Especially Sensitive or Unique Habitats of the Upper Hudson River.

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Abstract

Over 200 miles of the Hudson River is contaminated with PCBs discharged from two capacitor manufacturing plant sites located in Hudson Falls and Ft Edward, NY. Approximately 40 miles of highly contaminated sediments of the Upper Hudson River are designated for remedial action by EPA's Record of Decision (2002). The first phase of the Upper Hudson River remedy is scheduled for 2009. The full Remedial Design targets 490 acres of river for remediation, which includes removing 1.8 million cubic yards of PCB-contaminated sediments in the Upper Hudson (GE 2008). As part of the remedial design process, the Hudson River natural resource Trustees (NOAA, New York State, and the U.S. Fish and Wildlife Service) identified 57 especially sensitive or unique habitat (ESUH) areas in the Upper Hudson River between Fort Edward and the Troy Dam. These ESUH areas consist of nearshore, shallow, and vegetated areas; mouths of deltas formed by tributaries; riparian forests and wetlands; and riparian/transitional zones. The location, characteristics and attributes of these areas are discussed. In addition, estimates of pre- and post-remediation PCB concentrations are presented by ESUH area. These findings will be used by the Trustees in the evaluation of residual injury to natural resources and identification of appropriate on-site and/or off-site natural resource restoration.

Introduction

The Hudson River Trustees, NOAA, the State of NY (NYSDEC and NYSDOL) and the US Fish and Wildlife Service (USFWS) designated especially sensitive or unique habitat (ESUH) areas in the 40 miles of the Upper Hudson River between Fort Edward and Troy (Figure 1) as part of the consultation process identified in the Hudson River Record of Decision (EPA 2002). Natural resource agency scientists defined the attributes and characteristics of ESUH areas based on their knowledge of the habitats and experience with the Upper Hudson River ecosystem. Five attributes and five habitat types were used to designate 57 ESUH areas. ESUH areas range in size from approximately 1 to 133 acres and extend linearly for up to 2.8 miles. Most ESUH areas do not include the navigation channel.

Upper Hudson River Model Sections

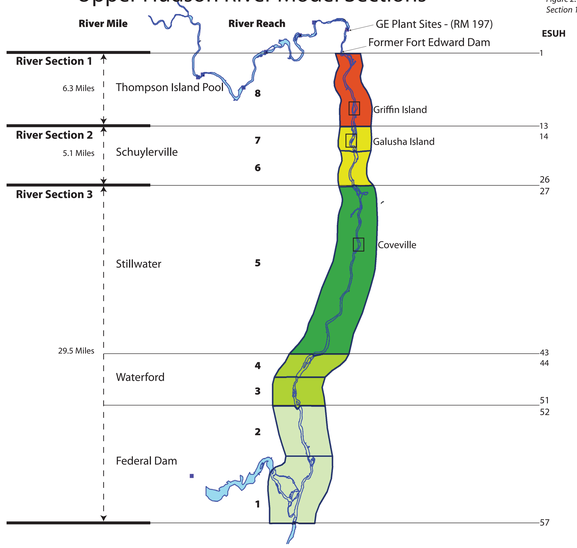

Figure 1. The Hudson River Superfund Site extends 200 miles from Ft Edward to the Battery in New York City, NY. The Upper Hudson River section, subsection and reach designations and locations of especially sensitive or unique habitat (ESUH) areas.

Figure 2. ESUH areas in the vicinity of Griffin Island, River Section 1, Reach 8.

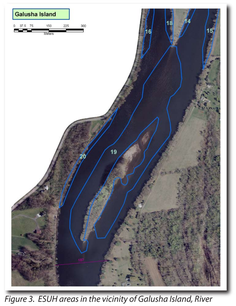

Figure 3. ESUH areas in the vicinity of Galusha Island, River Section 2, Reach 7.

Figure 4. ESUH areas in the vicinity of Coveville, River Section 3, Reach 5.

Attributes of ESUH Areas

Five physical, structural, and or biological components or attributes were selected to characterize especially sensitive or unique habitats.

- Support or are used by State or Federally-listed rare, threatened, or endangered species, or species of concern throughout their entire life cycle or portions of their life cycle
- Critical or unique to a particular species throughout its entire life cycle or portions of its life cycle; or
- Rare or occur infrequently; or
- Becoming increasingly isolated, and are declining in quality or extent, or are in danger of elimination due to human activities unrelated to contamination; or
- Possess some special characteristics
  - preferentially inhabited and used by complex assemblages of vegetation, aquatic invertebrates, fish, birds, and mammals;
  - particularly productive or highly valuable because they serve as impotant reproduction and spawning areas, nurseries, feeding areas, or migration routes, some of which may be restricted or localized; and
  - pathway for PCBs to bioaccumulate up the food chain into trust resources.

Photo 1. Water celery at mouth of Slocum Creek (ESUH 22).

Five ESUH types dominated the Upper Hudson River and are described below:

- **Nearshore, Shallow, and Vegetated Areas,** supporting submerged aquatic (Photo1) and emergent vegetation provide services to multiple species and are the foci of the Upper Hudson River food web. These areas extend linearly along the shore or as backwater areas and serve as refugia and foraging areas for early life stages of fish, turtles, frogs, aquatic and semi-aquatic salamanders, mammals such as muskrat (*Ondatra zibethica*) and mink (*Mustela vison*), and dabbling waterfowl such as mallards (*Anas platyrhynchos*), black duck (*Anas rubripes*), and wood duck (*Aix sponsa*). Largemouth bass (*Micropterus salmoides*) spawning and nursery areas occur in two backwater areas within the Upper Hudson, the west side of Griffin Island (ESUH 8) (Photos 2 and 3) and the cove at Coveville (ESUH 32).
- **Mouths of and Deltas Formed by Tributaries** serve as spawning and feeding areas for warm water fish and foraging areas for wildlife. The mouth of the Moses Kill (ESUH 11) is an important fish and freshwater mussel habitat (Photo 4).
- **Riparian Forests** provide roosting and breeding habitat for a large number of bird species including Federal and State protected species and/or a linkage between high value aquatic and terrestrial habitats. These areas include forested floodplains, are declining in abundance and quality due to human activities, such as land development. ESUH 40 adjoining the river at the Saratoga National Historic Park serves as a heron rookery.
- **Riparian Wetlands** provide multiple ecological services and linkages between aquatic and terrestrial systems. These complexes are of limited acreage and are declining in abundance and quality due to human activities such as land development. ESUH 7 provides high value feeding and nesting habitat for waterfowl. Many wetlands are associated with PCB hot spots including ESUH 48, 50 and 51.
- **Riparian/Transitional Zones** serve as transitional areas linking habitat types such as aquatic and terrestrial habitat. Ecotones are more dynamic, can have higher species richness and greater nutrient cycling, and function as migratory/access corridors. Examples include the narrow bands of wild rice between shoreline and open water habitat (ESUH 30), and bands of emergent plants between upland and submerged aquatic vegetation (SAV) beds (ESUH12).

Photo 4: Emergent and floating vegetation in Moses Kill (ESUH 11).

More information on each of the 57 ESUH areas will soon be available on NOAA's Hudson River website at http://www.darrp.noaa.gov/northeast/hudson/index.html.

Photo 2: Mouth of west channel of Griffin Island (ESUH 8).

Photo 3: Emergent and floating vegetation in west channel of Griffin Island (ESUH 8).

Estimates of Pre- and Post-Remediation PCB Concentrations

GE systematically collected sediment grab and core samples (n>9000) on an 80 to 160 ft. grid system during the 2002-2007 remedial design program throughout River Section 1 (RS1) and in the fine-grained sediments of RS2 and RS3. This extensive dataset was compiled into NOAA (2008) Hudson River database and mapping project.

Pre- and post-remediation total PCB (PCB) concentrations were estimated from the top core segments (0-2 inches in ~90% of the cores) and surface sediments (top 12 inches). Surface sediment was defined according to EPA (2006) as the maximum measured concentration within the top 12 inches or the length-weighted average representing the top 12 inches. Surface sediment concentrations provide a measure of environmental exposure for estimating future injury from post-remediation sediment PCB concentrations. The 0-2 inch depth is commonly used to represent the sediment surface in fate and transport models.

Average PCB concentrations were calculated using all of the pre- and post-remediation sediment samples within each ESUH area. Post-construction PCB sediment concentrations assumed a replacement value of 0.5 ppm PCB for areas targeted for removal in the dredge area delineation. The estimated pre- and post-remediation concentrations in the top cores segments and maximum surface (top 12 inches) for ESUH areas are presented in Figures 5-8. Average maximum surface sediment PCB concentrations were mostly higher than the concentrations in the top core segments.

Pre-remediation PCB concentrations in the majority of ESUH areas in River Sections 1 and 2 (Figures 5 and 6) are similar, approximately 40 ppm in the top core segments and 100 ppm in the surface 12 inches. Pre-remediation PCBs in most ESUH areas in River Section 3 are less than 10 ppm in the top slice and greater than 20 ppm in the surface (Figures 7 and 8). Higher PCB concentrations are found in subsurface sediments.

PCB surface concentrations in twenty-eight (53%) of the 53 ESUH areas considered in this evaluation are anticipated to exceed 10 ppm PCBs post-remediation. Another seven ESUH (13%) areas are expected to have PCB concentrations between 5 and 10 ppm. PCB concentrations in five (9%) of the ESUH areas are anticipated to approximate <1 ppm PCBs post-remediation. Estimated post-remediation concentrations are much lower (<1-3 ppm PCBs in the top slice and surface) for ten (77%) of 13 ESUH areas in River Section 1. The remaining 3 ESUH areas in River Section 1 had concentrations between 6 and 12 ppm. Post-remediation surface concentrations in most ESUH areas in Reaches 6 and 7 in River Section 2 and Reaches 4 and 5 in River Section 3 exceed 10 ppm (Figures 5-8). The much higher post-remediation PCB concentration in these areas compared to those in River Section 1 can be explained by the difference in target cleanup levels (Table 1).

Table 1. Target cleanup levels for the Upper Hudson River (EPA 2002).

River Section 1 (Reach 8: Thompson Island Pool):

3 g/m^2 Tri+ PCBs[1] 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 (Reaches 1-7)

10 g/m^2 Tri+ PCBs MPA

30 mg/kg Tri+ PCBs in surface sediment (~ 60-90 ppm total PCBs)

[1]Tri+ PCBs: sum of trichloro- through decachlorobiphenyl PCBs

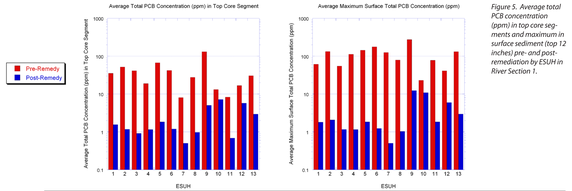

Figure 5. Average total PCB concentration (ppm) in top core segments and maximum in surface sediment (top 12 inches) pre- and post-remediation by ESUH in River Section 1.

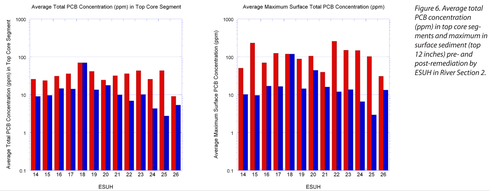

Figure 6. Average total PCB concentration (ppm) in top core segments and maximum in surface sediment (top 12 inches) pre- and post-remediation by ESUH in River Section 2.

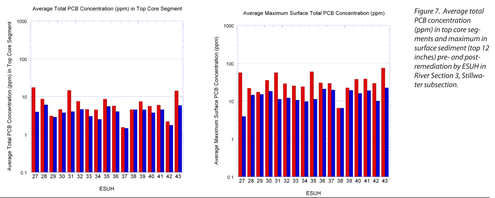

Figure 7. Average total PCB concentration (ppm) in top core segments and maximum in surface sediment (top 12 inches) pre- and post-remediation by ESUH in River Section 3, Stillwater subsection.

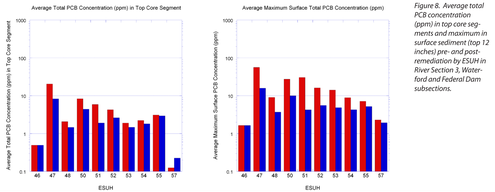

Figure 8. Average total PCB concentration (ppm) in top core segments and maximum in surface sediment (top 12 inches) pre- and post-remediation by ESUH in River Section 3, Waterford and Federal Dam subsections.

Conclusions

- ESUH areas are characterized by 5 attributes and 5 habitat types.
- Fifty-seven ESUH areas were designated in the Upper Hudson River.
- Post-remediation PCB concentrations in surface sediments are expected to exceed 10 ppm in most ESUH areas in River Section 2 and in the upper two reaches of River Section 3.
- Few ESUH areas are likely to have post-remediation concentrations less than 1 ppm PCB based on top slice or surface PCBs.
- Elevated levels of PCBs in ESUH post-remediation surface sediments represent a long-term exposure pathway to Trustee resources.
- The Trustees will evaluate past and future injury to natural resources and identify appropriate on-site and/or off-site natural resource restoration.

References

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