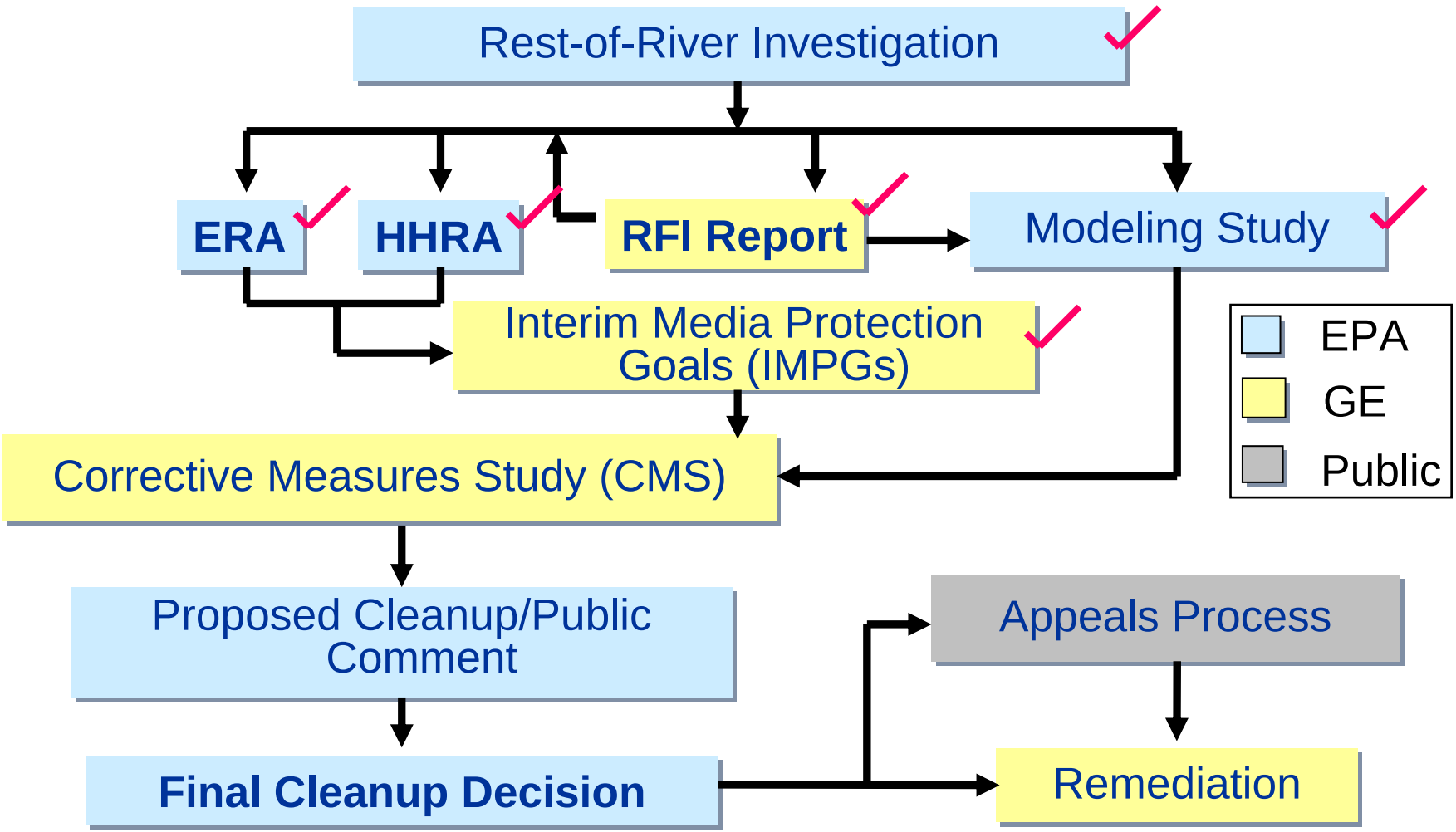
Corrective Measures Study (CMS) Proposal

Citizens Coordinating Council Meeting
March 7, 2007

Regulatory Background

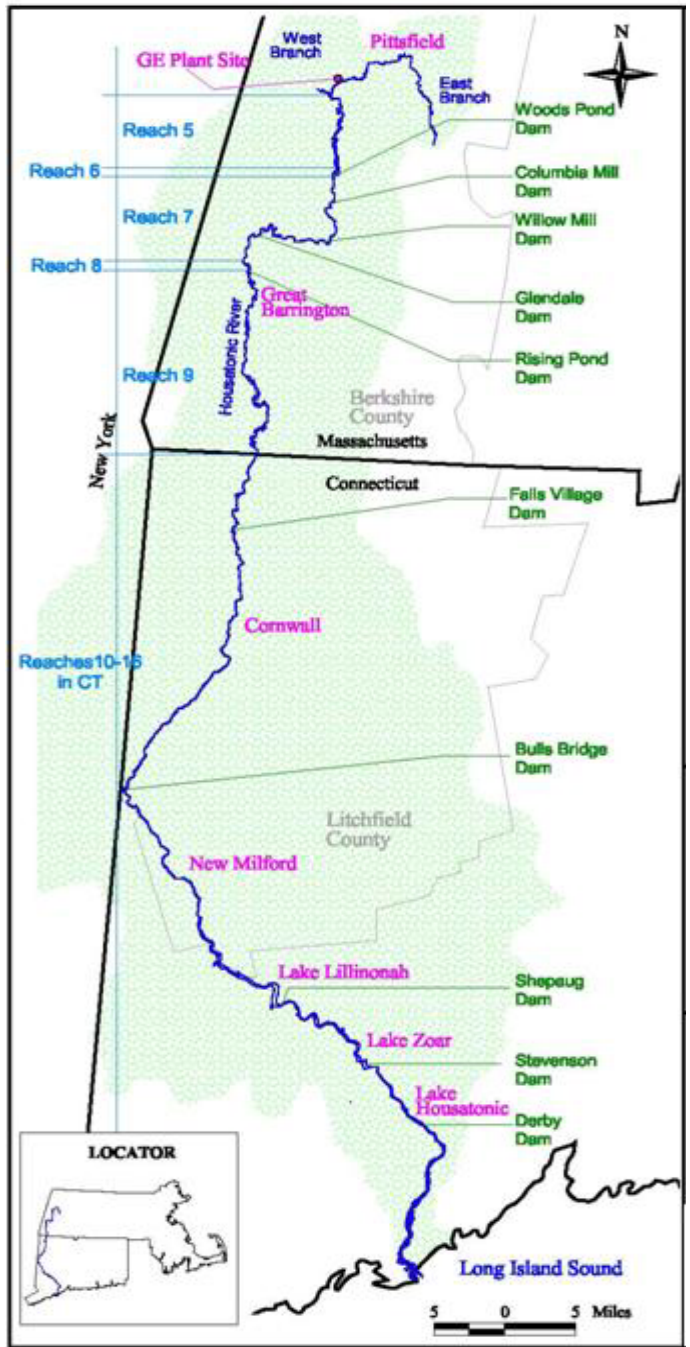
- Consent Decree – October 2000.
- The CD divides the River into 3 areas.
- GE remediated the Upper ½ Mile Reach under a negotiated Work Plan:
  - Sediment removal and engineered cap remedy; excavation of ~12,000 cy sediments. Project complicated by coal tar and PCB NAPL seeps.
  - ~6,000 cy of bank soils removed to achieve recreational PCB standards.
  - Materials placed in On-Plant Consolidation Areas (OPCAs).
  - 3 years to complete.
- EPA remediated the 1 ½ Mile Reach under a cost share agreement with GE:
  - EPA selected remedy: bank-to-bank removal of sediments and bank soils.
  - ~92,000 cy removed. 50,000 cy placed in OPCAs, remainder disposed off-site.
  - Coal tar NAPL found in upper section.
  - 4 years to complete.
- Rest-of-River: CD prescribes process to select remedy.

Rest of River (ROR) Process

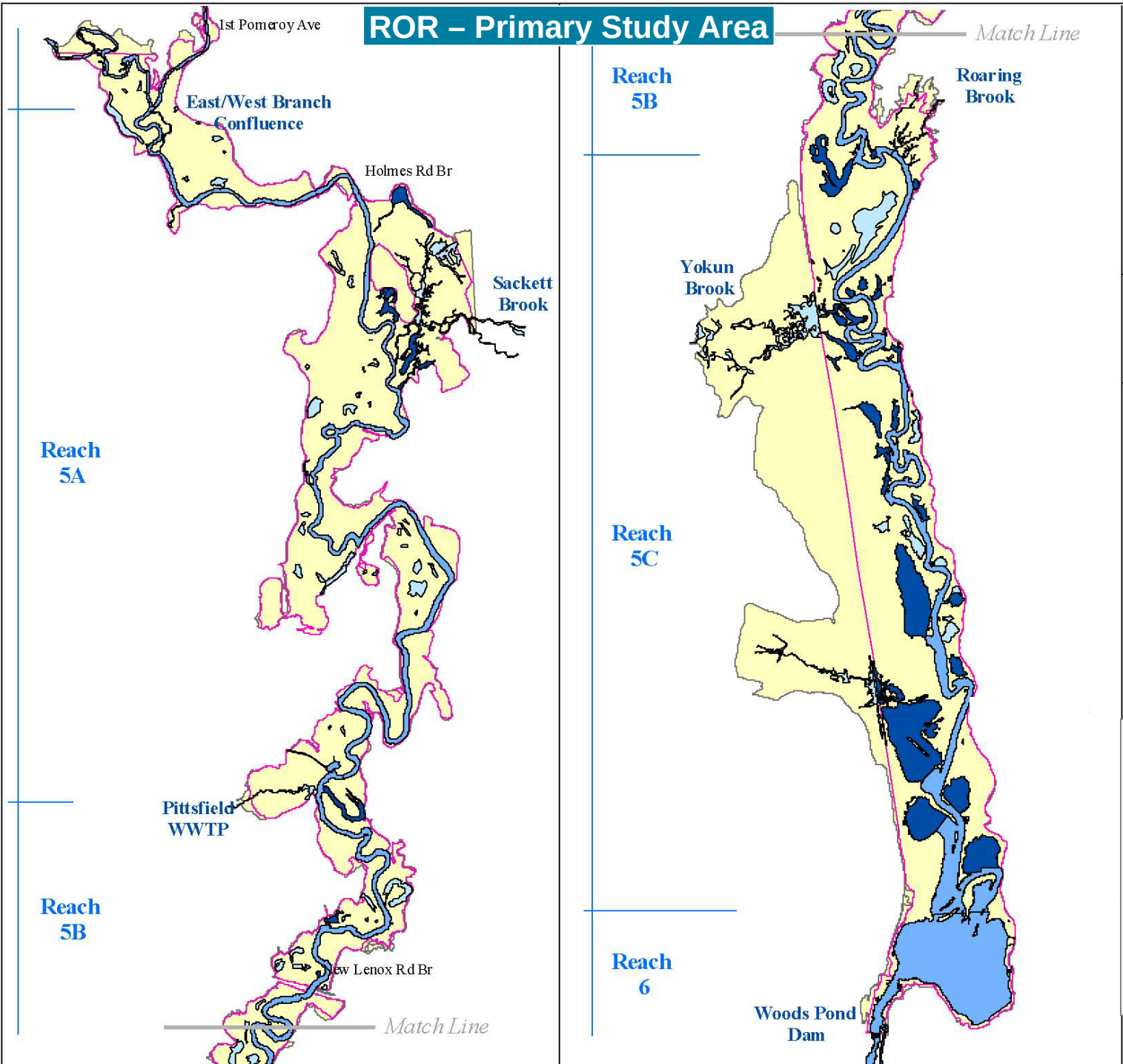


Rest of River Characteristics

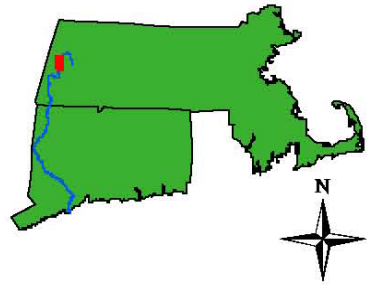
- ~ 135 miles from confluence of East and West Branches to Long Island Sound
- ~ 90% of total PCB mass is present in the 10-mile reach to Woods Pond Dam. Reach known as Primary Study Area.
- Mix of meanders, backwaters, impounded areas
- 10 dams present
- Sediments ranging from coarse sands to very fine sands/silts
- Tributaries increase flow moving downstream
- Changes in gradient affect sediment distribution and characteristics



ROR – Primary Study Area



LOCATOR MAP



SCALE

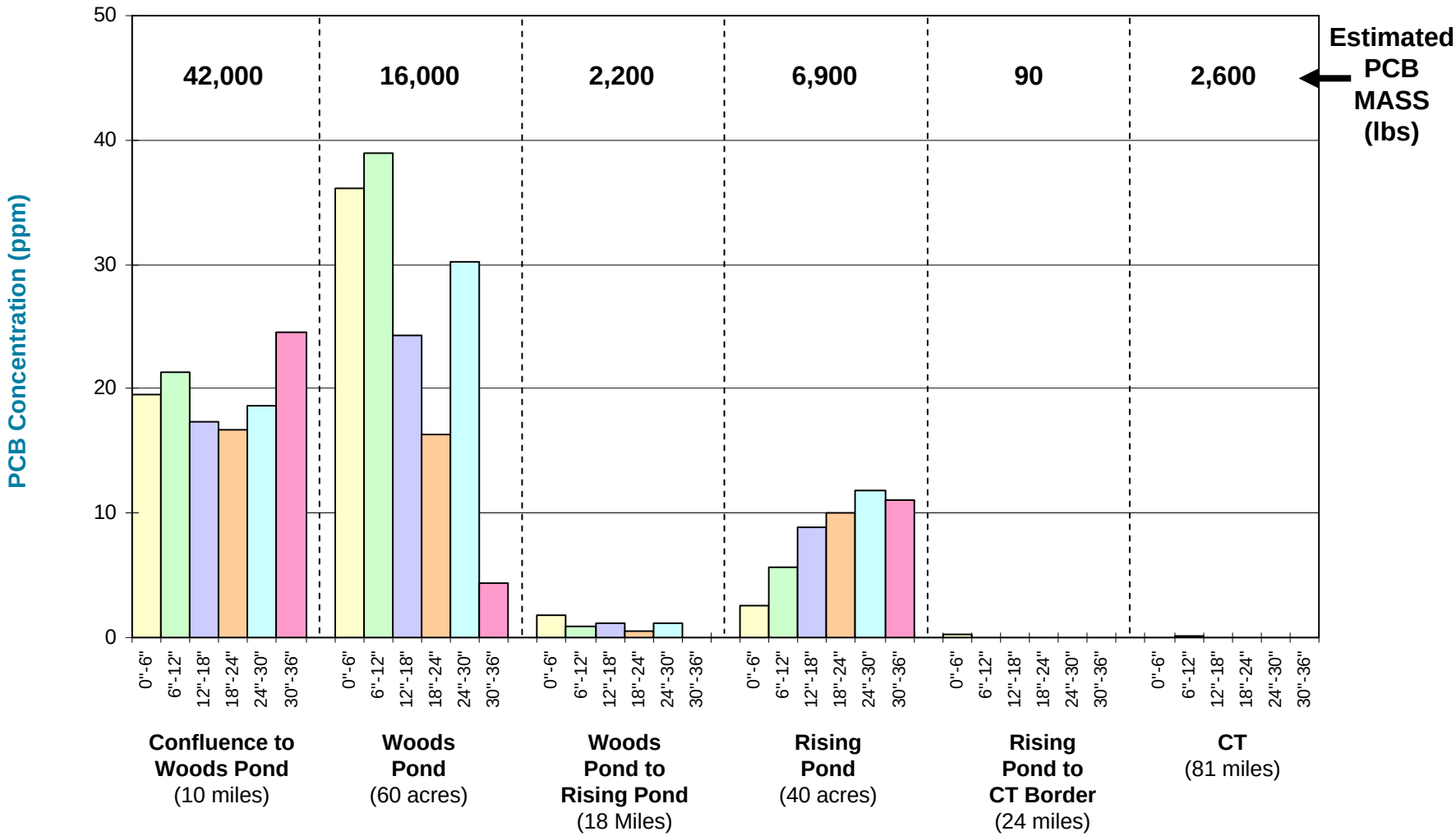
0 0.25 0.5 Miles

LEGEND

- 1 mg/kg PCB Isopleth
- 10-Year Floodplain
- Major Dams
- Main Channel
- Backwaters
- Pools/Tributaries

ROR Investigation Summary -

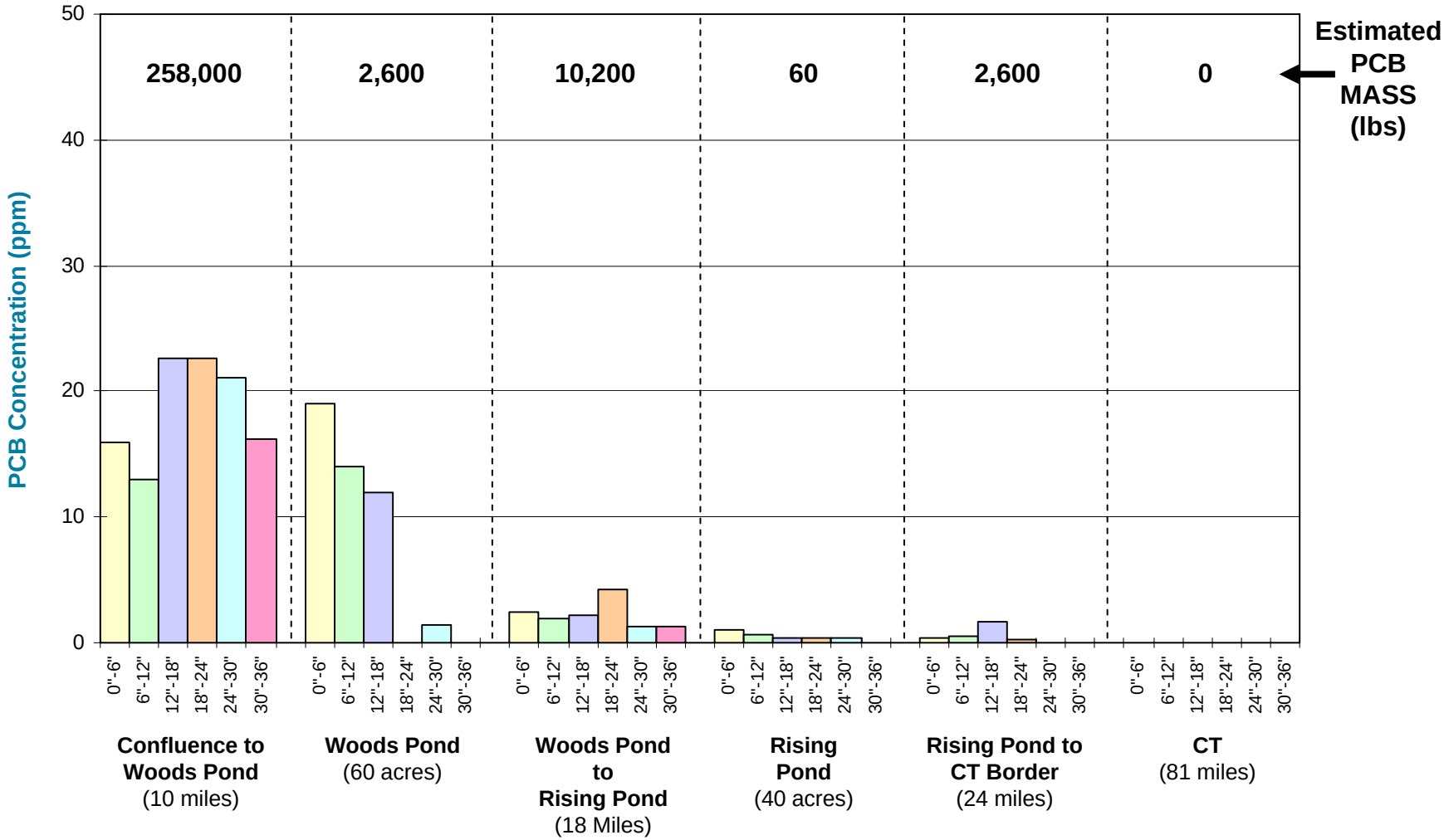
PCB Distribution in Sediments



~83% OF PCB MASS IN SEDIMENTS IS ABOVE WOODS POND DAM

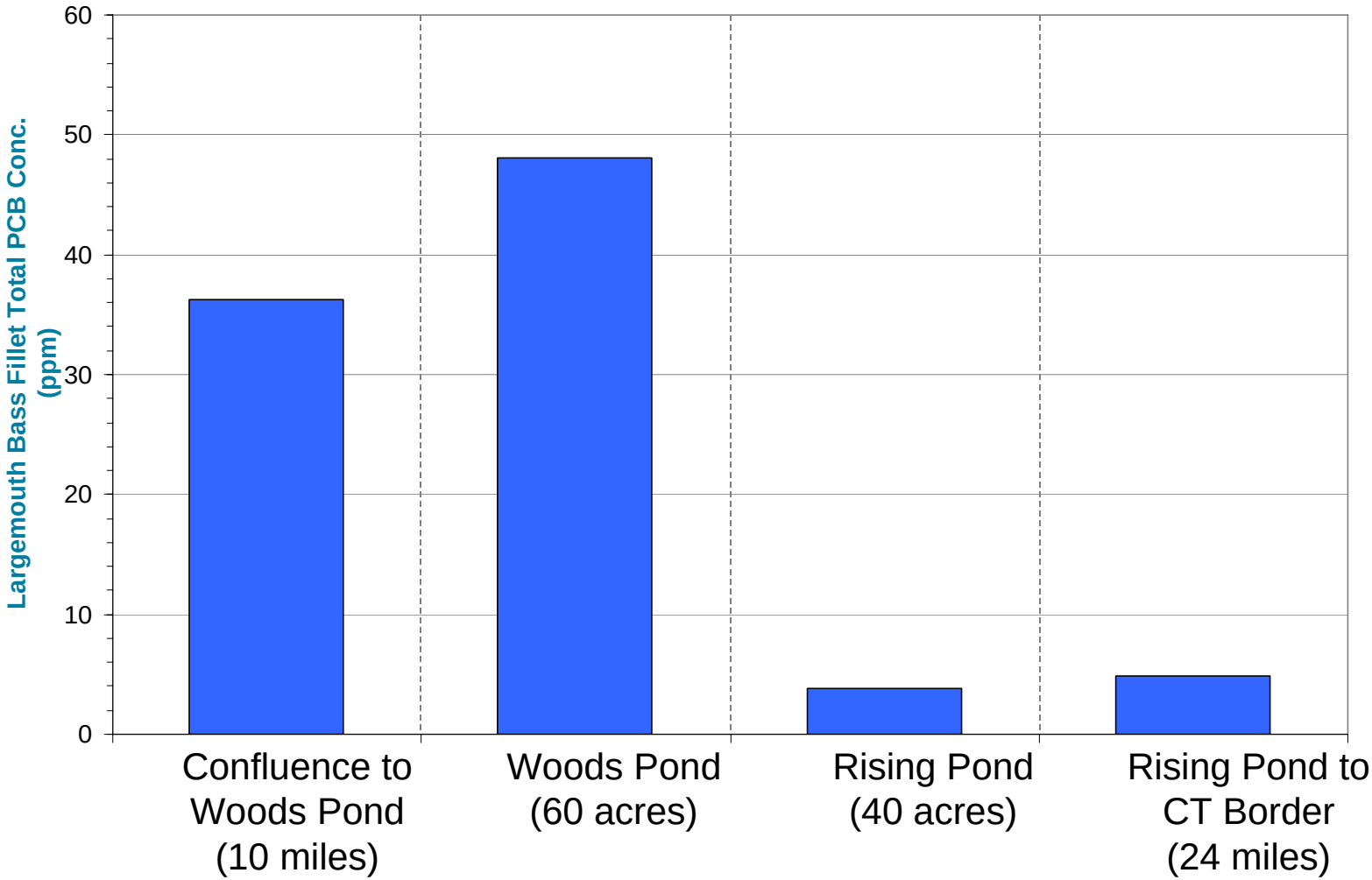
ROR Investigation Summary -

PCB Distribution in Floodplains



~95% OF PCB MASS IN FLOODPLAIN IS ABOVE WOODS POND DAM

ROR Investigation Summary – Massachusetts Fish Data

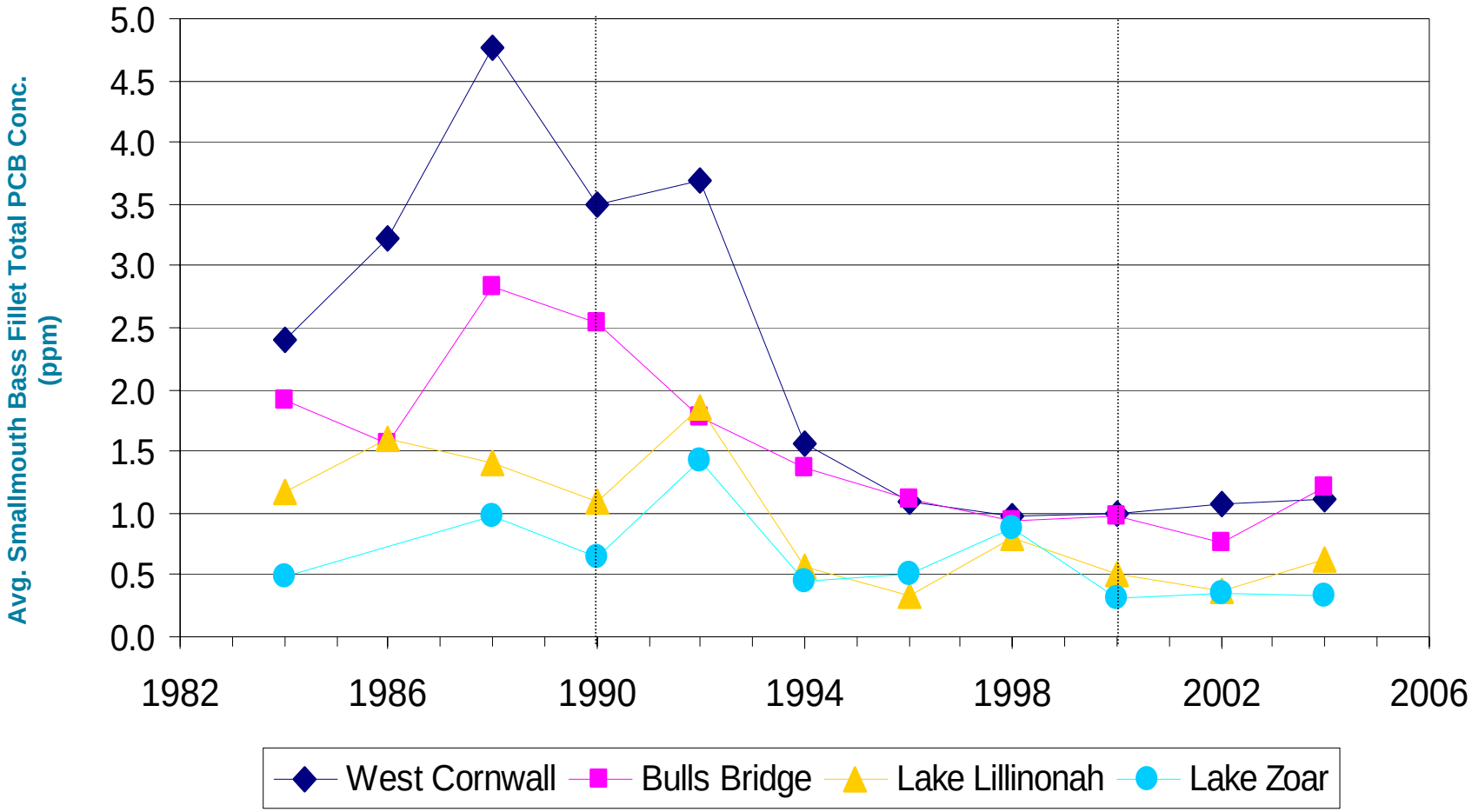


DATA SHOW LARGE DECLINE BELOW WOODS POND

Overview of Ct. Biota Monitoring Program

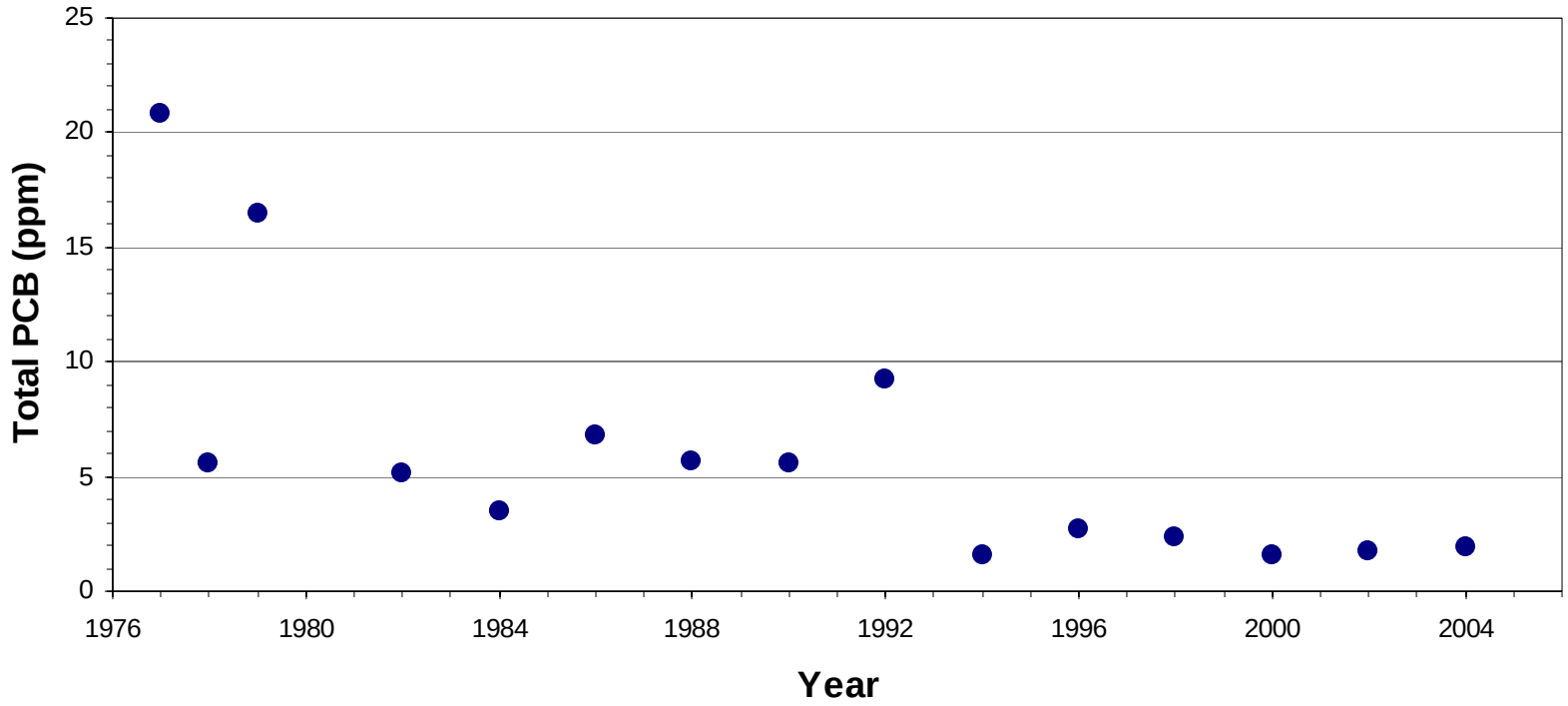
- GE has conducted biota sampling in Ct. under several Cooperative Agreements with CDEP since 1984.
- CDEP assists in fish collection and collected benthic invertebrate samples until 1990.
- Biennial program includes:
  - Brown trout at West Cornwall.
  - Smallmouth bass at West Cornwall, Bulls Bridge, Lakes Lillinonah and Zoar.
  - Benthic invertebrates at West Cornwall.
  - Additional fish samples collected at CDEP request.
- All samples analyzed by a third party laboratory.

ROR Investigation Summary – Ct. Fish Data

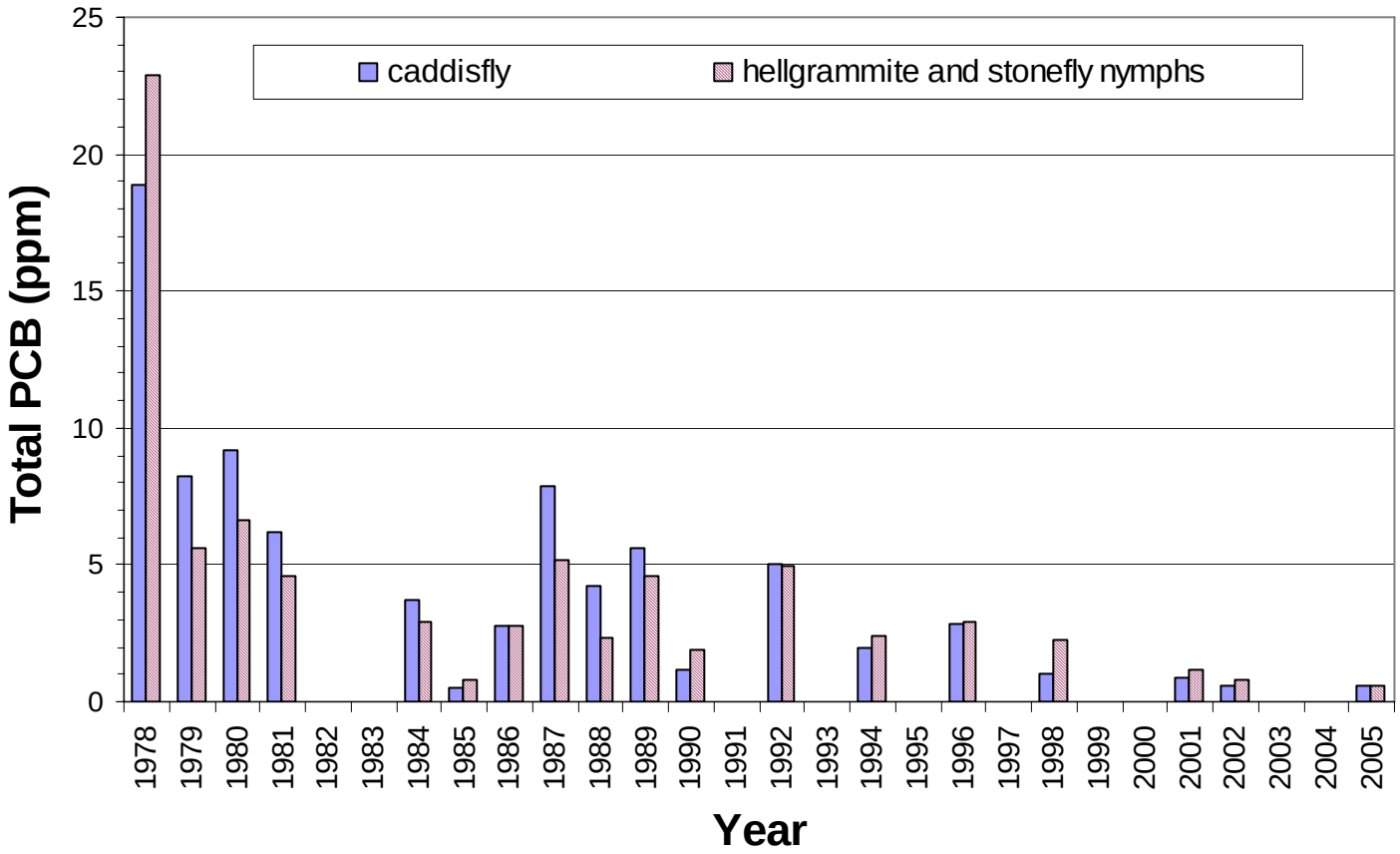


CT BASS PCB DATA ~1 PPM OR LESS SINCE 1996

PCBs in Brown Trout (West Cornwall, CT)



PCBs in Benthic Macroinvertebrates (West Cornwall, CT)



Interim Media Protection Goals (IMPGs)

- Interim Media Protection Goals (IMPGs) represent preliminary goals for protection of human health and environment.
- To be considered in CMS as one factor to evaluate potential remedial alternatives – not cleanup standards that remedy must meet.
- IMPGs were developed based on HHRA and ERA exposure assumptions, toxicity values, and data interpretations.
- EPA approved IMPGs in April 2006.

Examples of EPA-Approved Health-Based IMPG Ranges for PCBs

Exposure Scenario	Medium	RME Range (ppm)		CTE Range (ppm)	
		Cancer *	NC	Cancer *	NC
Based on Direct Human Contact					
High-use general recreation (young child)	FP soil	1.3 – 134	4.6	18 – 1842	32
High-use general recreation (adult)	FP soil	1.4 – 143	38	63 – 6305	234
Medium-use general recreation (adult)	FP soil	2.1 – 215	58	63 – 6305	234
Bank fishing (adult)	FP soil	2.6 – 256	56	70 – 7015	220
Based on Fish Consumption (values rounded)					
Bass consumption (child & adult)	Bass fillets	0.002 – 0.2	0.03	0.05 – 5	0.2
Trout consumption in CT (child & adult)	Trout fillets	0.005 – 0.5	0.07	0.1 – 11	0.4
Based on Agricultural Products Consumption (values rounded) #					
Consumption of cow milk at commercial dairy farm (child & adult)	Cow milk	0.00003 – 0.003	0.0003	0.0001 – 0.01	0.0005
Consumption of beef at commercial beef farm (child & adult)	Beef tissue	0.0003 – 0.03	0.008	0.002 – 0.2	0.01

* Range is 10-6 to 10-4.

NC : Non-cancer.

These tissue values will be converted to floodplain soil values in CMS, based on portion of farmland in floodplain.

EPA-Approved Ecological IMPGs for PCBs

Receptor Group	Medium	IMPG Values (ppm)
Benthic invertebrates	Sediments	3 to 10
Amphibians	Vernal pool sediments	3.27 to 5.6
Fish	Fish tissue upstream of Woods Pond Dam	55
	Fish tissue downstream of Woods Pond Dam	55 for warmwater fish 14 for coldwater fish
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2
Insectivorous birds (represented by wood ducks)	Aquatic and terrestrial invertebrate prey	4.4
Piscivorous mammals (mink and otter)	Prey items	0.98 to 2.43
Omnivorous and carnivorous mammals (represented by short-tailed shrew)	Floodplain soil	21 to 34
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.4

EPA Modeling Study Overview

- EPA developed a computer model to simulate fate, transport and bioaccumulation of PCBs in Housatonic River. Finalized November 2006.
- Model domain extends from Confluence to Rising Pond Dam.
- Model to be used by GE to predict and compare future sediment, surface water and fish tissue PCB concentrations for each CMS alternative.
- GE proposing a semi-quantitative approach in CMS to predict sediment and fish concentrations for Connecticut impoundments.

Corrective Measures Study Overview

- CMS Proposal is the work plan for the CMS.
- CMS Proposal submitted to EPA on February 27, 2007.
- As required by RCRA permit, CMS Proposal must:
  - Identify the remedial alternatives (for both sediments and floodplain soils) that GE proposes to study in the CMS.
  - Provide justification for selection of those alternatives.
  - Describe the methodology that GE proposes to use for evaluating alternatives.

Identification and Screening of Technologies/Process Options

- Range of remedial technologies for sediments and soils were compiled and screened.
- Initial screening to identify potentially viable remedial technologies:
  - Technically implementable based on site conditions, chemical or physical characteristics of media.
  - Full-scale application on other PCB sites.
- Secondary screening to develop the most promising based on:
  - General effectiveness.
  - Implementability.
- Retained technologies to be subsequently combined into a manageable set of alternatives for detailed and comparative evaluation in the CMS Report.

In-River Sediment Technologies/Process Options

Retained:

- **No Action** – required by EPA regulations; will provide baseline for comparison to other options.
- **Institutional/Engineering Controls** – includes access restrictions, fishing/hunting restrictions, and biota consumption advisories.
- **Removal** – includes both mechanical and hydraulic dredging.
- **Capping** – may be applied either alone or following removal of some sediments.
- **Monitored Natural Recovery (MNR)** – includes both MNR and enhanced MNR (i.e., thin-layer capping).
- **Rechannelization** – considering for potential use in limited reaches (e.g., oxbows).

Screened Out:

- **In-Situ Treatment (Physical, Chemical, Biological)** – currently no technologies identified which have been successfully demonstrated for PCBs at pilot/full scale.
- **Enhanced Sedimentation** – may result in flooding of adjacent land areas; could alter habitat and future use.

Erodible Bank Technologies/Process Options

Retained:

- **No Action**.
- **Remove/Replace** – Includes soil excavation, backfilling and stabilizing banks.
- **Bank Stabilization using Armor Stone and/or Revetment Mats.**

Screened Out:

- **Bank Stabilization Using Gabions or Retaining Walls** – not necessary since other representative bank stabilization techniques retained for CMS with wider applicability, lower cost.

Floodplain Soil Technologies/ Process Options

Retained:

- **No Action**
- **Engineering/Institutional Controls** – includes access restrictions, activity and use restrictions, Conditional Solutions, and consumption advisories.
- **Monitored Natural Recovery** – potential remedy component for areas slightly above cleanup objectives, inaccessible areas, and/or sensitive habitats.
- **Remove/Replace** – includes soil excavation and backfilling.
- **In-Situ Containment** – includes soil covers and engineered barriers.

Screened Out:

- **In-Situ Treatment (Physical, Biological, Chemical, Thermal)** – not well suited for large areas; not successfully implemented full scale elsewhere with significant PCB reduction

Management Technologies/Process Options for Removed Sediments/Soils

Retained

- **Dewatering** – retained options are stockpiling (gravity) and filter press (mechanical).
- **Treatment** – retained options are:
  - Ex-situ stabilization/solidification (physical treatment).
  - Chemical extraction (chemical treatment).
  - Thermal desorption (thermal treatment).
- **Disposal** – retained options are confined disposal facility (in water), local upland facility, and off-site permitted landfill.

Management Technologies/Process Options for Removed Sediments/Soils (cont'd)

<u>Screened Out</u>:

- **Dewatering** – Several other technologies considered (e.g., evaporator, centrifuge, geotubes, etc.) but not retained for CMS due to costs, efficiency, space requirements, etc. compared to those retained.
- **Treatment:**
  - Biological treatment not retained due to effectiveness, and time and space requirements.
  - Chemical and thermal destruction not retained, due to effectiveness, implementability, and costs compared to other technologies.
  - Beneficial reuse not retained at this time due to lack of full scale applications for sites with comparable PCB concentrations.

Development of Sediment Alternatives

- Identified broad range of alternatives ranging from no action to extensive removal.
- Alternatives focus on reaches with highest PCB concentrations.
- Use various combinations of three main sediment remedial technologies identified in EPA guidance – capping, removal, and monitored natural recovery.
- Consider suitability of technologies for different river conditions:
  - Water depth.
  - Water velocities.
- 8 sediment/riverbank alternatives proposed for detailed evaluation.

Sediment Alternatives

Sediment Alternative #1

- No action in all reaches (consideration of this alternative is required by EPA regulations).

Sediment Alternative #2

- Monitored natural recovery (MNR) in all reaches.

Sediment Alternatives (cont'd)

Sediment Alternative #3

- Confluence to Woods Pond:
  - Combination of removal with engineered capping, thin-layer capping, and MNR.
  - Bank removal/stabilization.
- Woods Pond: Thin-layer capping.
- Below Woods Pond: MNR.

Sediment Alternative #4

- Confluence to Woods Pond:
  - Combination of removal/capping, capping-only, thin-layer capping, and MNR.
  - Bank removal/stabilization.
- Woods Pond: Combination of removal/capping and thin-layer capping.
- Below Woods Pond: MNR.

Sediment Alternatives (cont'd)

Sediment Alternative #5

- Confluence to Woods Pond:
  - Combination of removal/capping in most areas, capping-only in remaining areas. Thin-layer capping and MNR in the backwater areas.
  - Bank removal/stabilization.
- Woods Pond: Combination of removal/capping and capping only.
- Rising Pond: Thin-layer capping.
- Other Areas Below Woods Pond: MNR.

Sediment Alternative #6

- Confluence to Woods Pond:
  - Removal/capping in river channel; combination of removing higher PCB levels and thin-layer capping in backwaters.
  - Bank removal/stabilization.
- Woods Pond: Combination of removal/capping and capping only.
- Reach 7 impoundments: Thin-layer capping.
- Rising Pond: Combination of capping and thin-layer capping.
- Below Rising Pond: MNR

Sediment Alternatives (cont'd)

Sediment Alternative #7

- Confluence to Woods Pond:
  - Deeper removal with backfill/capping in river channel.
  - Combination of removing higher PCB levels and thin-layer capping in backwaters.
  - Bank removal/stabilization.
- Woods Pond: Combination of deeper removal/capping in shallow areas, capping-only in deep areas.
- Reach 7 impoundments: Combination of removal with backfill/capping for higher PCB concentrations areas and thin-layer capping in other areas.
- Rising Pond: Combination of removal with backfill/capping for higher PCB concentration areas, capping of other areas.
- Below Rising Pond: MNR

Sediment Alternative #8

- Removal to 1 ppm and backfill in all reaches from Confluence to Rising Pond Dam.
- Bank removal/stabilization.
- Below Rising Pond: MNR.

Development of Floodplain Soil Alternatives

- Floodplain areas to be evaluated consistent with EPA's HHRA and ERA:
  - 90 exposure areas for human health.
  - Farm areas.
  - Ecological habitat areas (some overlap with above areas).
- Alternatives initially developed based on consideration of human health IMPGs.
- Supplemental evaluation to determine need/extent of additional remediation based on ecological considerations:
  - Separate evaluations for amphibians (wood frogs), omnivorous/carnivorous mammals (shrews), and insectivorous birds (wood ducks).

Floodplain Soil Alternatives

Alternative	Description
FP 1	No Action (required by EPA regulations).
FP 2	Remove/replace soils to achieve a cancer risk of 10^{-4} or non-cancer Hazard Index (HI) of 1.
FP 3	Same as FP-2 except in heavily used areas (e.g., trails, access points, and known recreational areas) and farms, remove/replace to achieve a cancer risk of 10^{-5} or non-cancer of HI of 1.
FP 4	Remove/replace soils to achieve a cancer risk of 10^{-5} or non-cancer HI of 1.
FP 5	Remove/replace soils with a PCB concentration of 50 ppm or greater.
FP 6	Remove/replace soils with a PCB concentration of 25 ppm or greater.
FP 7	Remove/replace to achieve a cancer risk of 10^{-6} or non-cancer HI of 1. Soils below 2 ppm would not be removed.

CMS Alternatives Evaluation Criteria

RCRA Permit requires GE to evaluate alternatives according to two tiers of factors:

General Standards for Corrective Measures

1. **Overall Protection of Human Health and the Environment –** ability to provide overall protection of human health and environment.
2. **Control of Sources of Releases –** ability to further minimize PCB releases to ROR.
3. **Compliance with Substantive Federal and State Regulatory Requirements –** ability to meet these substantive requirements, or basis for a waiver.

CMS Alternatives Evaluation Criteria (cont'd)

Selection Decision Factors **(balancing factors)**

1. **Long-Term Reliability and Effectiveness** - Magnitude of residual risk, adequacy and reliability of alternatives, and any potential long-term adverse impacts.
2. **Attainment of IMPGs** – Ability of alternatives to achieve IMPGs, including time period for attainment and extent to which it would accelerate attainment compared to natural processes.
3. **Reduction of Toxicity, Mobility, or Volume.**
4. **Short-Term Effectiveness** – Impacts to nearby communities, workers, or environment during implementation, including risks associated with excavation, transportation, dewatering, disposal, or containment.
5. **Implementability** – Ability to construct and operate the technology, reliability and availability of technology.
6. **Cost.**

Evaluation Process for Alternatives

- Use EPA model to predict future sediment and biota PCB concentrations for each sediment remedial alternative:
  - Simulate a 52 year period.
  - Predictions by river reach/impoundment.
- Determine volumes and locations associated with the floodplain alternatives.
- Perform detailed evaluations of sediment/riverbank soil, floodplain, and sediment/soil management alternatives.
- Perform comparative evaluations of alternatives to each other.
- Recommend remedial alternative(s) for sediment/riverbank soil, floodplain soil, and sediment/soil management.
- CMS Report due 180 days after EPA approval of CMS Proposal (or later if approved by EPA).