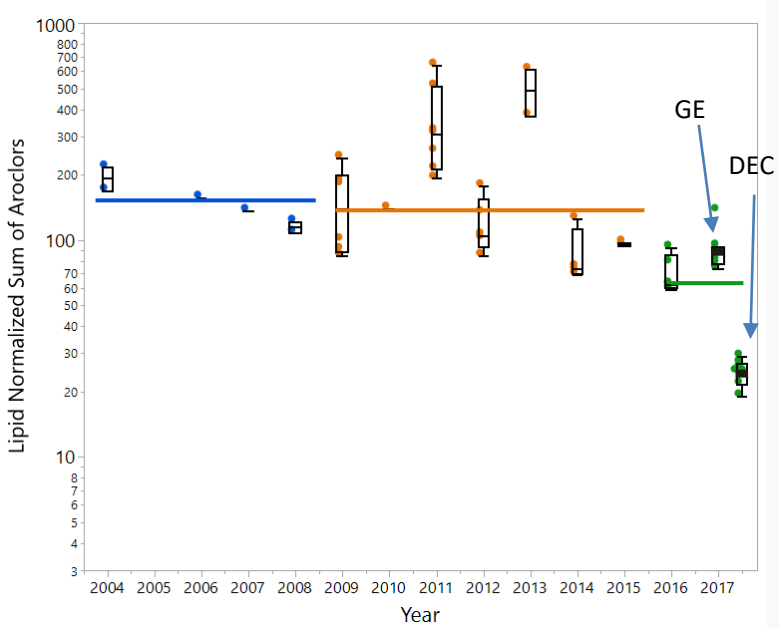
WSP Louis Berger

Upper Hudson Spot-Tailed Shiner (Forage) – Lipid-Normalized

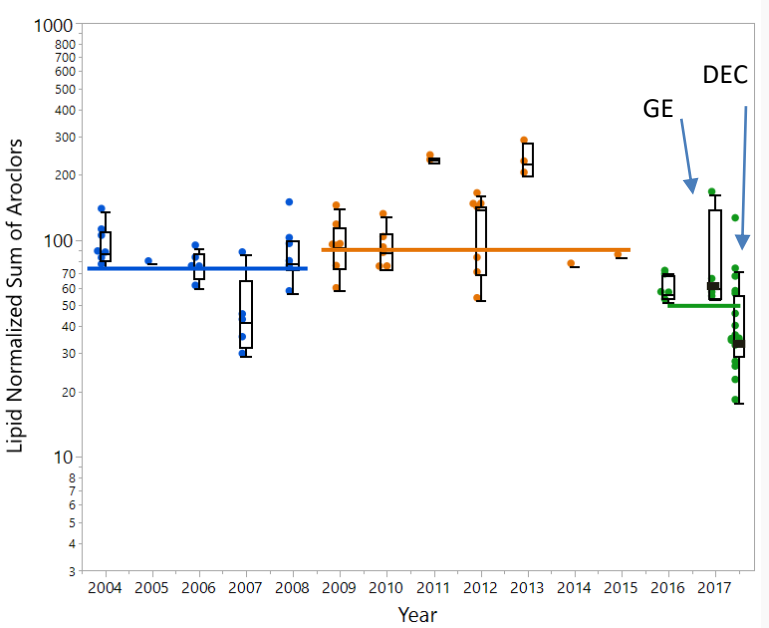
River Section 1



River Section 2



River Section 3



Before Dredging (2004-2008)

During Dredging (2009-2015)

After Dredging (2016-2017)

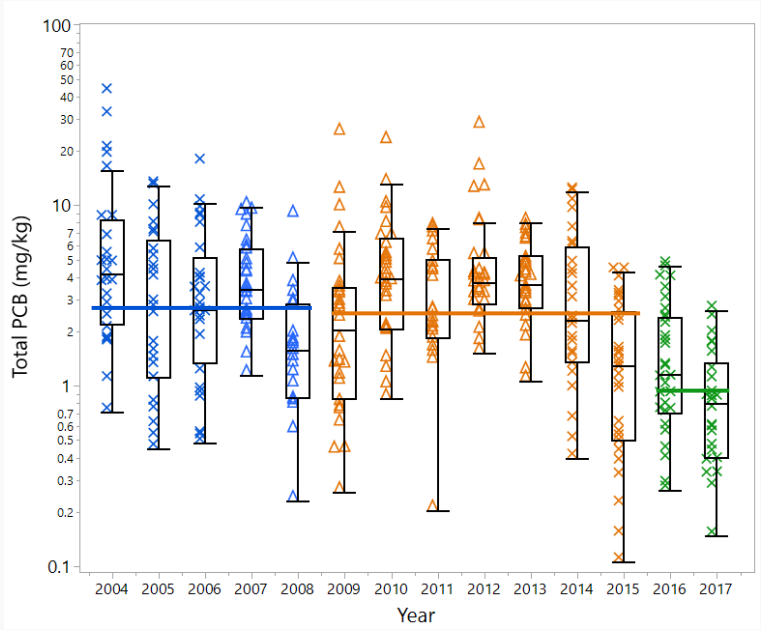
- Excluded data R1(1-4), R2(1-4), R3(1-3), R4(1-3),R6-4, R6-3, R8-6

Hudson River PCBs SUPERFUND SITE

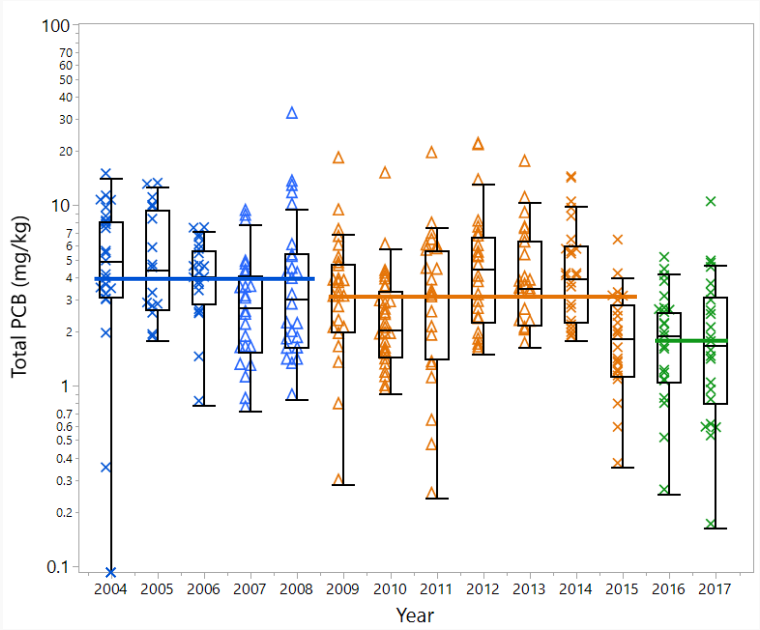
WSP Louis Berger

Upper Hudson Brown Bullhead – Wet Weight

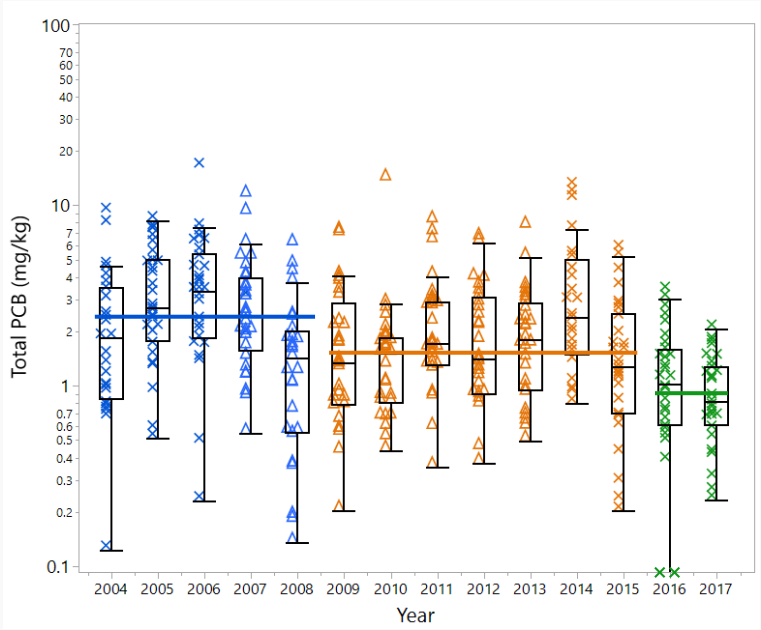
River Section 1



River Section 2



River Section 3



Before Dredging (2004-2008)

During Dredging (2009-2015)

After Dredging (2016-2017)

Standard Fillet

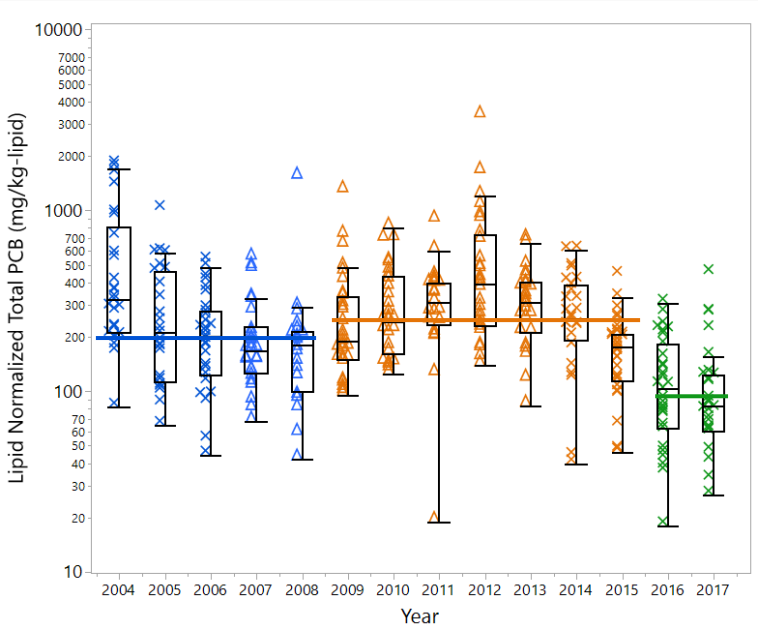
Rib-out Fillet

Hudson River PCBs SUPERFUND SITE

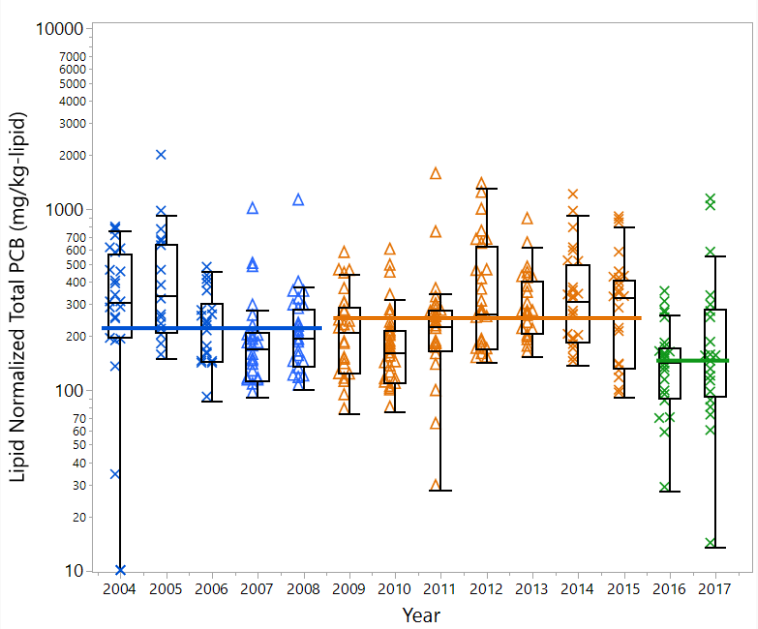
WSP Louis Berger

Upper Hudson Brown Bullhead – Lipid Normalized

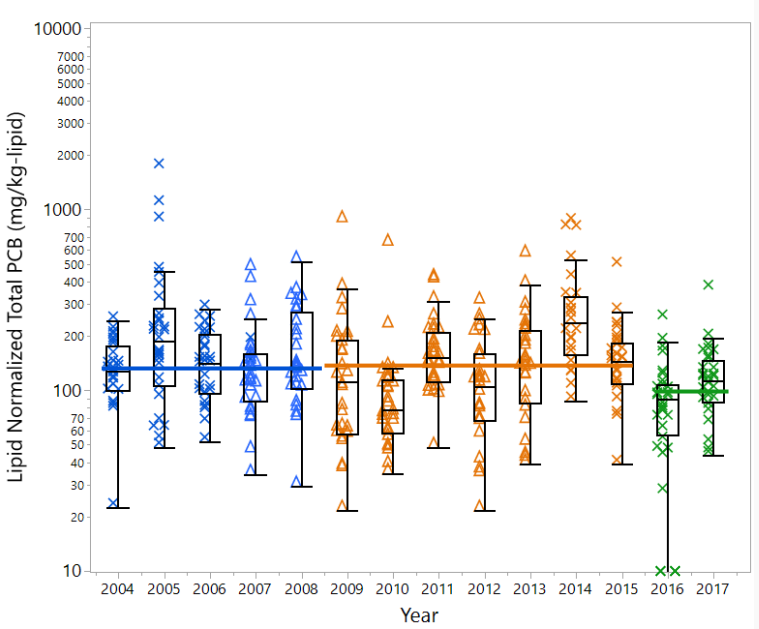
River Section 1



River Section 2



River Section 3



Before Dredging (2004-2008)

During Dredging (2009-2015)

After Dredging (2016-2017)

Standard Fillet

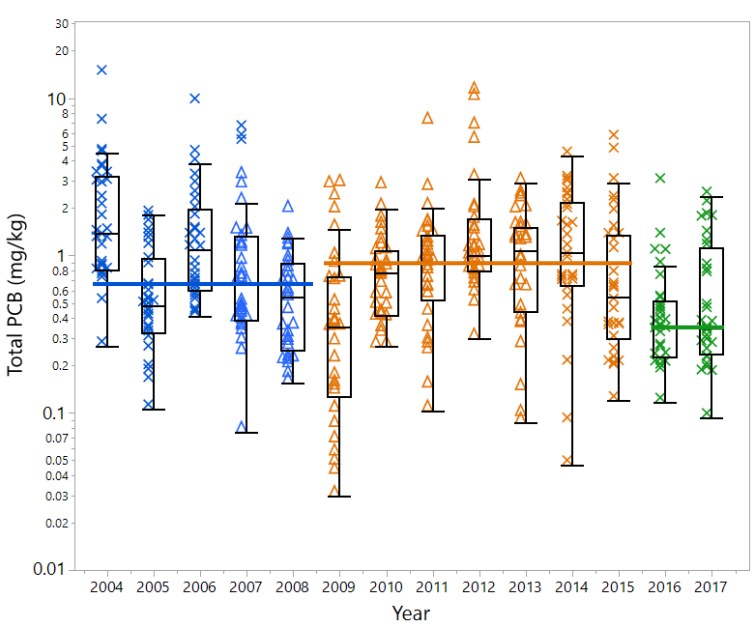
Rib-out Fillet

Hudson River PCBs SUPERFUND SITE

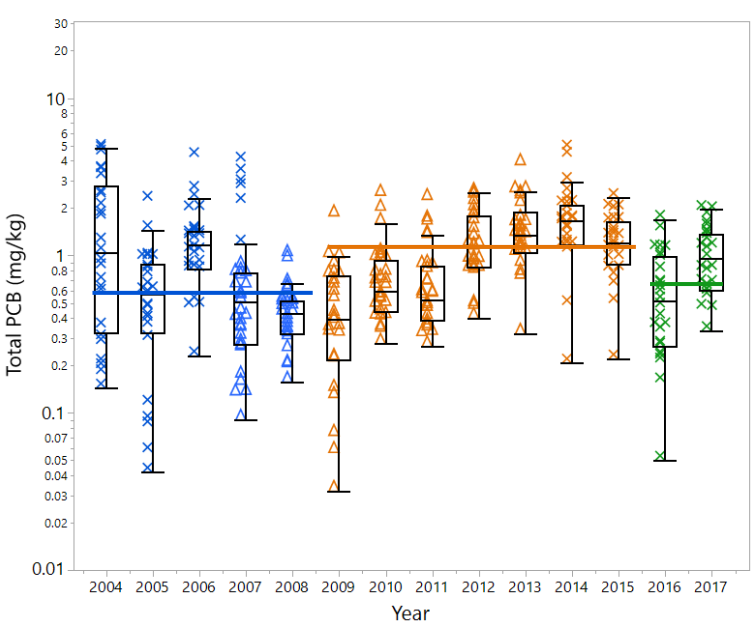
WSP Louis Berger

Upper Hudson Yellow Perch – Wet Weight

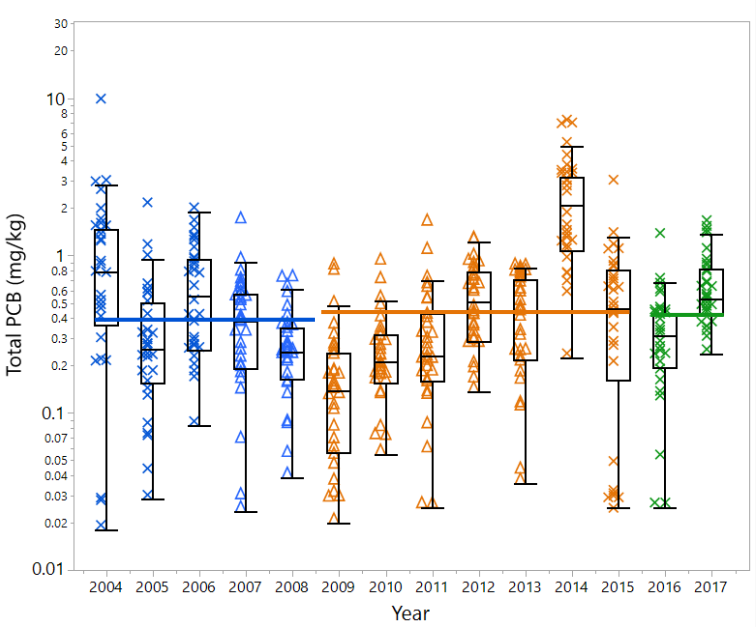
River Section 1



River Section 2



River Section 3



Before Dredging (2004-2008)

During Dredging (2009-2015)

After Dredging (2016-2017)

Standard Fillet

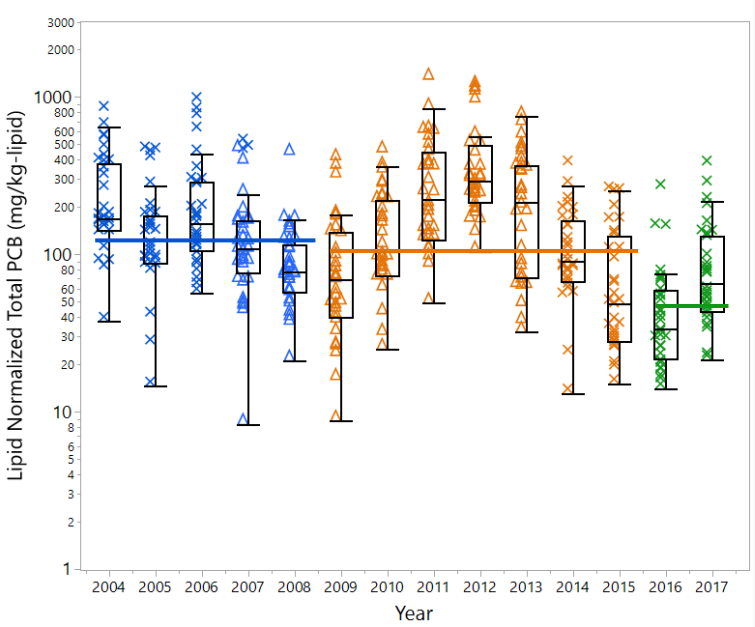
Rib-out Fillet

Hudson River PCBs SUPERFUND SITE

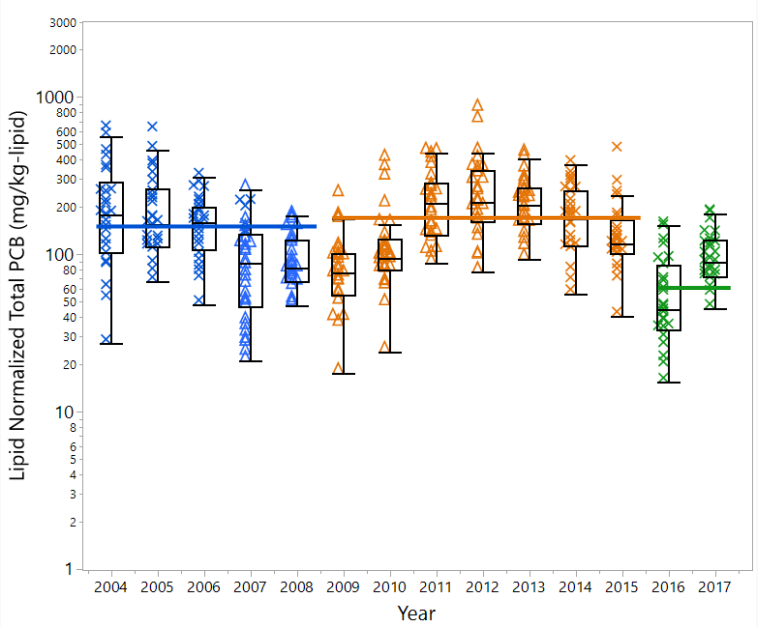
WSP Louis Berger

Upper Hudson Yellow Perch – Lipid Normalized

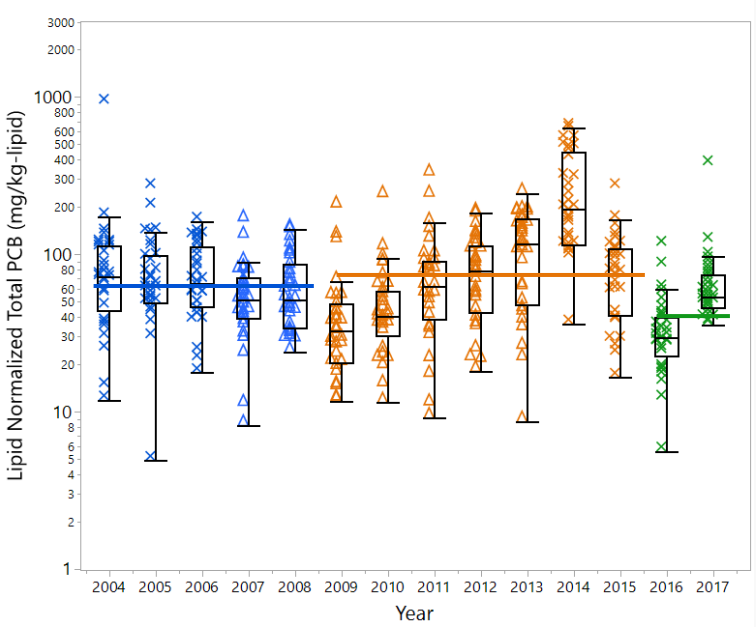
River Section 1



River Section 2



River Section 3



Before Dredging (2004-2008)

During Dredging (2009-2015)

After Dredging (2016-2017)

Standard Fillet

Rib-out Fillet

Hudson River PCBs SUPERFUND SITE

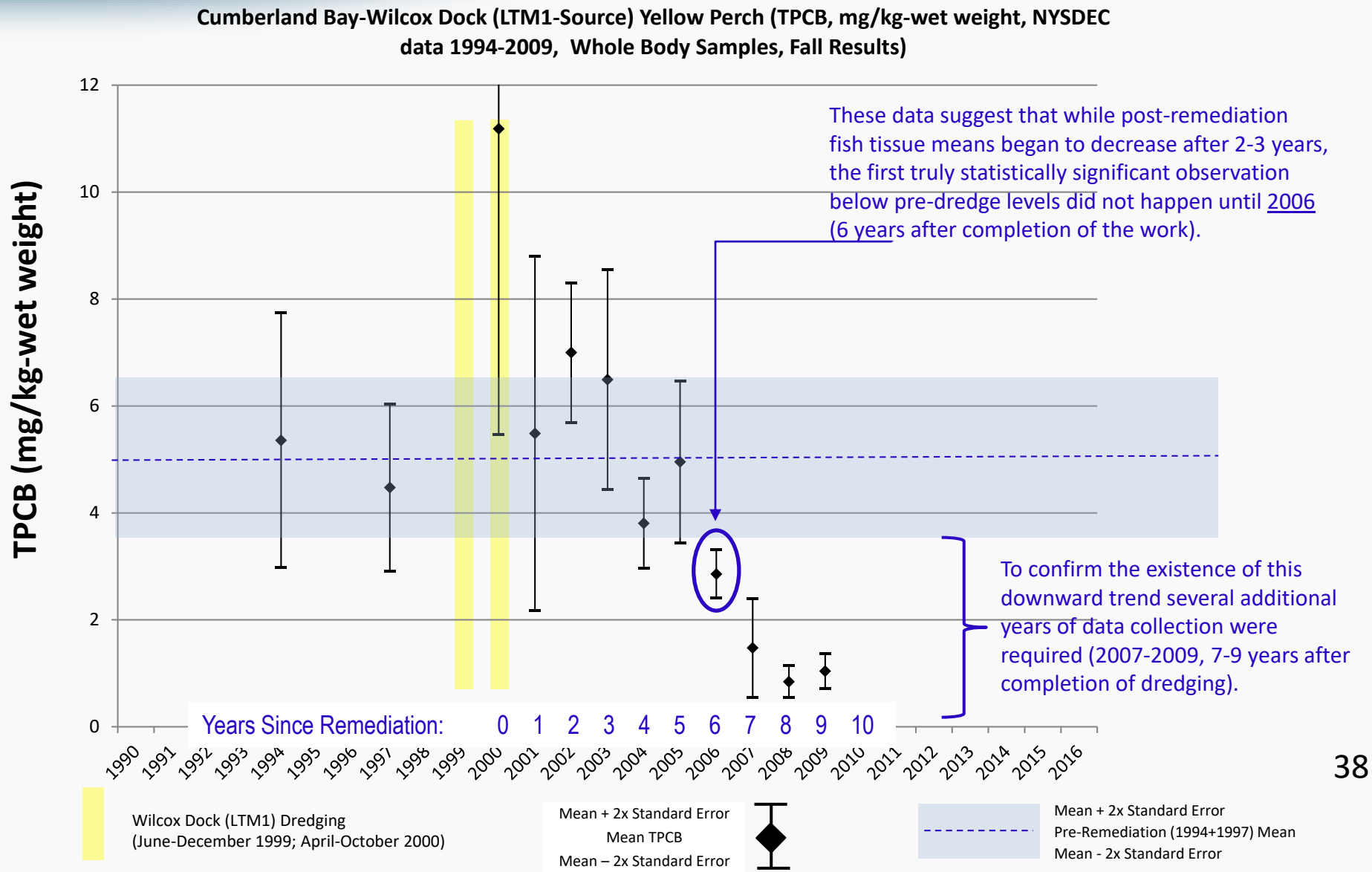
WSP Louis Berger

Time Needed to Recover

Other sites have exhibited long post-dredging recovery times

Example:

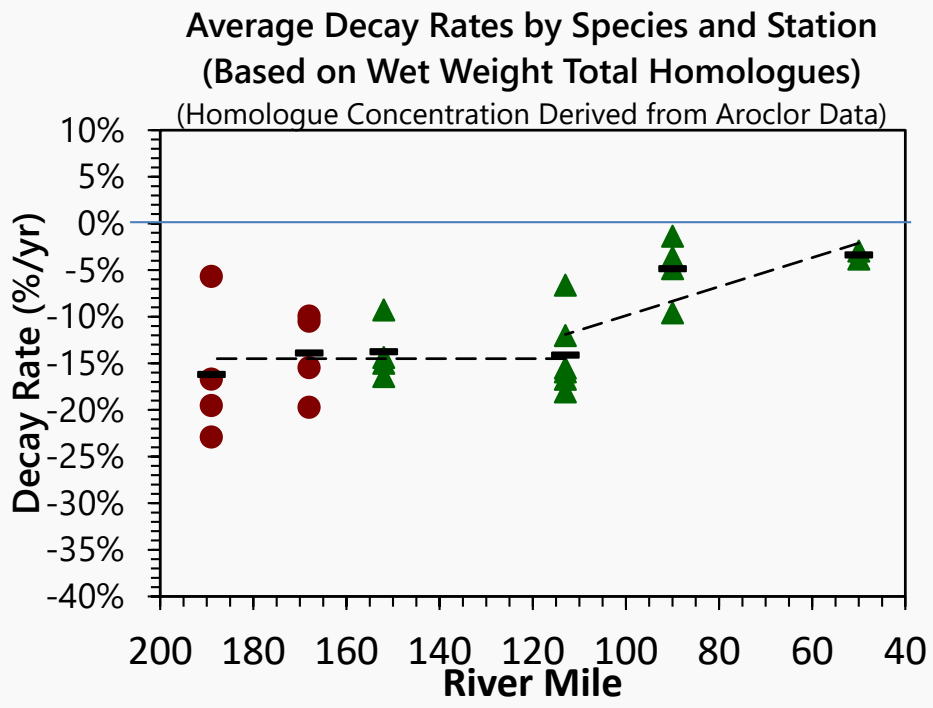
Cumberland Bay Site - yellow perch



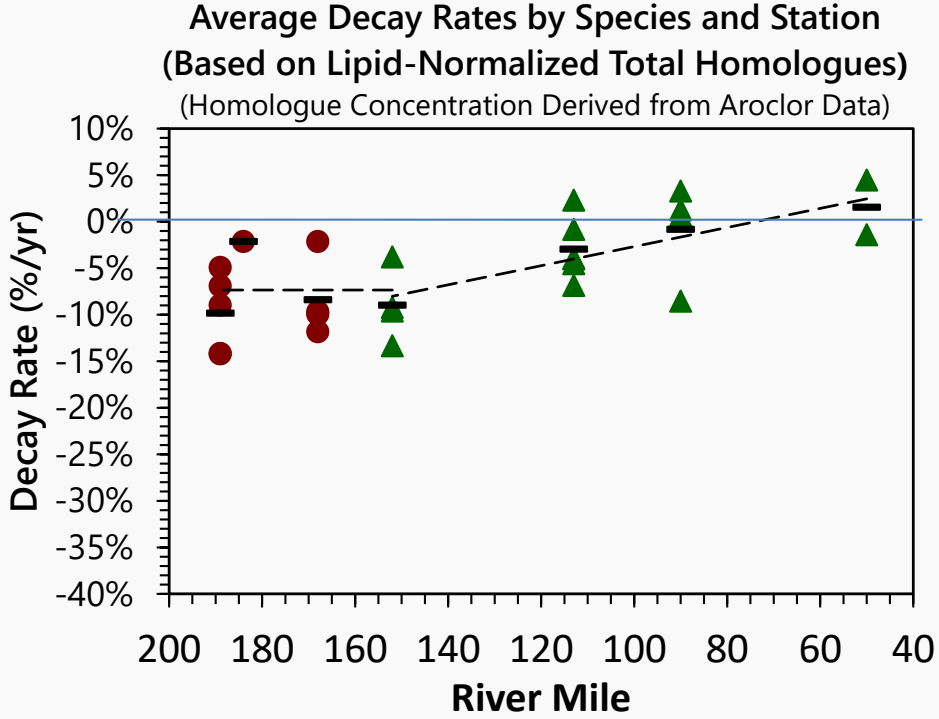
Hudson River PCBs SUPERFUND SITE

Fish PCB Recovery Rates Across Upper and Lower Hudson (Pre-remediation data)

Wet Weight Basis



Lipid-Normalized Basis



Upper River Lower River Average Decay Rate

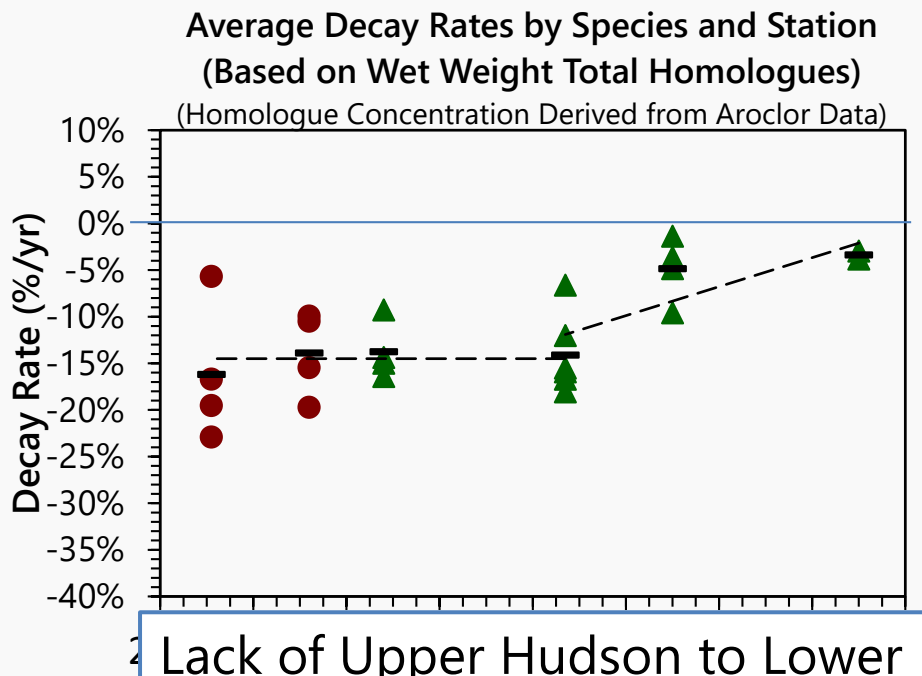
Pre-remediation fish tissue recovery rates decline with distance downstream in the Lower Hudson

Hudson River PCBs SUPERFUND SITE

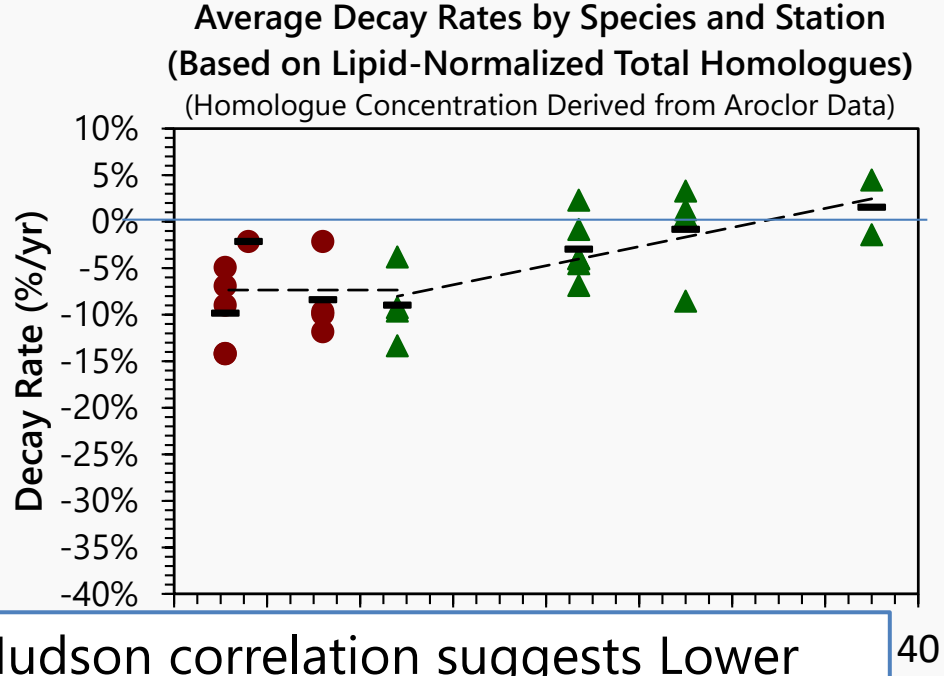
WSP Louis Berger

Fish PCB Recovery Rates Across Upper and Lower Hudson (Pre-remediation data)

Wet Weight Basis



Lipid-Normalized Basis



Lack of Upper Hudson to Lower Hudson correlation suggests Lower Hudson fish burdens are controlled by local conditions.

The impact of further Upper Hudson improvements on downstream conditions is unclear, particularly below RM 110 (Catskill).

Pre-remediation fish tissue recovery rates decline with distance downstream in the Lower Hudson

Conclusions and Summary (1)

- The remedy is focused on Tri+ PCB for the simple reason that this fraction represents ~95% or more of the fish body burden.

- Water column PCB concentrations have declined throughout the Upper Hudson by 35 to 60%.
- Loads to the Lower Hudson have also declined.
  - This decline is present even at the highest flow conditions.
- Water column concentrations well downstream did not respond to dredging releases.
  - This suggests downstream conditions are controlled by legacy sediment contamination and local sources.

- EPA estimates that as many as 8 years or more of post-dredging fish data will be needed to discern the new rate of recovery.
  - No fish station has more than 6 years of post-dredging data. Additionally, most stations with longer records had extensive vessel traffic for several years post remediation.
- The difficulties in maintaining consistent fish sampling locations adds variability to time trends.
  - More time needed to determine recovery rates.

Conclusions and Summary Cont.

- Differences between the NYSDEC and GE fish results for 2017 further emphasize the inherent variability in the fish data and the difficulties in determining long term recovery rates.
- The species-weighted average provides a means to track and integrate recovery in a consistent manner over time.
- Young-of-the-year and forage fish appear to be recovering faster than sport fish, as expected.
- Long recovery times have been observed at other sediment remediation sites (*e.g.*, Cumberland Bay, an NYSDEC-led site).
- Pre-remediation fish data are consistent with the dredging period water column data for the Lower Hudson.
  - Suggesting Lower Hudson conditions are influenced by legacy contamination and/or local sources.

- The remedy significantly reduced PCB concentrations in targeted areas (dredged zones).
- There has not been substantive recontamination of dredged areas.
- There has been a significant decrease in PCB concentrations across the entire Upper Hudson due to remediation and natural recovery.
  - Most river reaches are on average 1 ppm Tri+ PCB or less.

Going Forward

- EPA plans to monitor all three media (fish, water and sediment) to track the recovery of the Hudson. EPA evaluating the relationship between the three media.
- EPA is monitoring recovery at several scales including:
  - River Section
  - River Reach
  - Entire Upper Hudson
  - Lower Hudson
- EPA will continue to monitor multiple fish species throughout the Hudson, including species not included in the species-weighted average.
- EPA is currently developing the scope of its Lower Hudson investigation and intends to begin this work soon.

Questions?

Gary Klawinski
Klawinski.Gary@epa.gov
(518)407-0400