LOWER FOX RIVER, WI

PAUL MONTNEY

GEORGIA-PACIFIC CONSUMER PRODUCTS

Lower Fox River Site Overview

Fox River Operable Units (OUs)

- OU 1 (Little Lake Butte des Morts): 7.2 mi.
  - Dredging from 2004 to 2009
- OU 2 (higher gradient river): 18.8 mi.
  - Three ongoing natural recovery subareas
- OU 3 (DePere): 6.0 mi.
  - Dredging/capping: 2009 to 2011
- OU 4 (City of Green Bay): 7.1 mi.
  - Dredging/capping: 2007 to 2020
- OU 5 (Green Bay): 1 million acres
  - Two ongoing natural recovery subareas

Summary of Remedy

- 2004 to 2020 actions under different orders
- More than 6.1 million cubic yards dredged
  - Largest environmental dredging project in N. America
  - 8- and 12-inch articulated cutterhead hydraulic dredges
  - Sediment dewatering and regional landfill disposal
- 737 acres engineered caps and sand covers
  - 161 acres engineered caps
  - 100 acres 6-inch covers over thin, low-level deposits
  - 476 acres 6-inch covers for dredge residual mgmt.

Objectives of Remediation

- Remedial action objectives
  - Reduce PCB bioaccumulation to protect human health and ecological receptors
  - Reduce downstream transport of PCBs by reducing surface water concentrations
- Cleanup remedy (ROD)
  - Address PCB-contaminated sediments above 1 ppm
  - Achieve OU-specific surface weighted average concentration (SWAC) goals (0.25 to 0.28 ppm)

Remedy Objectives

- Reduce surface water PCB concentrations
  - Target 90% reduction from baseline or achieve background concentration
- Reduce fish tissue PCB concentrations (eco and human health species)
  - Target 90% reduction from baseline or achieve background concentrations
  - Achieve lowest adverse effect level to protect eco species
  - Reduce fish advisories
- Achieve remedial action objectives in 30 years
  - Trend analyses

Source Control

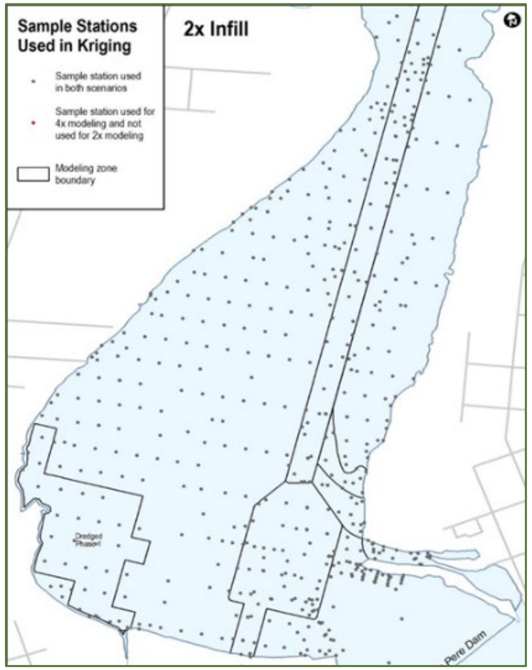
- PCBs from carbonless copy paper discharged into Fox River from 1954 to 1971
  - Production of carbonless paper ceased in 1971
- Effective PCB source control verified during 1990s RI/FS
  - In-river sediment deposits confirmed as primary source to surface water and food web bioaccumulation
  - Ongoing lower-level wastewater and stormwater discharges determined unlikely to result in exceedance of sediment cleanup goal (0.25 ppm)

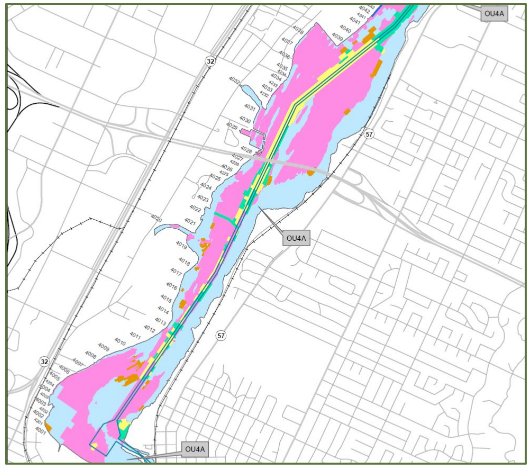
Significant Remedy Scope/Schedule Deviations

- Original 2003 ROD amended in 2007
  - Result of more detailed data collection and engineering analyses
  - Thin low-level sediment layers and deeply buried sediments
  - Hybrid dredge, cap, and cover remedy determined to be more protective and cost effective than dredging-only remedy
- Cleanup remedy expanded in scope during construction
  - Construction duration was 30% longer (12 vs. 9 years)
  - Dredge volume was more than 75% greater (6.1 vs. 3.5 million cubic yards)
  - Less capping approved by agencies (potential prop wash concerns)
  - Cost was 100% greater: $1.2 billion (EPA)

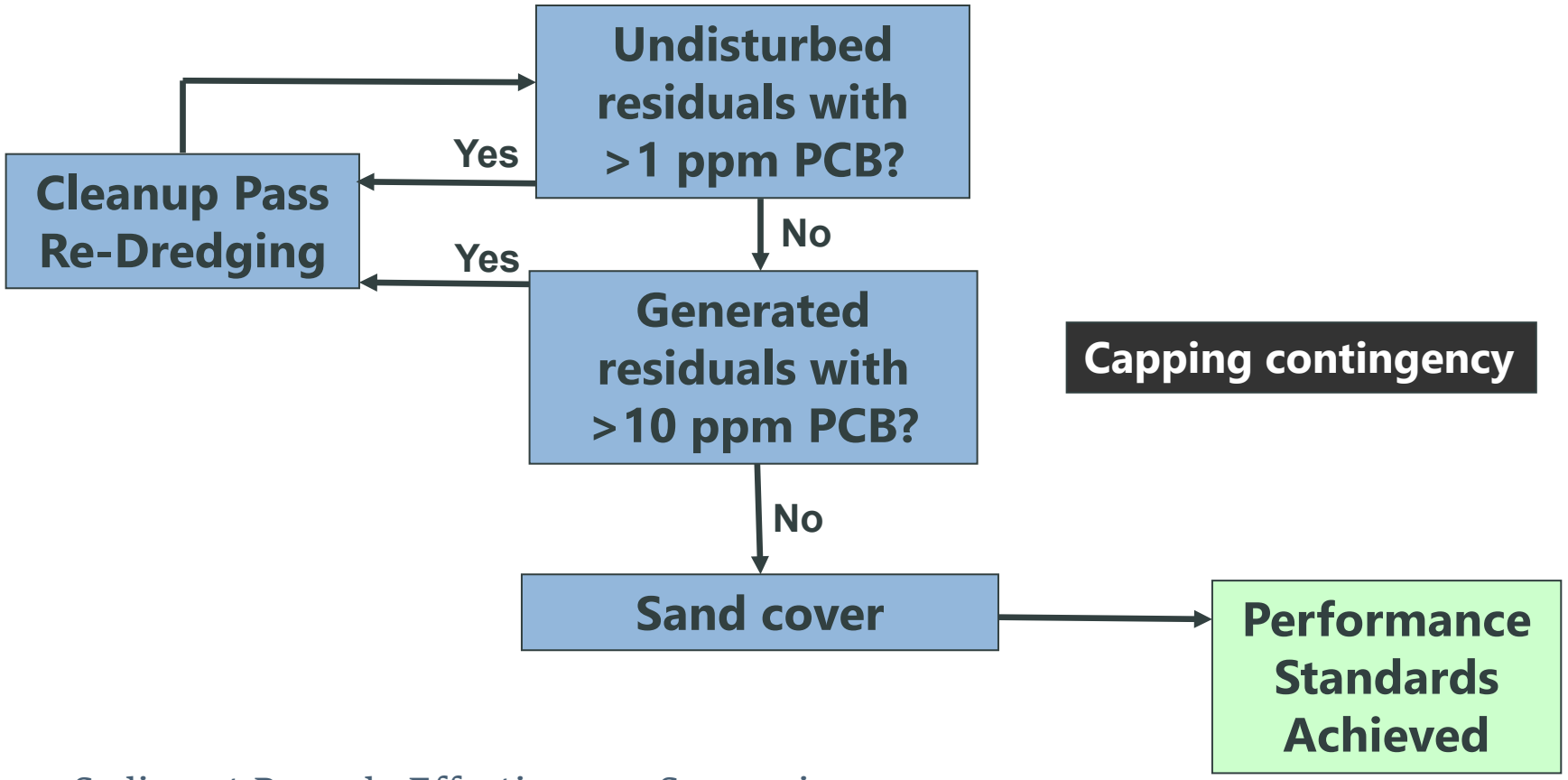
Detailed OU 2 to 5 Pre- and Post-Dredge Sediment Sampling

- More than 8,500 coring locations
  - 100- to 200-foot spacing
- Detailed pre-dredge delineation provided high confidence in geostatistical dredge plan
- Detailed post-dredge residuals dataset operationally distinguished
  - Undisturbed residuals (missed inventory): >6-inch post-dredge >1 ppm PCBs
  - Generated residuals: <6-inch post-dredge >1 ppm PCBs, up to 10 ppm PCBs



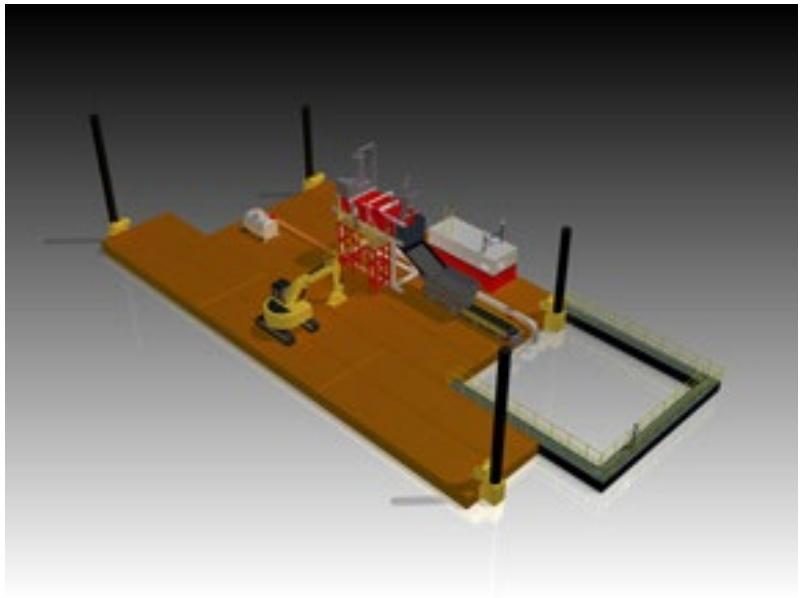


OU 2 to 5 Post-Dredge Residual Management Decision Framework



Dredge Residual Management

- No further action
  - Approximately 50% of dredge area
- Sand cover only
  - Approximately 35% of dredge area
- Cleanup pass re-dredging
  - Approximately 15% of dredge area
  - Sand cover after re-dredging in approximately 50% of re-dredge area



Source: http://foxrivercleanup.com/

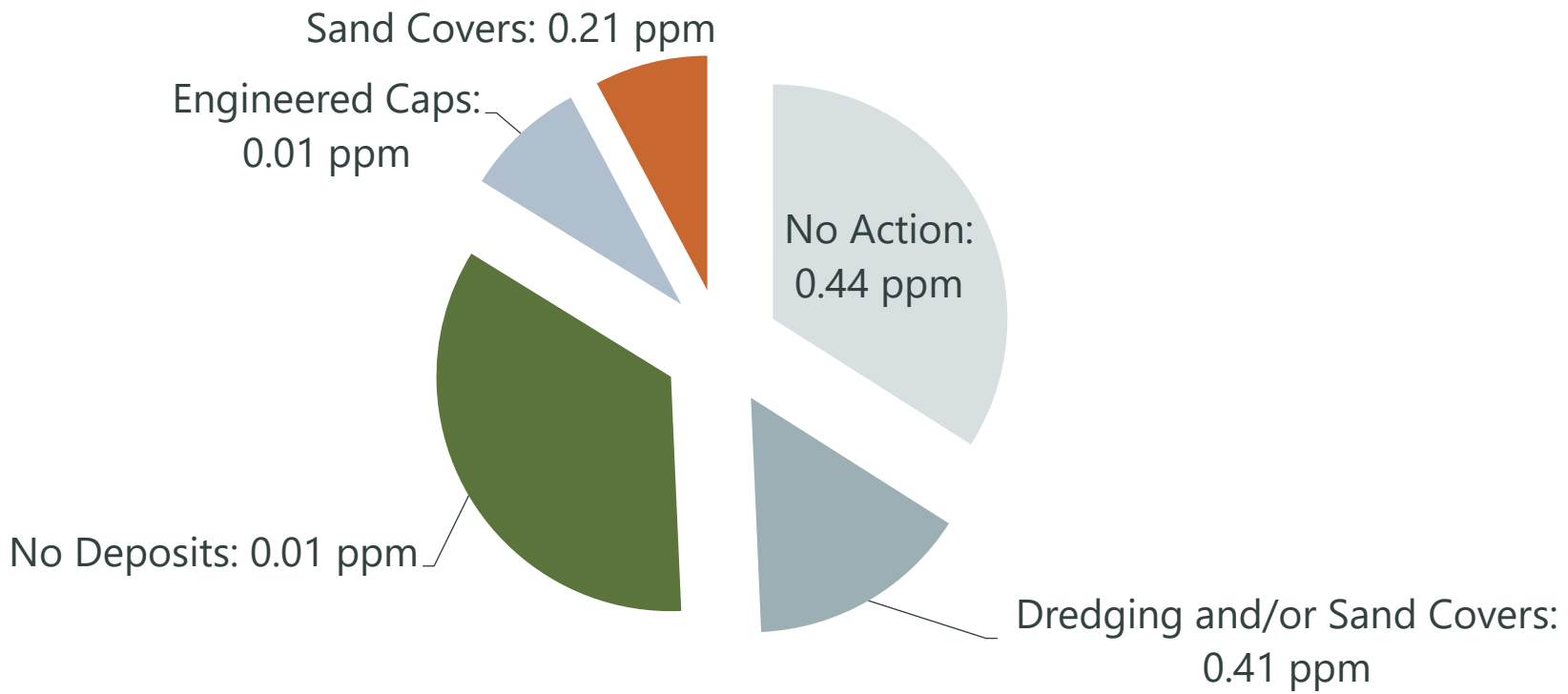
Pre- and Post-Remedy PCB Effectiveness Monitoring

- 2006 site-wide baseline monitoring (during OU 1 dredging)
- Post-construction monitoring linked to decision criteria
- Surface sediment (natural recovery areas; 0 to 15 cm; every 5 years)
- Water column (10 stations; every 5 years)
- Fish tissue (9 stations; every 5 years)
  - Walleye or smallmouth bass: individual fish fillets (human health)
  - Carp: individual or composite whole body (eco)
  - Drum: individual or composite whole body (eco)
  - Gizzard shad young-of-year: composite whole body (early trend)

Remedy Effectiveness: PCB SWAC

- OU 1: 88% reduction
- OU 2: 80% reduction (natural recovery)
- OU 3: ~75% reduction
- OU 4 (still in progress)
- OU 5 (still in progress): ~50% reduction (natural recovery)

Components of OU 1 Post-Construction SWAC (0.23 ppm; 88% Reduction)



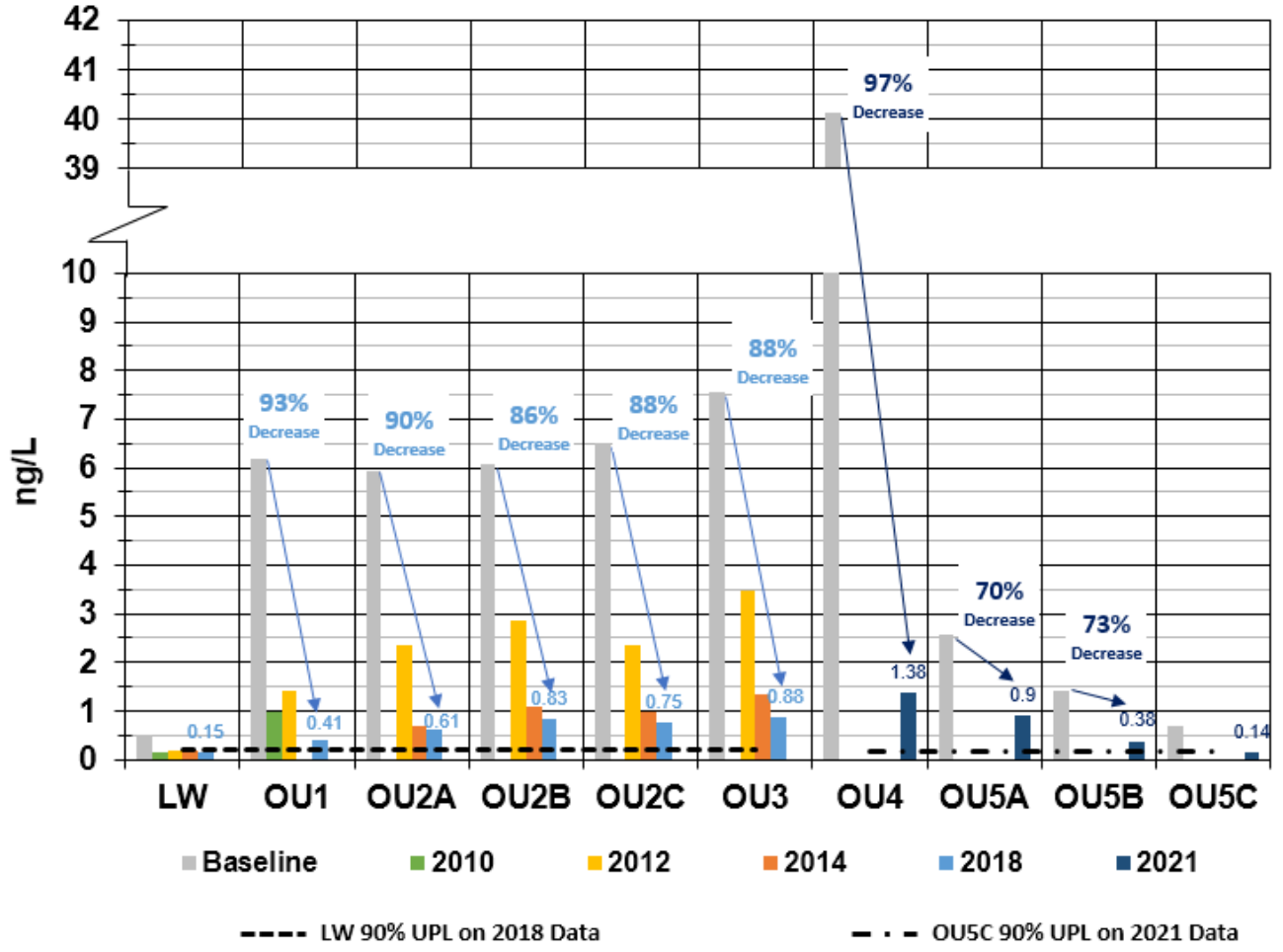
Components of OU 3 Post-construction SWAC (~1.31 ppm; ~75% reduction)

- Preliminary OU 3 SWAC analysis
  - Post-dredge (pre-cap or residual sand cover): 50% reduction
  - Post-remedy (including all sand covers, caps, and residual sand covers)
    - ~50% reduction from post-dredge conditions
    - ~75% reduction from pre-construction conditions
- Sand cover and cap key to reducing PCB SWAC

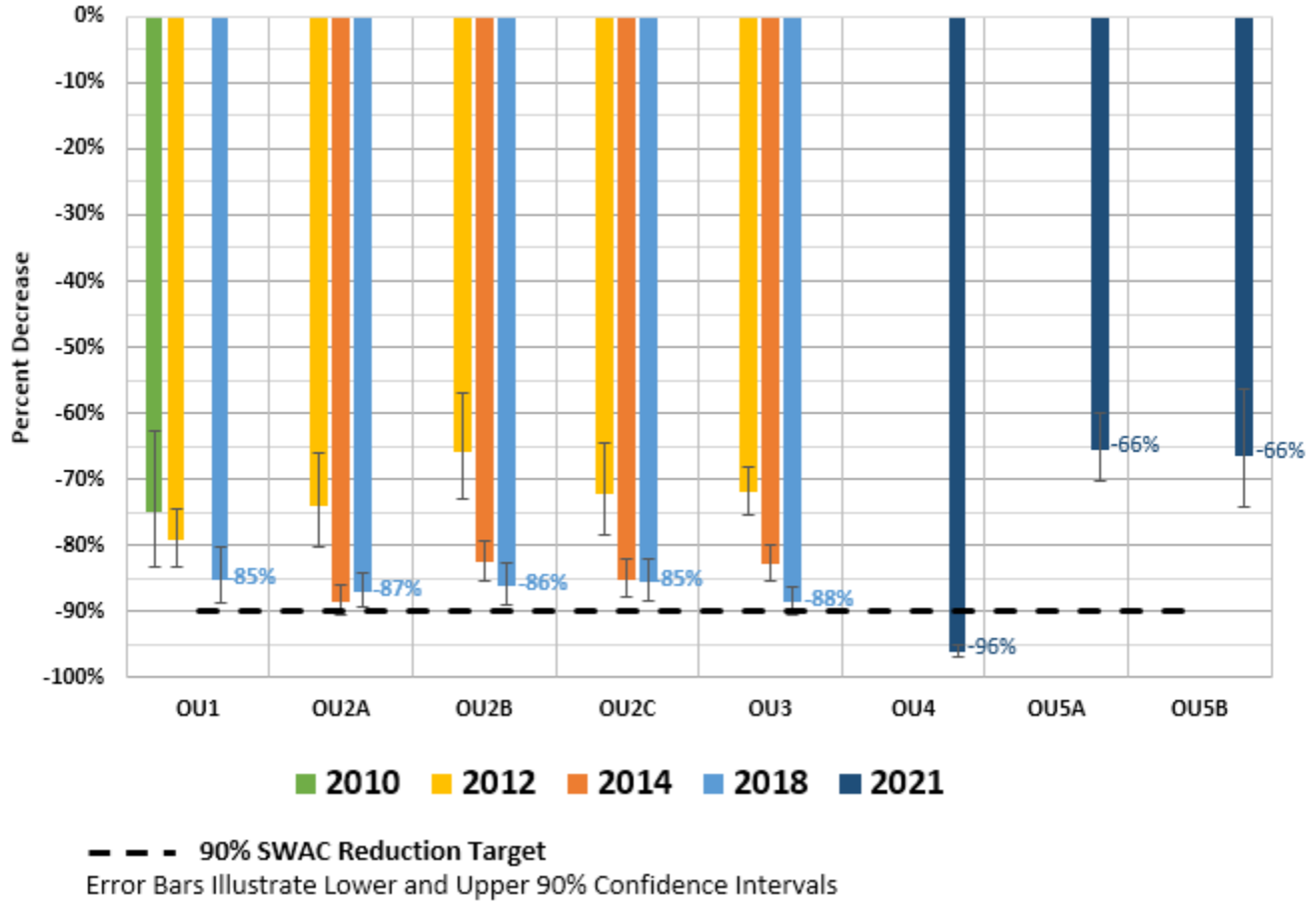
Remedy Effectiveness: Water and Biota PCBs

- Surface water concentration reductions
  - OUs 1, 3 and 4: ~90% reductions below baseline (similar to SWAC reductions)
  - At or near ROD performance standards
- Fish tissue concentration reductions
  - 90% reductions from baseline already achieved for some species
  - All OUs trending to upstream background (Lake Winnebago; LW) levels
  - Lowest adverse effect level to protect eco species achieved in OUs 1, 3 and 4
  - Concentration reductions may allow relaxation of fish consumption advisories
- OUs 2 and 5 recovery consistent with natural recovery projections

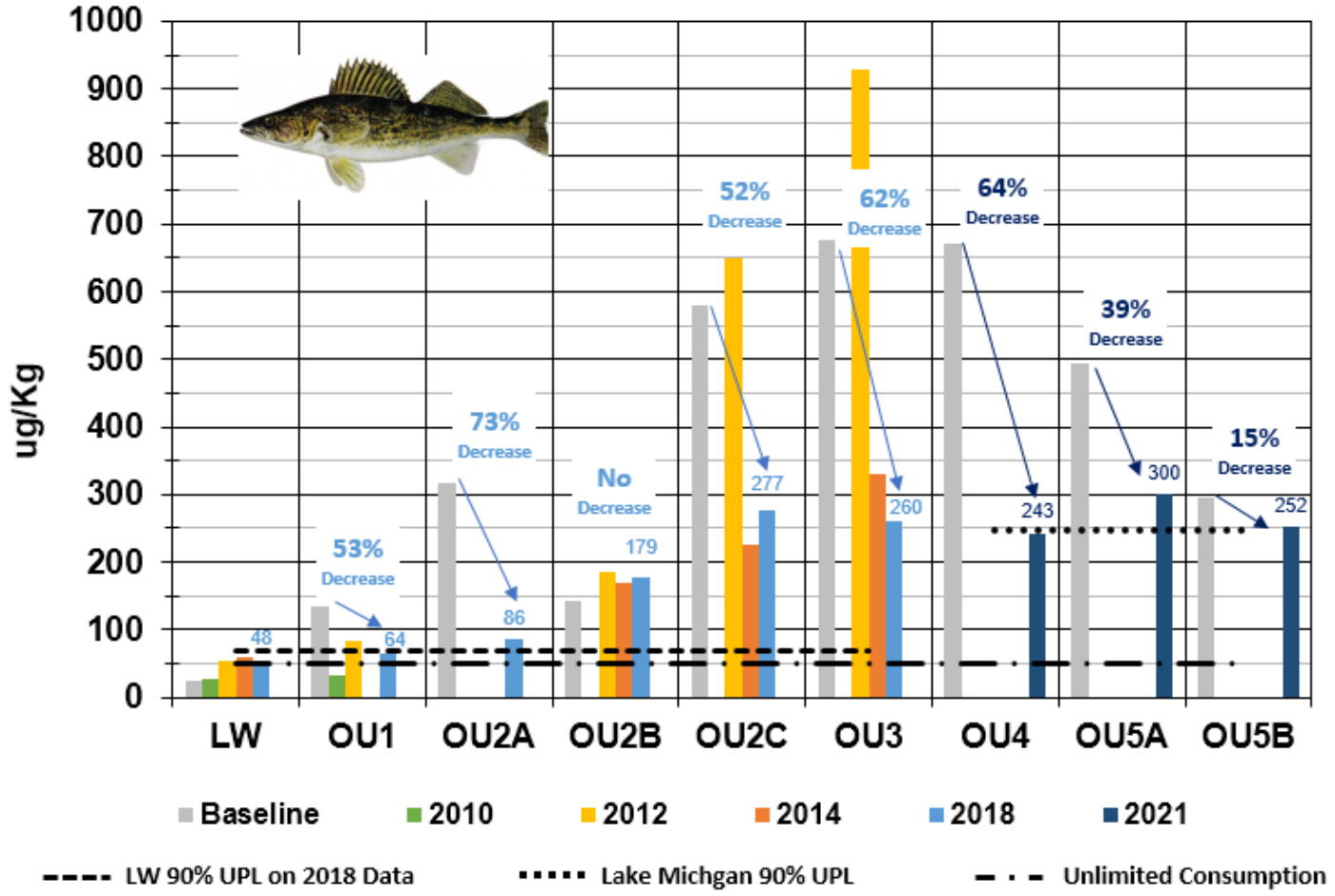
Surface Water PCB Recovery



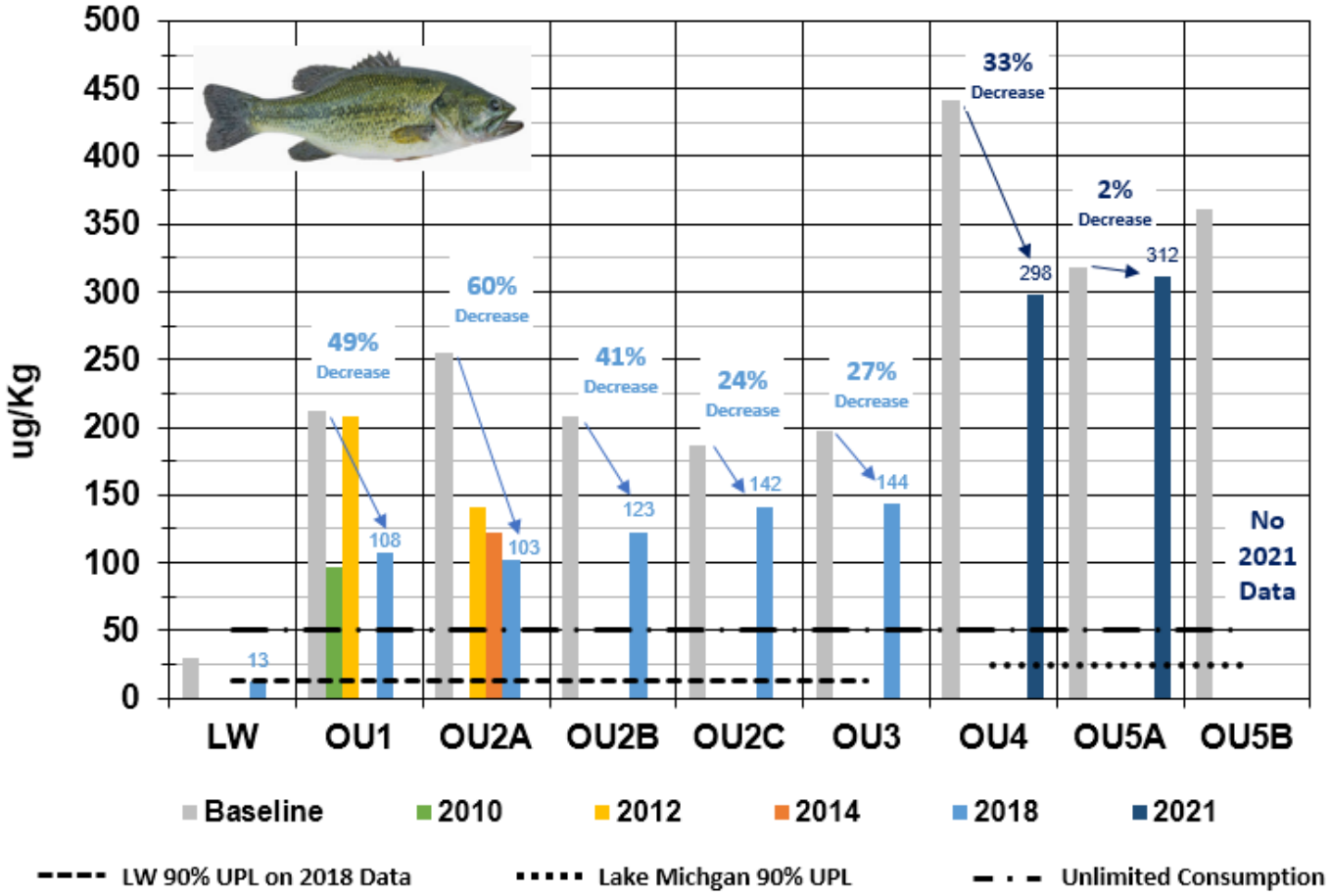
Surface Water Reductions: With Covariate Data



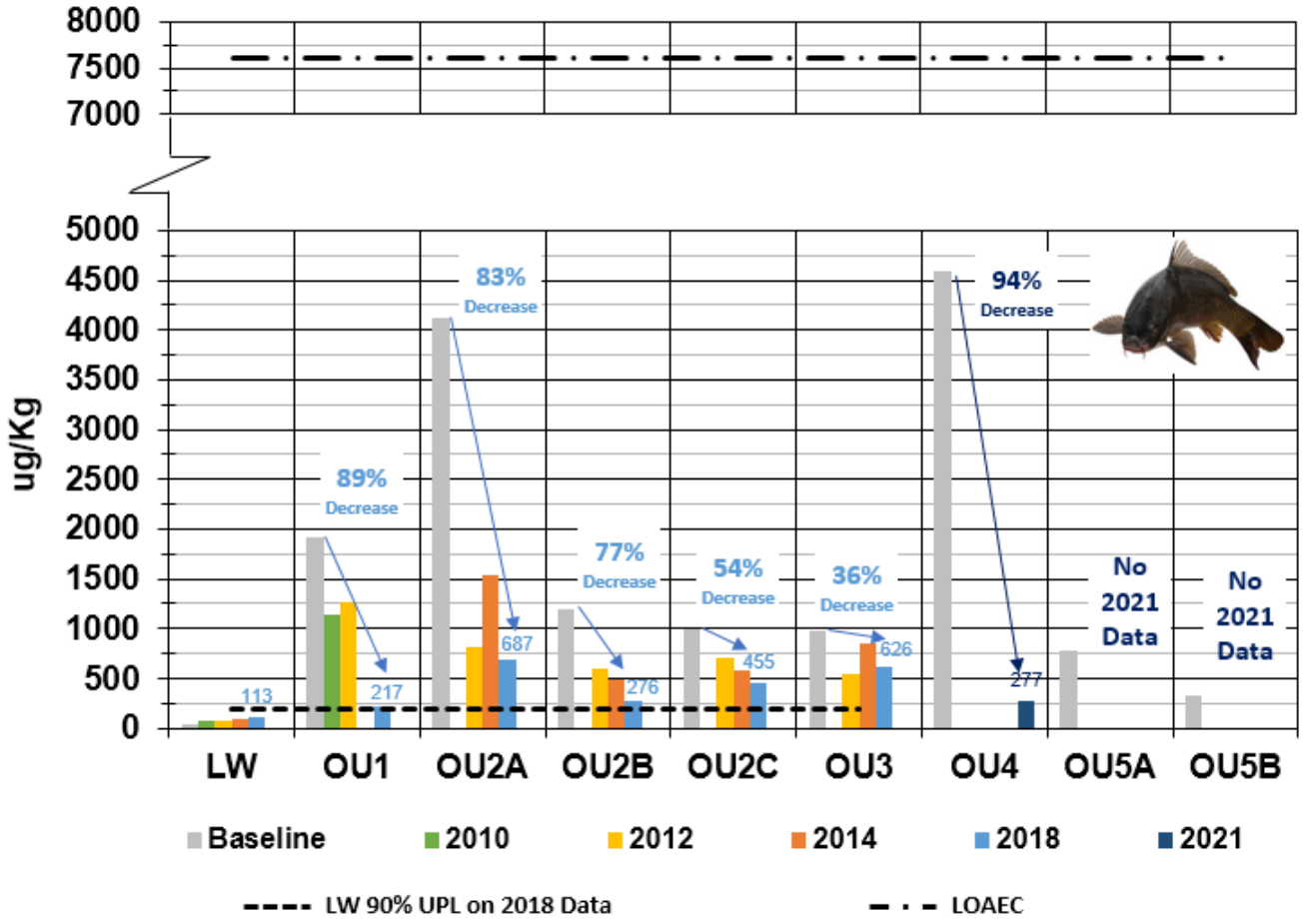
Walleye Fillet Tissue PCB Recovery



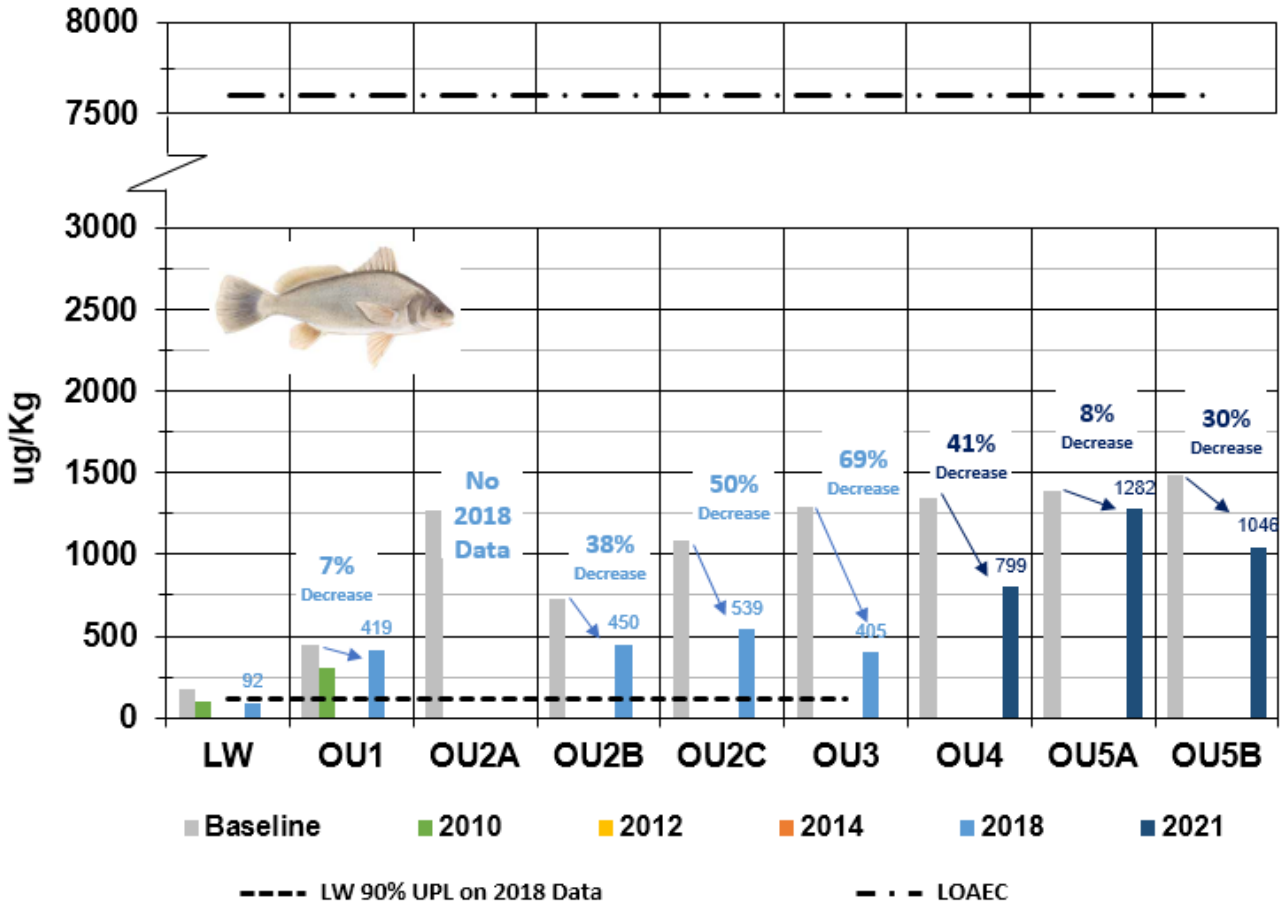
Smallmouth Bass Fillet Tissue PCB Recovery



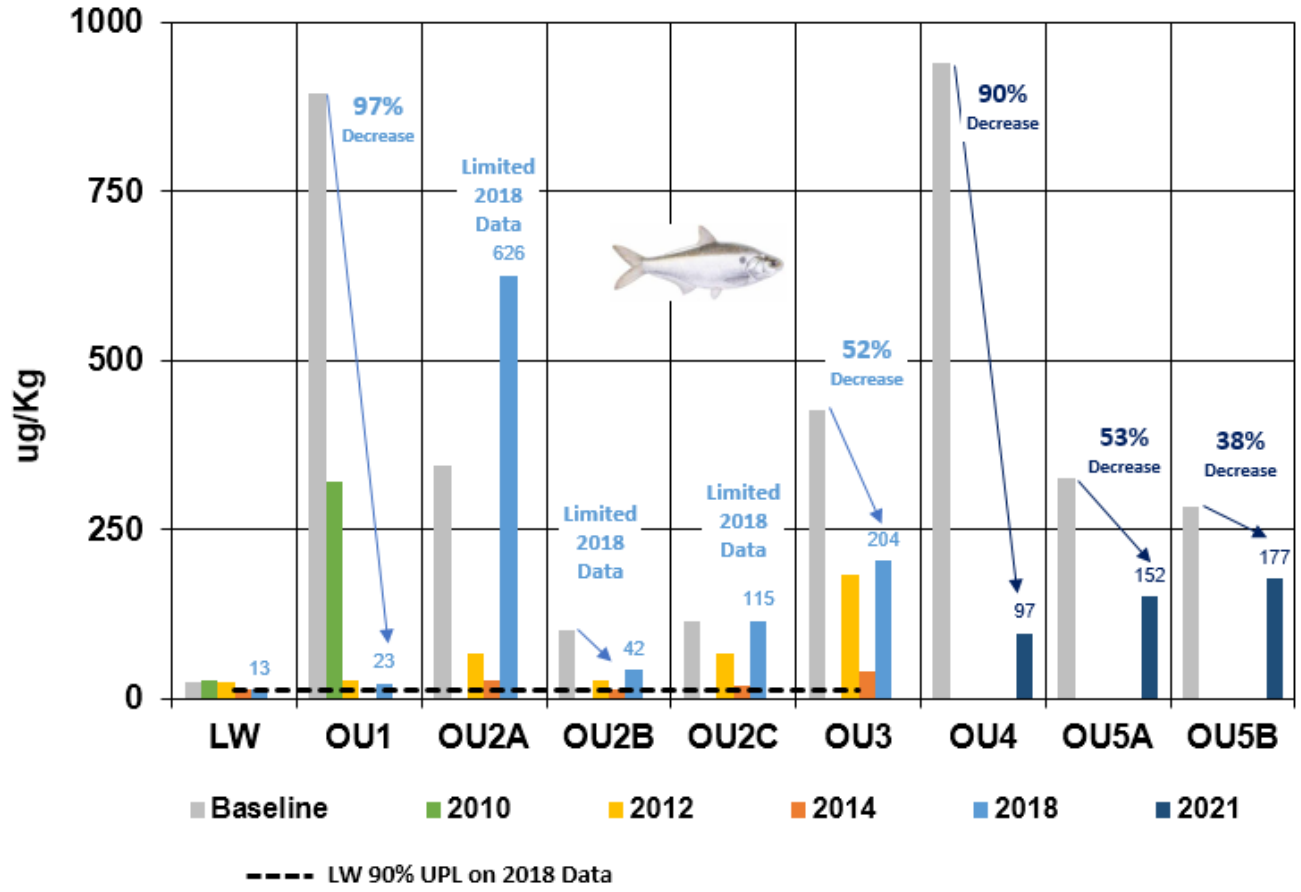
Carp Whole-Body Tissue PCB Recovery



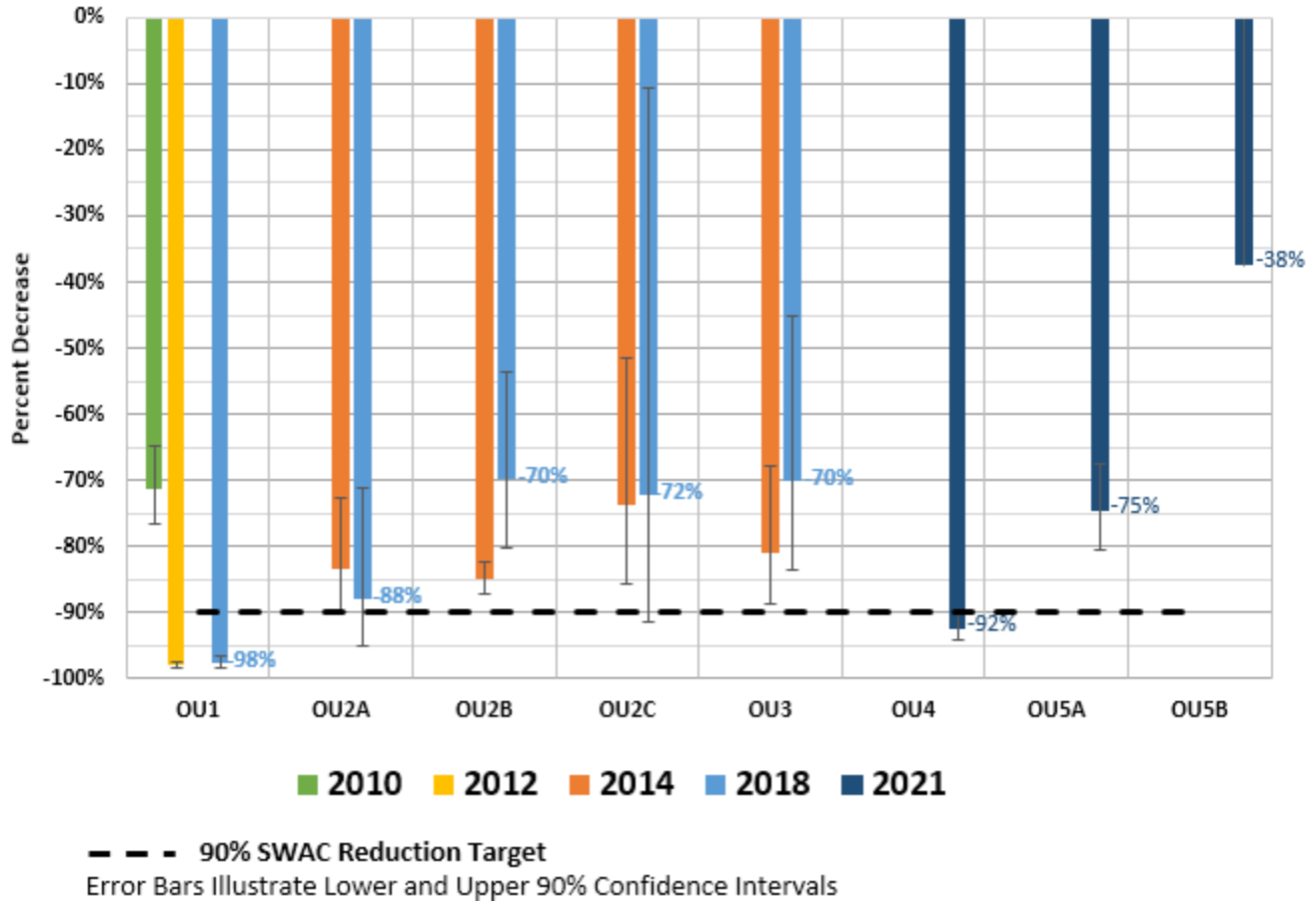
Drum Whole-Body Tissue PCB Recovery



Gizzard Shad Whole-Body Tissue PCB Recovery (young-of-year)



Gizzard Shad Reductions: With Covariate Data



Key Take-Home Messages

- ROD needed to be amended due to detailed design data collection
- Up-front residuals management decision framework was key
- Up-front remedy effectiveness criteria drove remedy design
- Exposure reduction achieved by both dredging and caps/covers
- Sediment cleanup rapidly reduced surface water concentrations
- Fish tissue data variable but trending in the right direction
  - 5 to 10 years post-remedy data may be required for effectiveness confirmation