HUDSON RIVER NATURAL RESOURCE DAMAGE ASSESSMENT (NRDA)

Pre-CAG Meeting, Ft. Edward, NY

June 30, 2011

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Introduction on Trustee Perspectives

- **Superfund –hazardous waste releases**
  - cleanup (EPA, NYSDEC): reduce or eliminate present and future threats to human health and/or the environment
  - restoration (trustees: USFWS, NOAA, NYSDEC): protect and restore injured natural resources; NRDA: past, present and future injuries/lost uses from release and remedy
- **Coordination of cleanup and restoration -broad trustee goals:**
  - Minimize remaining surface contamination, and
  - Maximize amount and quality of reconstructed habitat
- **Why?** Most effective restoration and recovery begins with cleanup and reconstruction of habitats

Today:

Presentations: *analyses and recommendations to GE on improvements to the Phase 2 Remedial Design that could be implemented to reduce ongoing and remedial injury to natural resources and accelerate recovery of the river.*

1. **Unremediated PCBS in the Hudson River: Implications for Recovery and Restoration**
2. **Habitat Replacement and Reconstruction and the Implications for Restoration**
3. **Q&A**

Websites for Additional Information

- http://www.fws.gov/contaminants/restorationplans/HudsonRiver/index.html
- http://www.darrp.noaa.gov/northeast/hudson/admin.html

Trustees Letter to GE on the Phase 2 Design Report

- http://www.darrp.noaa.gov/northeast/hudson/pdf/lettertoGEPhase2design_signed.pdf. June 21, 2011

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Websites (cont.)

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http://www.darrp.noaa.gov/northeast/hudson/pdf/final_GE_letter_August_2006.pdf

Trustees Letter to General Electric regarding Intermediate Design Report, November 7, 2005.

http://www.darrp.noaa.gov/northeast/hudson/pdf/letter_GE_November_2005.pdf

UNREMEDIATED PCBS IN THE HUDSON RIVER: IMPLICATIONS FOR RECOVERY AND RESTORATION

Jay Field[1], Lisa Rosman[1], Tom Brosnan[1], Bob Foley[2]

1. NOAA/OR&R/Assessment and Restoration Division
2. US Fish and Wildlife Service

Unremediated PCBs: Summary

- Phase 2 remediation requires GE to remove at least 95% of PCBs from the areas designated for dredging.
- Pre-dredging PCB concentrations in the Upper Hudson River are much higher than the levels predicted by the EPA’s models.
- Post-dredging, high levels of PCBs will remain in the surface in areas *not* designated for dredging, especially in River Section 2 and 3 ---these are unremediated PCBs.
- Most of the unremediated PCBs are found in close proximity (within 200 ft) of existing dredge area boundaries
- Unremediated PCBs are likely to negatively impact the recovery and restoration of the river.

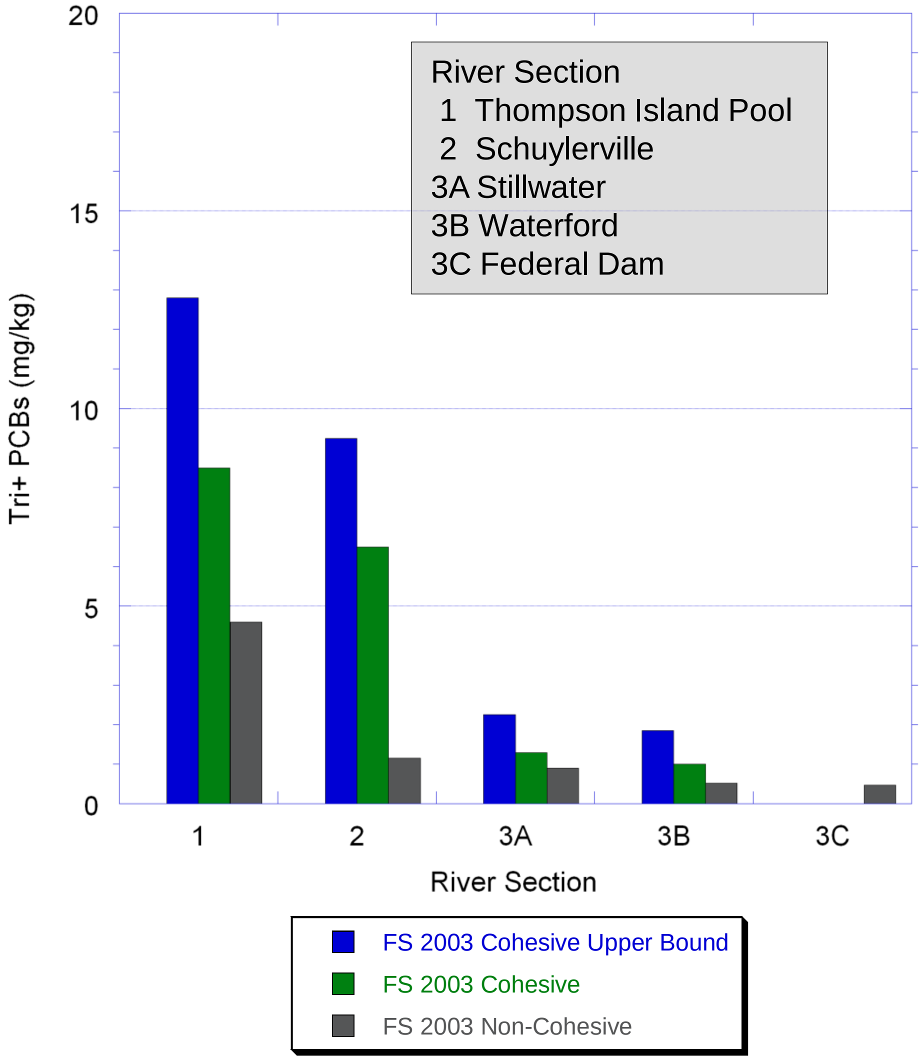
Key Questions

- Model Predictions: How do PCB concentrations in the surface compare with the PCB concentrations predicted by a model? (both before and after dredging)
- Extent of Unremediated PCBs: What are the expected PCB concentrations in the surface sediment outside areas designated for dredging?
- Impacts of Unremediated PCBs: What are the potential impacts of these high levels of unremediated PCBs in surface sediment on the recovery and restoration of the river?

Model Predictions: Pre-Dredging Surface Sediment Concentrations

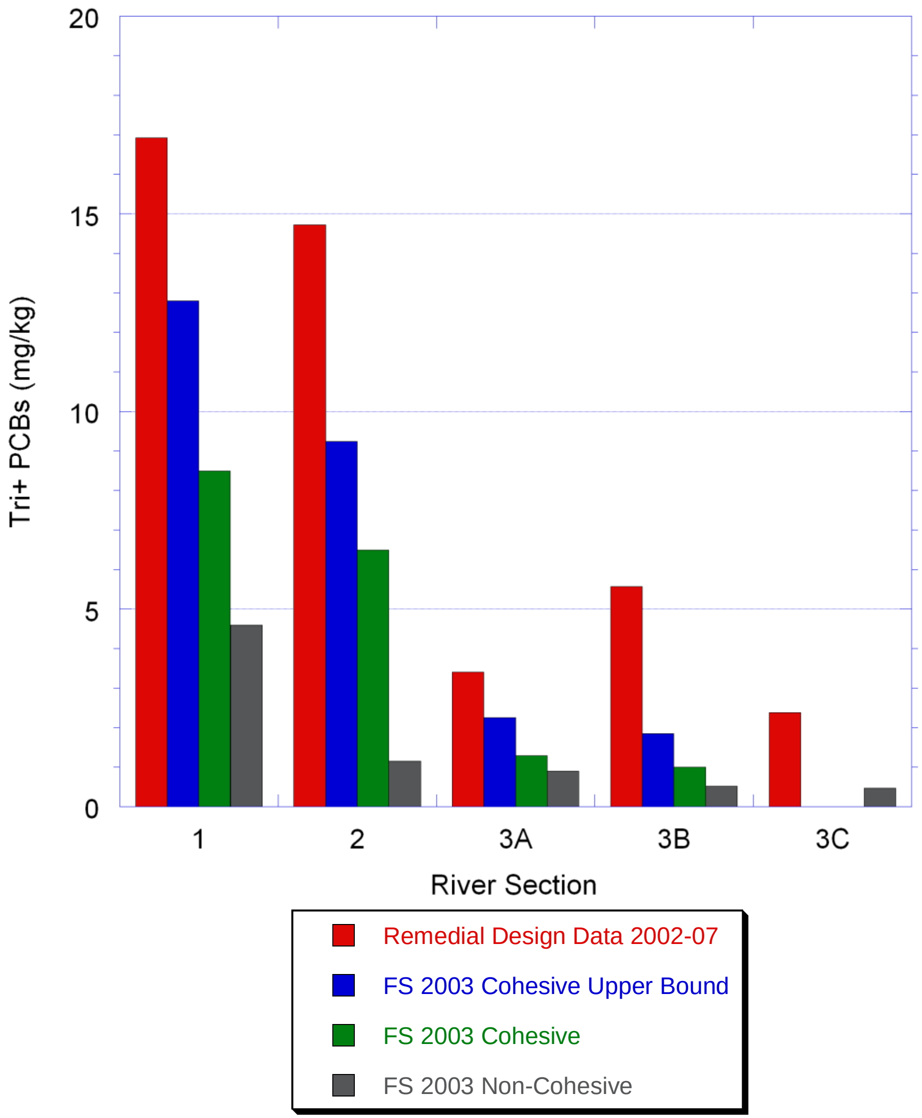
- EPA (and GE) used models to predict the PCB concentrations in the surface sediment at the time of dredging (dredging was expected to begin in 2003) and after dredging was completed.
- Between 2002 and 2007, GE collected about 9000 sediment cores to define areas that needed to be dredged according to the selected remedial alternative in the ROD.

Model Predictions for 2003 Average Surface Tri+ PCBs by River Section (top 5 cm)



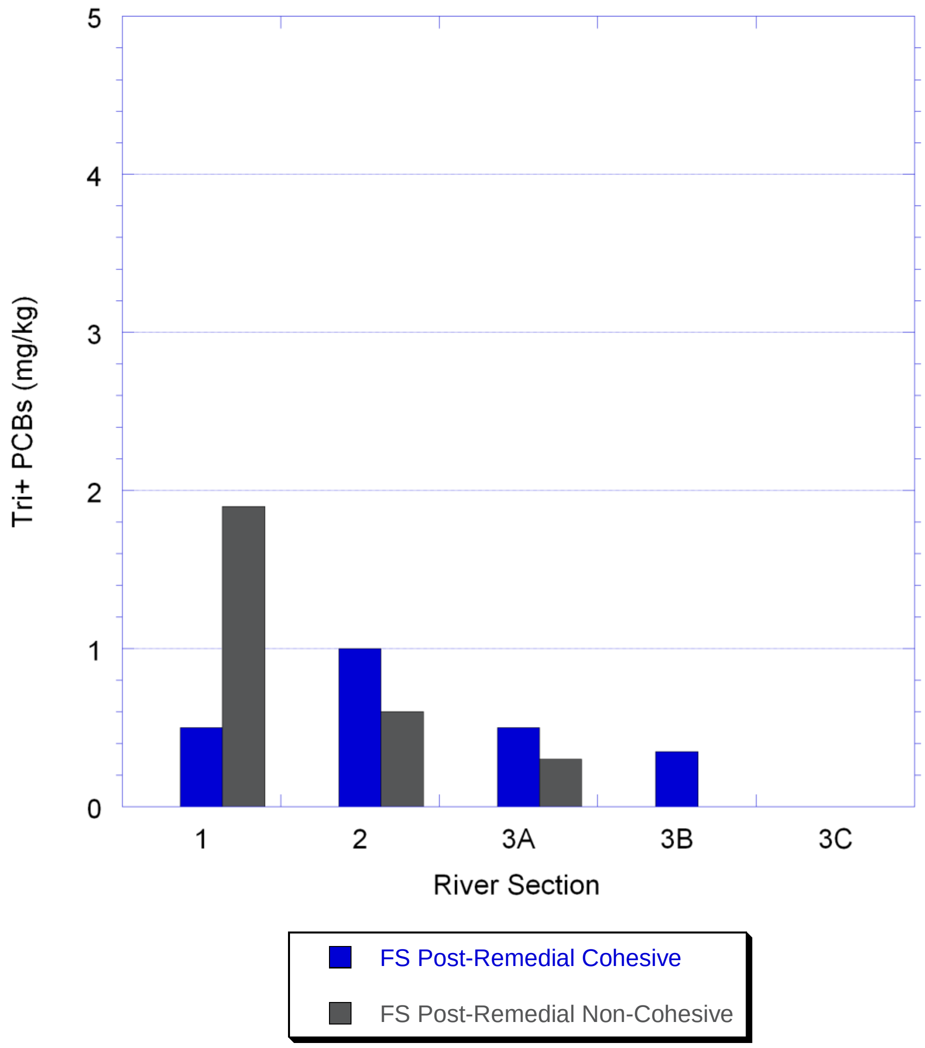
- Models evaluated cohesive (fine-grained) and non-cohesive sediments.
- Model predictions of Tri+ PCB concentrations in the surface by river section and sediment type before the start of dredging.
- Samples collected to define dredge areas in River Sections 2 and 3 targeted fine-grained sediment (cohesive sediment).

Comparison of Average Tri+ PCBs by River Section from Remedial Design with Model Predictions for 2003 Surface (top 5 cm)



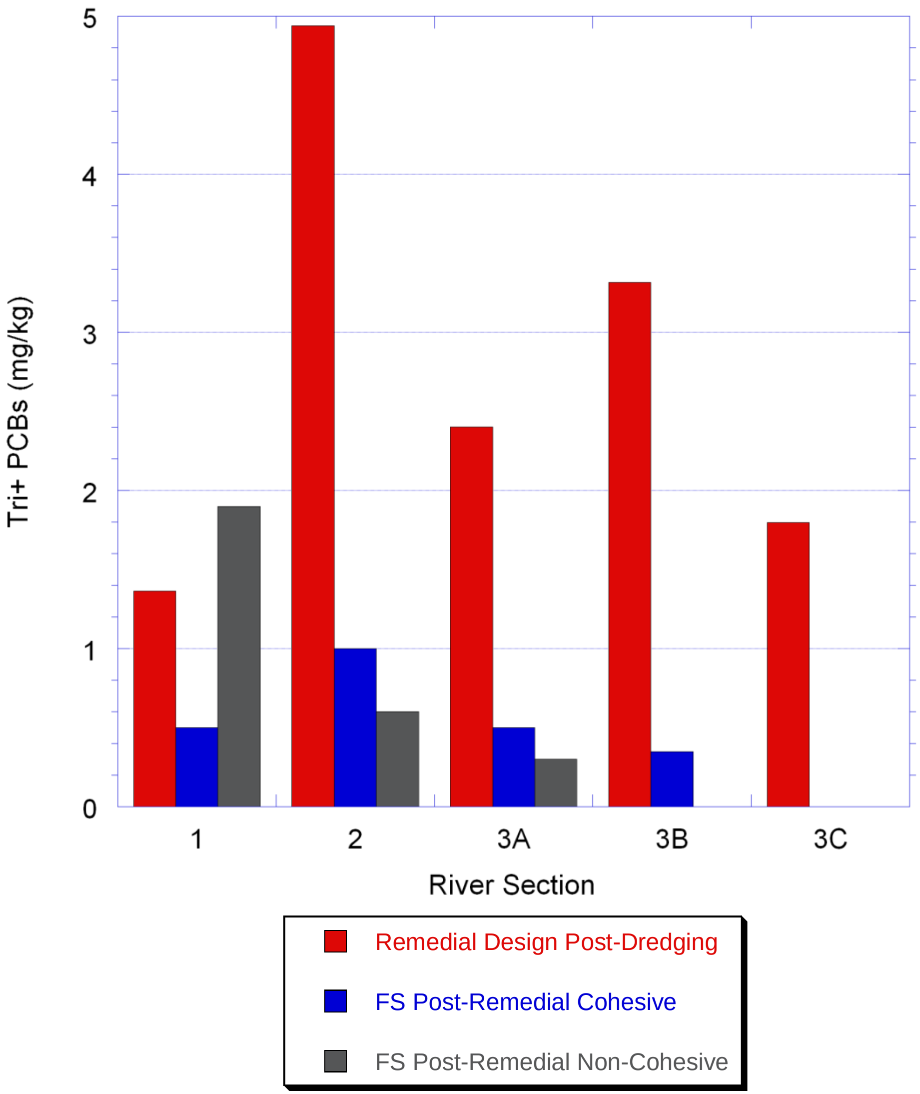
- Natural recovery models greatly overestimated the rate of recovery.
- Remedial Design Tri+ PCB concentrations from the top 5 cm (red bars) exceeded the upper bound of model predictions (blue bars) and were more than 2X the concentration predicted for cohesive sediments in all 3 river sections (green bars).
- Widespread burial of PCBs in the surface sediment was not observed.

Estimated Post-Dredging Surface Concentrations from Model Predictions



- The Record of Decision expected that the selected alternative would result in average Tri+ PCB concentrations in the upper 5 cm in cohesive sediments less than 1 ppm throughout the Upper Hudson.

Estimated Post-Dredging Surface Concentrations Compared to Remedy Expectations



- River Section 1: Estimated post-dredging Tri+ PCB concentrations from Remedial Design data for the top 5 cm (red bars) are comparable to model predictions
- River Sections 2 and 3: Post-dredging concentrations are estimated to be about 5X higher than model predictions

Unremediated PCBs: Surface

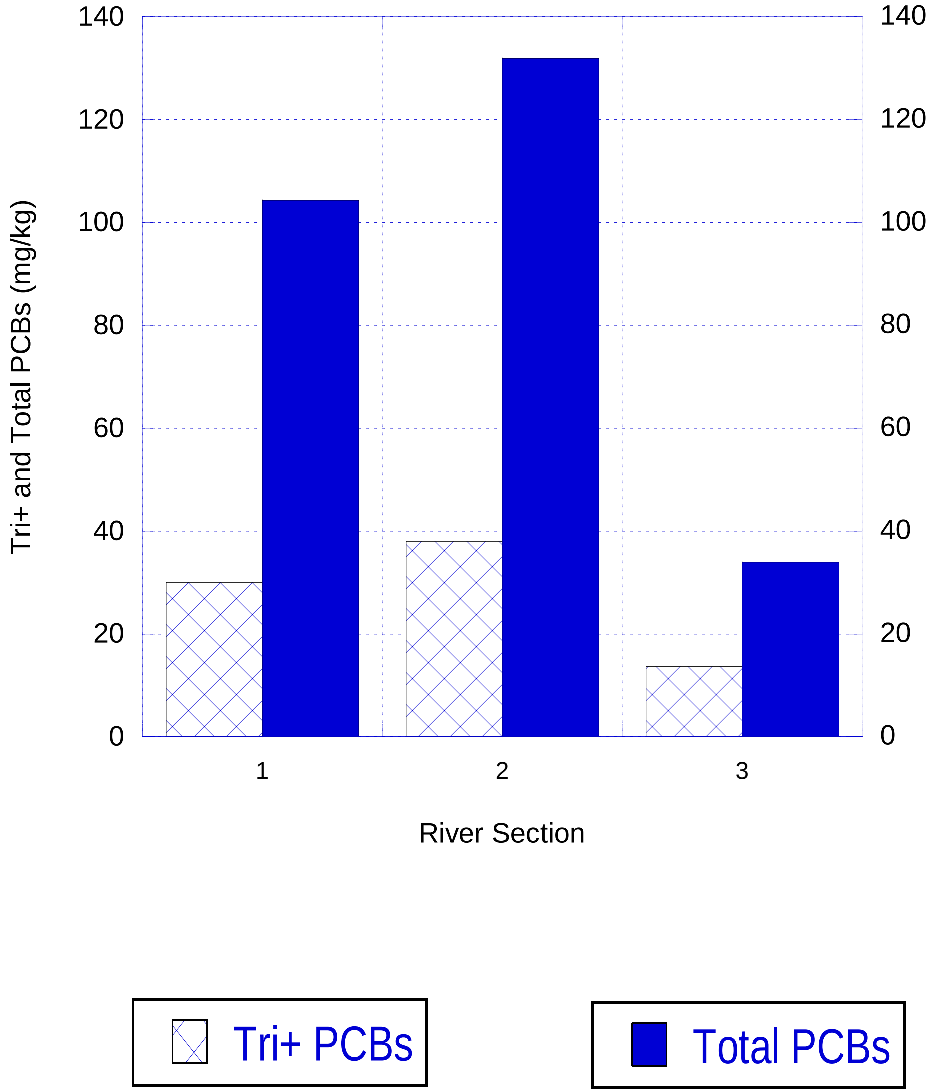
- “Surface” for the purposes of the target cleanup triggers is defined by EPA as the concentration of the PCBs in the top 12 inches of sediment

Target Cleanup Triggers

- River Section 1 (Thompson Island Pool):
  - 3 g/m^2 Tri+ PCBs Mass per unit area (MPA)
  - **10 mg/kg Tri+ PCBs in surface sediment** (in top 12 inches) (~ 25-30 ppm total PCBs)
- River Sections 2 & 3
  - 10 g/m^2 Tri+ PCBs MPA
  - **30 mg/kg Tri+ PCBs in surface sediment**

    (~ 60-90 ppm total PCBs)

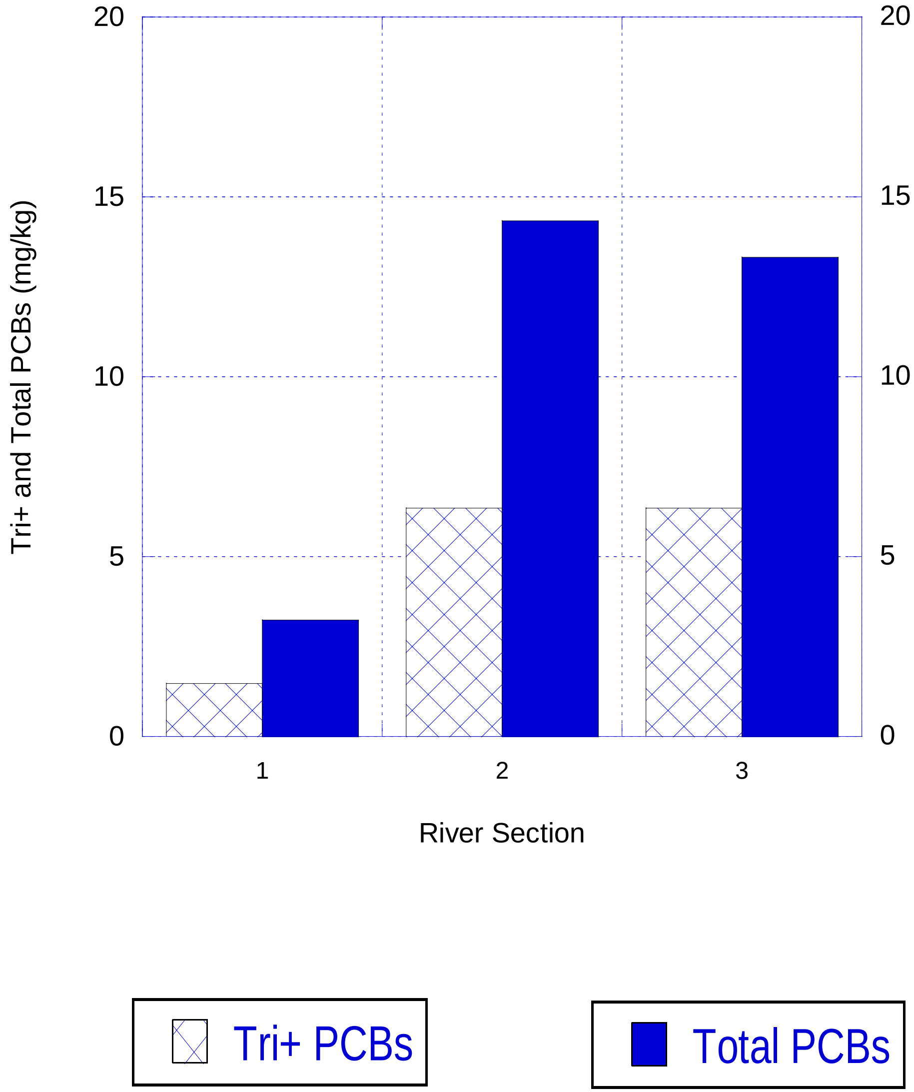
Pre-Dredging Surface PCBs



Prior to dredging:

- Average PCB concentrations in the surface (top 12 inches) in River Sections 1 and 2 exceed 100 ppm total PCBs (solid blue bars) and 30 ppm Tri+ PCBs (hatched blue bars).

Estimated Post-Dredging Surface PCBs



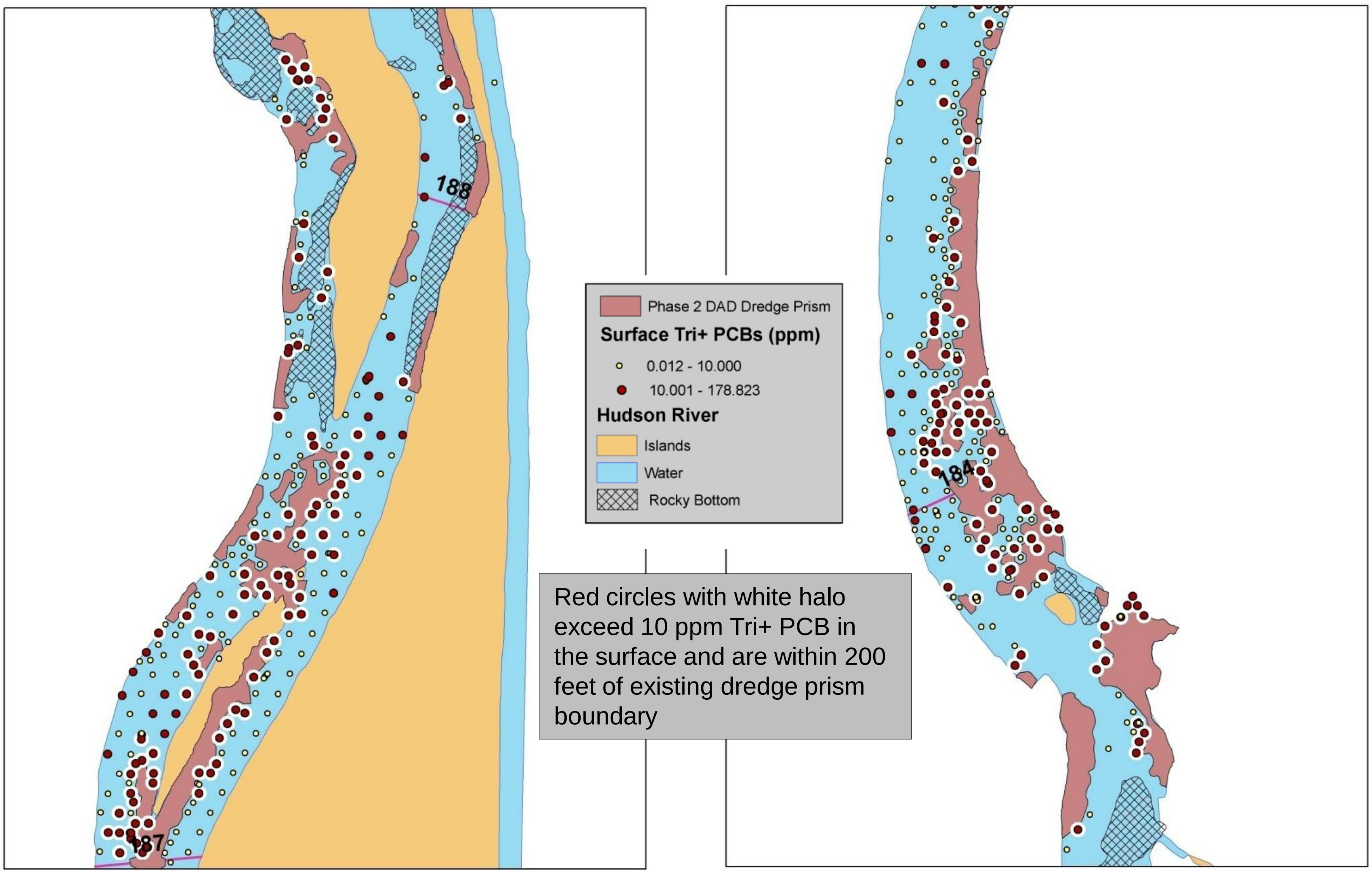
Post-dredging:

- Surface PCB concentration in River Section 1 will be greatly reduced.
- Surface PCB concentration in River Sections 2 and 3, though reduced, will remain highly elevated

River Section 2

Upper Fort Miller Pool

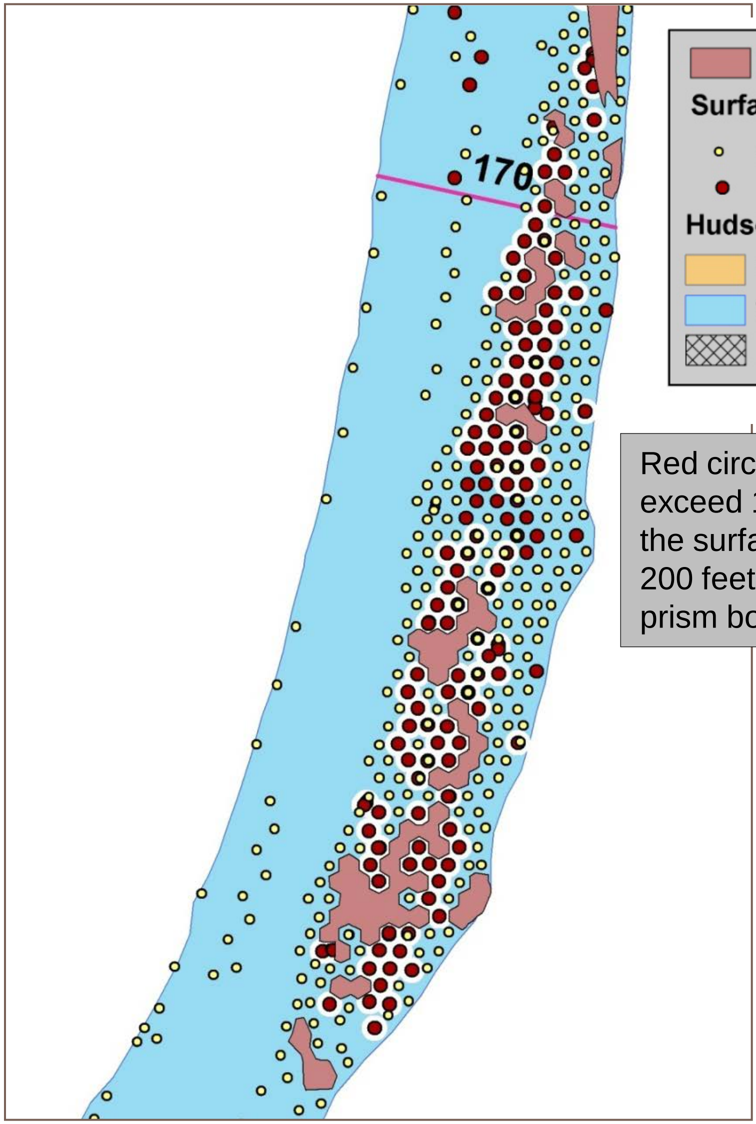
Northumberland Pool



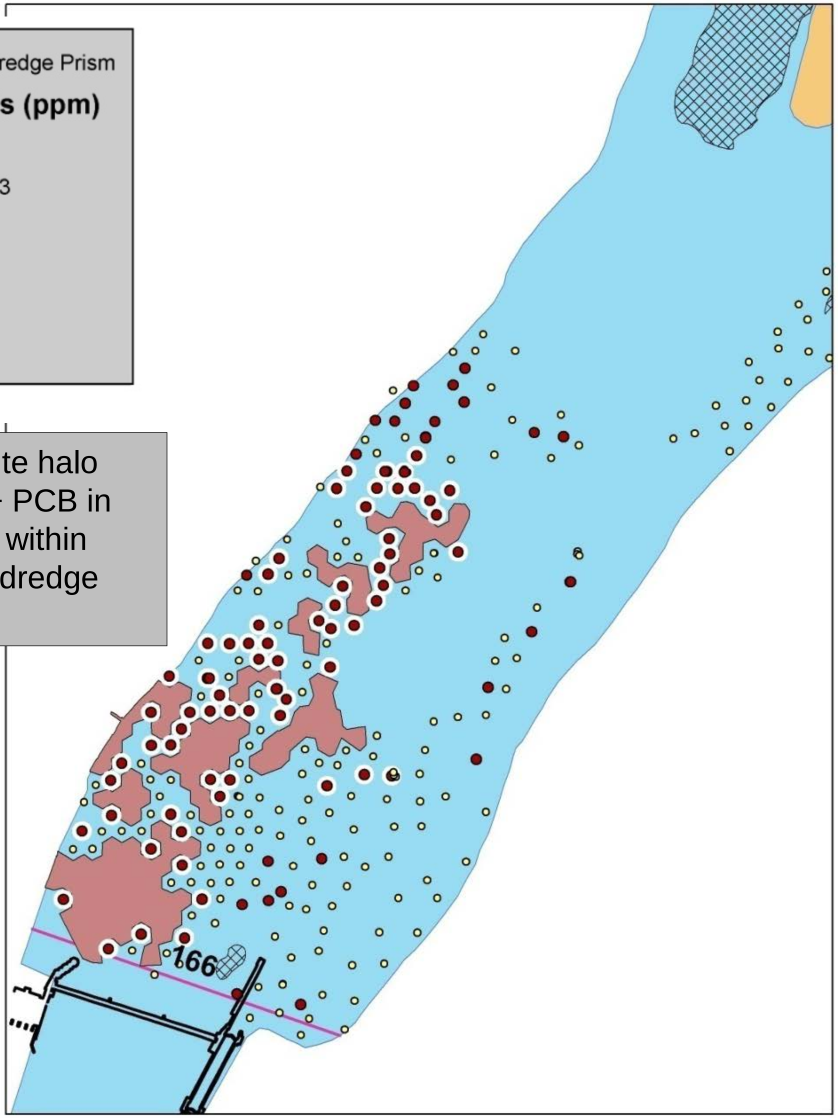
Red circles with white halo exceed 10 ppm Tri+ PCB in the surface and are within 200 feet of existing dredge prism boundary

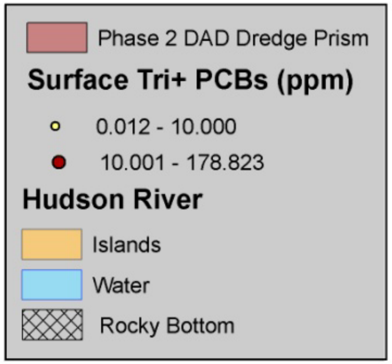
River Section 3

Hot Spot 36



Hot Spot 37





Red circles with white halo exceed 10 ppm Tri+ PCB in the surface and are within 200 feet of existing dredge prism boundary

Weed Bed at Hot Spot 36

Estimated number of additional acres and post-remedial surface Tri+ PCB concentrations

Table shows the estimated **number of acres** and post-remedial surface Tri+ **PCB concentrations** based on additional removal of cores outside of the current Phase 2 dredge prisms exceeding the River Section 1 surface criterion.

River Section	Total Number of Acres Outside Dredge Prisms with Surface Tri+ PCB >10 ppm		Estimated Tri+ PCB (ppm) in Surface Following Additional Removal of Cores with Surface Tri+ PCB >10 ppm		
	Cores within 200 ft of Dredge Prism	All Cores Outside Dredge Prism	Cores within 200 ft of Dredge Prism	All Cores Outside Dredge Prism	No Additional Removal
RS2	37 acres	45 acres	2.5 ppm	1.6 ppm	6.4 ppm
RS3	62 acres	91 acres	3.2 ppm	1.9 ppm	6.4 ppm
Total	99 acres	136 acres			

Note: Basis for the acreage estimate: one core=1/8 acre from E. Garvey personal communication 2010. Surface PCB concentrations as defined by EPA (2004).

Model Predictions of Natural Recovery: Pre- and Post-Dredging Surface Sediment Concentrations (top 5 cm)

- Pre-dredging sediment concentrations exceeded the upper bound of model predictions and were more than two times higher the mean concentration predicted for cohesive sediments in all 3 sections of the Upper River.
- In River Section 1, the estimated post-dredging surface concentration of PCBs is consistent with model predictions
- In River Sections 2 and 3, estimated post-dredging surface concentrations of PCBs are **five times higher** than the expected concentrations based on model predictions.

Unremediated PCBs

- Average surface PCB concentrations pre-remediation in River Sections 1 and 2 are comparable and exceed 100 ppm total PCBs.
- Surface cleanup trigger for River Sections 2 and 3 is three times higher than for River Section 1. Consequently, estimated post-remediation surface PCB concentrations will be greatly reduced in River Section 1, but not nearly to the same degree in River Sections 2 and 3.
- High percentage of cores outside of dredge areas with surface concentrations exceeding 10 ppm Tri+ in River Sections 2 and 3 are in close proximity (within 200 feet) to the areas designated for dredging.

Concerns about Unremediated PCBs

- PCB hot spots will be only partially remediated in River Sections 2 and 3
- Highly contaminated areas will remain adjacent to dredged areas post-remedy.
- Many of these areas are located in shallow (<10 ft) water, making the adjacent non-dredged areas vulnerable to disturbance and resuspension.
- Recontamination of remediated areas is likely.

Potential Impacts on Recovery

- Highly elevated PCB concentrations will remain in the surface following remediation, with average surface concentrations 5X higher in River Sections 2 and 3 than anticipated in the ROD.
- Recovery of the Upper and Lower Hudson River is likely to take much longer than anticipated by the 2002 ROD.

Potential Impacts on Restoration

- The magnitude of contamination remaining post-dredging may limit the type and amount of in-river restoration options in the Upper Hudson, where it would be most valuable.
- In-river restoration projects may need to be located further from the areas of greatest remaining contamination.
- Recovery of the Hudson could be significantly accelerated through additional removal of highly contaminated surface sediments adjacent to currently delineated dredge areas. This would also provide the trustees with additional opportunities for restoration in the Upper Hudson.

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HUDSON RIVER REMEDY PART II:

Habitat Replacement and Reconstruction and the Implications for Restoration

Lisa Rosman[1], Carl Alderson[2], Bob Foley[3], Tom Brosnan[4]

1. NOAA/OR&R/Assessment and Restoration Division
2. NOAA/Restoration Center
3. US Fish and Wildlife Service
4. NOAA/OR&R/Assessment and Restoration Division

Outline

- **Brief Status of the Hudson River Remedy**
- **Habitat Replacement/Reconstruction Program**
- **Habitat Quality Issues**
- **Recommended Components of a High Quality Habitat Design**
- **Summary**

Status of the Remedy: Phase 2

- EPA and GE agreed on a remedy that includes river bottom dredging and a habitat replacement and reconstruction program.
- Phase 1 of the remediation was conducted in River Section 1 in 2009. The habitat replacement and reconstruction program for Phase 1 focused on four habitat types.
- Phase 2 comprises the rest of the dredge areas, including completion of River Section 1, beginning in Spring 2011, and similarly includes a habitat replacement and reconstruction component for four habitat types.

Habitat Replacement and Reconstruction Program

- The Habitat Replacement and Reconstruction program was designed to partially replace the habitat destroyed by remediation.
- Primary goal: replace the functions and characteristics of impacted habitats so that they return to the range of functions and characteristics found in similar areas of the river not impacted by dredging.
- The Trustees have identified improvements to this program that will reduce the time to recovery of the Hudson River ecosystem.

Unconsolidated River Bottom (UCB)

- UCB Defined as Unvegetated River Bottom

- One of Two Backfill Types Placed in Dredged UCB
  - Type 1: Medium Sand
  - Type 2: Coarse Sand/Gravel

- Examples of Ecosystem Services
  - Habitat for plants, invertebrates, fish and wildlife
  - Sediment for replenishing floodplains

Aquatic Vegetation Beds (SAV)


Wild celery, *Vallisneria americana*


White water lily, *Nymphaea odorata* (foreground)

- SAV Defined as Vegetated (Submerged or Floating Plants) River Bottom;
- Numerous SAV Present but Dominated by Wild Celery
- Two Methods for Re-establishment
  - Active: Planting 2 submerged &1 floating spp.
  - Passive: Natural recolonization
- Examples of Ecosystem Services
  - Sediment stability
  - Nutrient and organic cycling
  - Provision of habitat for invertebrates, fish and wildlife

Riverine Fringing Wetlands (RFW)

- RFW Defined as Emergent Vegetation;
- Numerous RFW species present
- Method for Re-establishment
  - Zone A: Seeding
  - Zone B: Planting
- Examples of Ecosystem Services
  - Sediment stability
  - Energy Dissipation
  - Nutrient and organic cycling
  - Provision of habitat for invertebrates, fish and wildlife

Shoreline (SHO)

- SHO Defined as Banks above 5000 CFS;
- Methods for Stabilizing
  - Backfill (soft)
  - Biologs (Phase 1 only, soft)
  - Angular stone (hard)
- Method for Re-Vegetating
  - Plantings using Live Stakes
  - Lawn or Herbaceous Seed Mix
- Examples of Ecosystem Services
  - Shoreline stability
  - Shade and cover
  - Nutrient and organic cycling
  - Provision of habitat for invertebrates, fish (when inundated) and wildlife

Woody debris provides habitat and dissipates energy

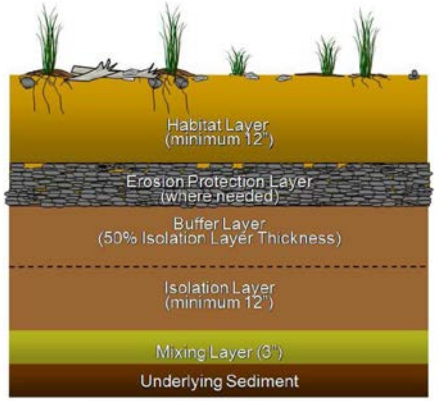
Examples of Habitat Quality Issues

- Potential for Recontamination of Remediated Sediments and Continued PCB Exposure

- Steep ($\geq$3:1) and Unstable Slopes
- Hardened Shorelines and River Bottom
- Delayed and Prolonged Recovery of Freshwater Mussels
- Reduced Bottom Habitat Available for Recolonization of Aquatic Vegetation Bed
- Lower Diversity of Plant Community
- Poorer Quality Breeding, Nursery, Foraging, and Sheltering Habitat
- All the Above Result in the Loss of Habitat Complexity, Function, Resiliency, and Sustainability

Recommended Components of a High Quality Habitat Design

1. Greater PCB removal in the Upper Hudson River
2. More than 1:1 replacement and reconstruction of SAV, RFW, and SHO habitat
3. Provision of sufficient backfill quantity and quality for optimal re-establishment of all disturbed SAV beds
4. Backfill tolerances should be more suitable for habitat reconstruction (RFW: $\pm$0.1 ft, SAV: -0.25 ft to +1ft)
5. More gradual river bottom slopes ($\leq$10:1) for re-establishment of SAV, RFW, sediment stability, low resuspension of sediments
6. Habitat layer on top of all caps to support emergent and aquatic plants, nesting fish, burrowing invertebrates and wildlife

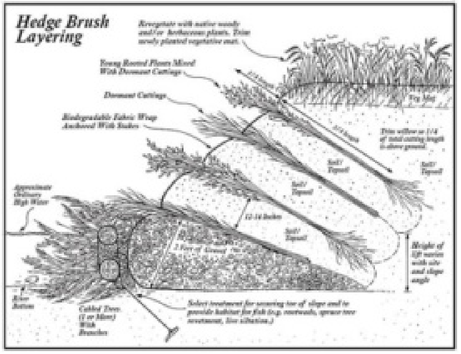


General Schematic of Cap

Source: NYSDEC 2010

Recommended Components of a High Quality Habitat Design

7. Revegetate from locally collected stock (EPA Eco Level III Region 59 Hudson River sub-region)



8. Replacement of plant species diversity and structure

9. Reconstruction and seeding of dredged freshwater mussel beds lost during remediation.

10. Place stronger emphasis on reconstructing natural soft shorelines.

11. Improve the outcome and function of ecosystem and habitats monitoring and using models in an adaptive management strategy.

12. Use performance-based criteria that define the successful recovery of function, sustainability, and resilience of reconstructed habitats

Implications of the Habitat Replacement and Reconstruction on Recovery of the River

- The Trustee's starting point is a robust PCB clean up and a high quality design for habitat replacement and reconstruction. These should be the first stage in recovering all habitats in the Hudson River.

- The quality of the reconstructed four habitat types impacted by remedial activities is of great importance to the Trustees.

- Further reductions in PCBs in sediments, and improvements to both the habitat components of the remedial design and the adaptive management plan could accelerate the recovery of the Hudson River.

- These changes could also reduce short- and long-term residual and remedial injury to natural resources (Brosnan and Foley 2011).

QUESTIONS?




For More Information

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NOAA

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Website: http://www.darrp.noaa.gov/northeast/hudson/admin.html