THE PHASE 1 DREDGING PROJECT: What Did We Learn and How Do We Apply The Lessons?

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Hudson River Dredging Project

- EPA chose dredging as preferred remedy to address PCBs in river-bottom sediments in Upper Hudson River in 2002
- ROD envisioned dredging in two phases over six-year period; first phase in 2009 was a full-scale test
- Project goals were to reduce PCB levels in water, in fish, in sediment and flowing downstream
- Performance standards were set to govern the project and achieve the goals

Hudson River Dredging Overview

- GE designed, coordinated, contracted and paid for the project
- EPA approved GE plans and supervised work; daily coordination meetings
- GE reimbursed EPA and New York State for past costs and oversight: $90MM to date
- EPA, GE evaluated Phase 1; independent peer review panel now reviewing Phase 1; reports expected this summer

Phase 1: What EPA Sought to Accomplish

- Removal of 265,000 cubic yards of sediment from 18 dredge areas
- Removal of 89,000 cubic yards of sediment during one 30-day period (at pace required to ensure project is completed in six years)
- Keep PCB levels in water below the federal drinking water standard (500 parts per trillion)

Phase 1: What EPA Sought to Accomplish

- Keep PCBs released downstream during dredging no more than 117 kg (258 pounds)
- Ensure PCB levels on the surface of the river bottom post-dredging are below an average of 0.25 parts per million
- Keep PCB levels in air below 110 nanograms per cubic meter in residential areas and 260 nanograms per cubic meter in commercial/industrial areas

Phase 1: What It Required

- Dredging conducted around the clock from May through October. Operations concluded Dec. 4.
- 500 employees on job; 100 vessels in river.
- 55% of dredged areas subject to flow control/diversion during dredging
- 18,000 environmental samples collected
- Seven major contractors and 210 local companies

Phase 1: What It Required

- 110-acre processing and transportation facility on the Champlain Canal
  - — 1,500 foot wharf
  - — Canal widened by 65 feet
  - — 12 filter presses — 140,000 pounds each
  - — 41,000-square-foot filter press building
  - — 27,000-square-foot water treatment building
  - — Seven miles of railroad track; 450 rail cars to transport dried sediment to disposal facility
  - — 2.4 million square feet of geomembrane liner to protect ground beneath facility

Phase 1: Lessons Learned

- Resuspension occurred at about the rate as experienced at other sites (3-4%)
- This resulted in higher PCB levels in water, in sediments, in fish and in water downstream
- State-of-the-science technologies employed to control resuspension did not reduce it significantly
- Multiple unproductive dredging passes required to meet residual standard, impeding productivity

GE’s Recommendations

- Continue dredging — but with adjustments to make it more effective and to ensure EPA’s goals are met
- To protect the river and fish, set standards to limit release of PCBs into the water during Phase 2
- Target high-priority deposits of PCBs to reduce PCB levels in fish while minimizing downstream impacts from resuspension
- Complete Phase 2 in five years so benefits to river begin sooner
- Conduct long-term monitoring to ensure dredging was effective and achieved EPA’s goals

Dr. John Connolly

AnchorQEA

Goals of the Remedy:

- Reduce PCB concentrations in fish
- Reduce PCB concentrations in river water
- Reduce the <u>bioavailable</u> inventory (mass) of PCBs in sediments
- Minimize the long-term downstream transport of PCBs in the river

Performance Standards Established to:

… ensure that the cleanup meets the human health and environmental protection objectives of the Record of Decision.”

Basics of the Resuspension Standard

- Meant to ensure that resuspension does not:
  - Cause violations of the drinking water standard
  - Compromise the benefits of the remedy by releasing more PCBs than would happen without dredging
- Constitutes a set of criteria that trigger efforts to reduce resuspension

What Happened in Phase 1?

Criteria	Planned	Actual	Difference
Sediment Volume (cy)	**265,000**	**286,000**	**10%**
PCB Removed (kg)	**20,000**	**16,300**	**-19%**
Resuspension Load (kg)	**117**	**200**	**71%**

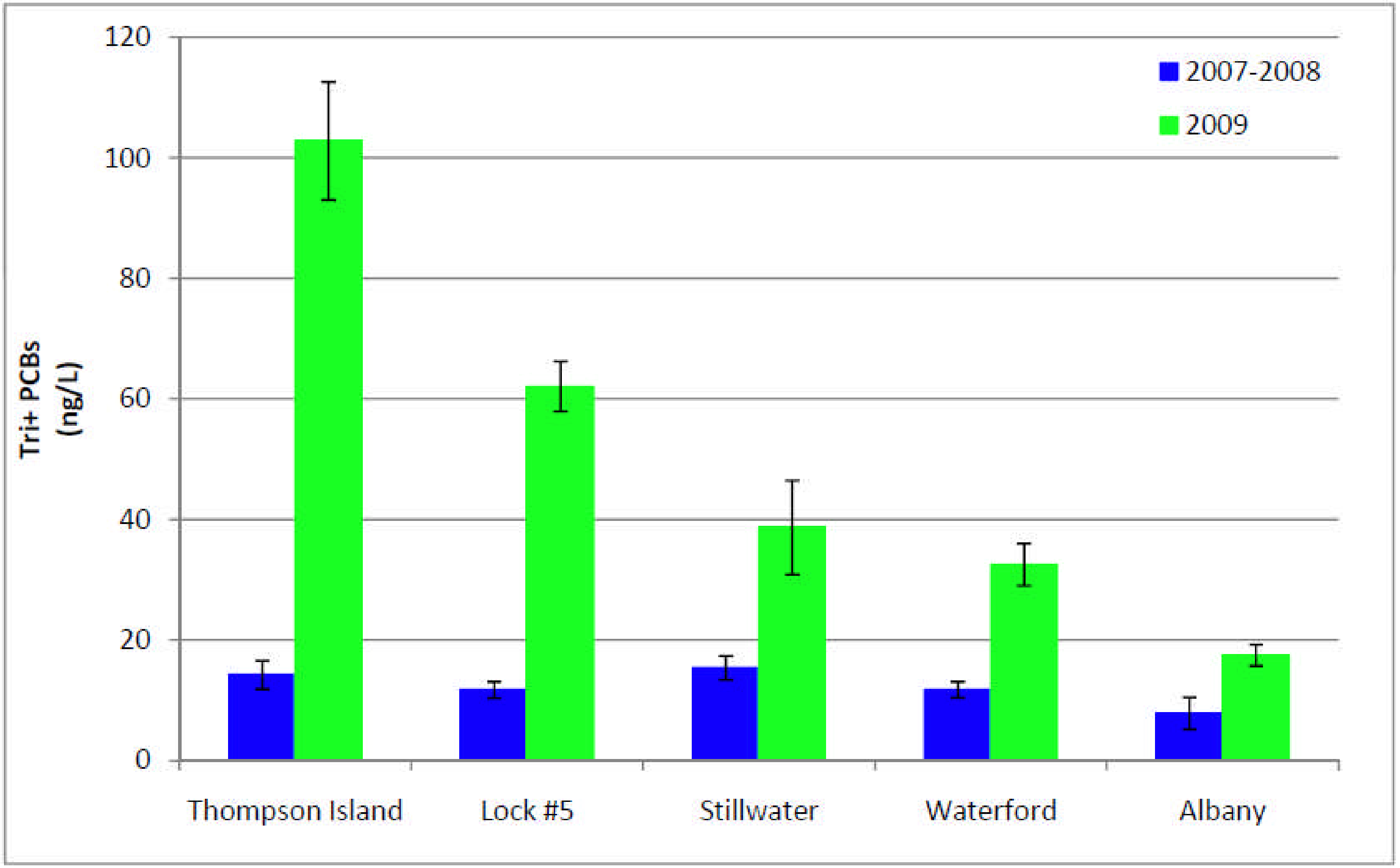
More resuspension than annual allotment

- 4% in areas without structural controls – 3% overall (similar to other dredging projects)
- Triggers exceeded despite structural controls and BMPs
  - Exceeded drinking water standard 10 times
  - Above 350 ng/L control level 20% of the project
  - Above 1080 g/d load control level for almost entire project
  - Exceeded allowable annual load

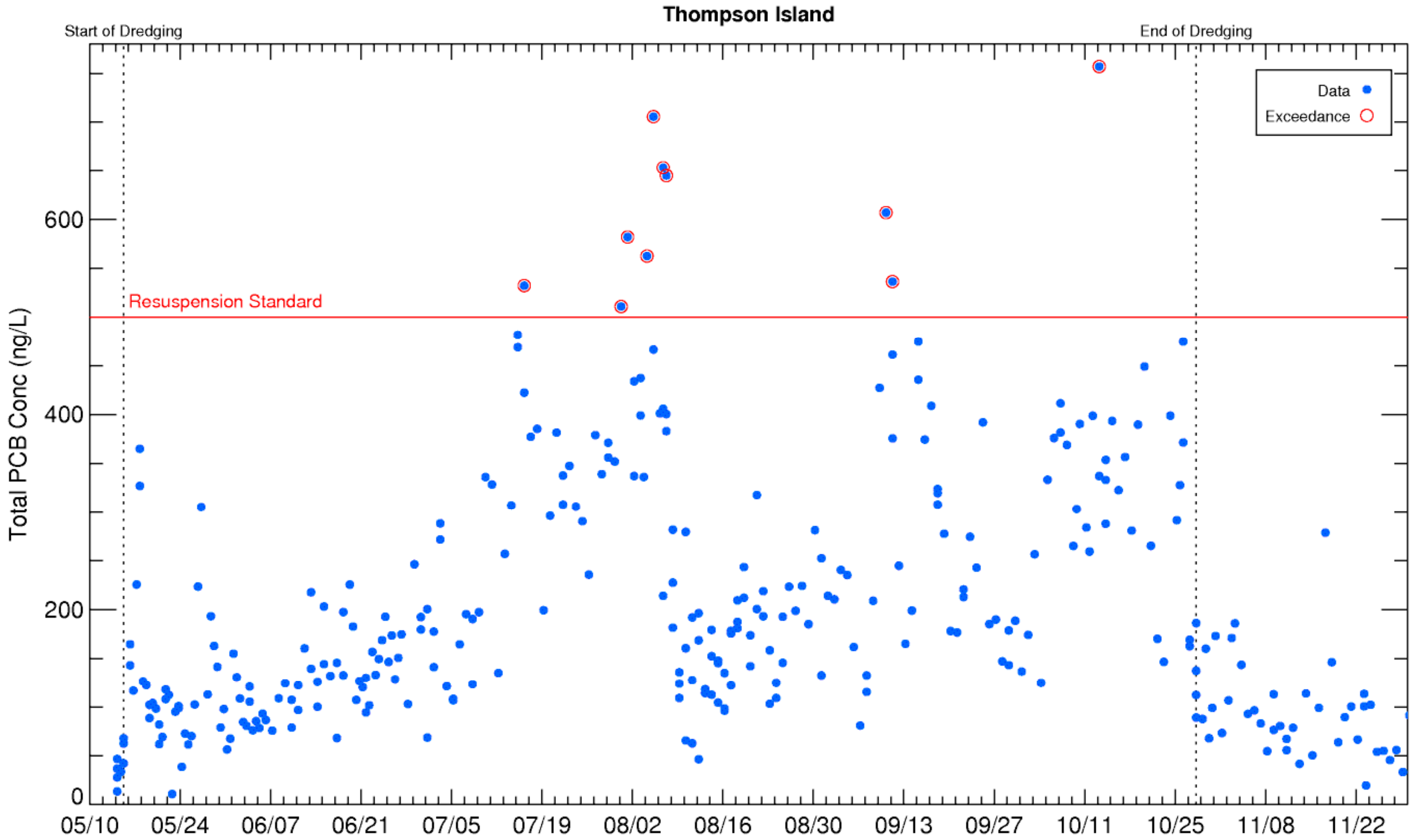
Resuspension had impact unaccounted for in standard

- Resuspended sediments spread to downstream areas
- Created bioavailable layer and resuspension after dredging was completed

All Stations Showed Increased PCB Levels in Water



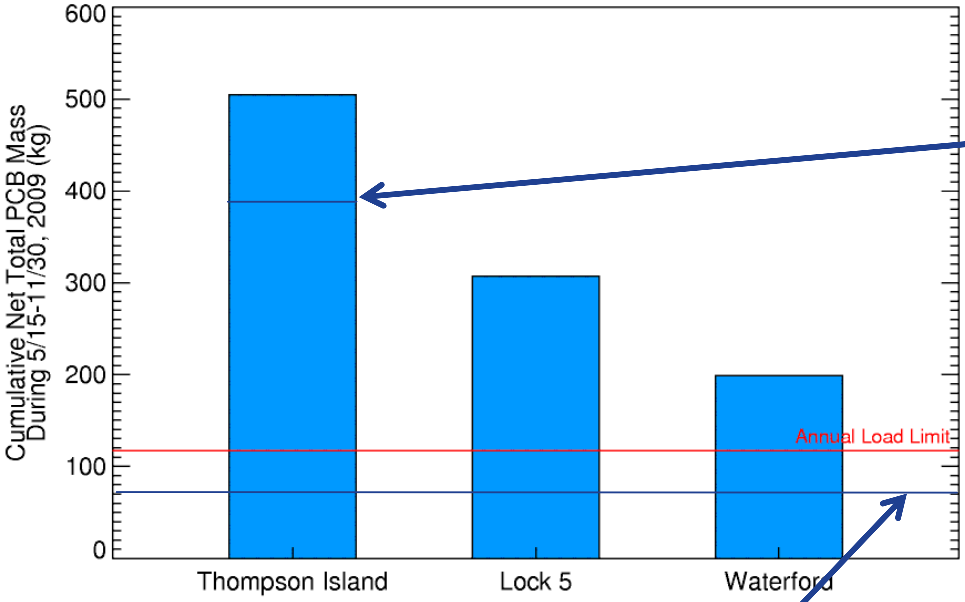
PCBs in Water at 1st Far-Field Station



500 ppt water quality standard exceeded on 10 occasions at Thompson Island Station

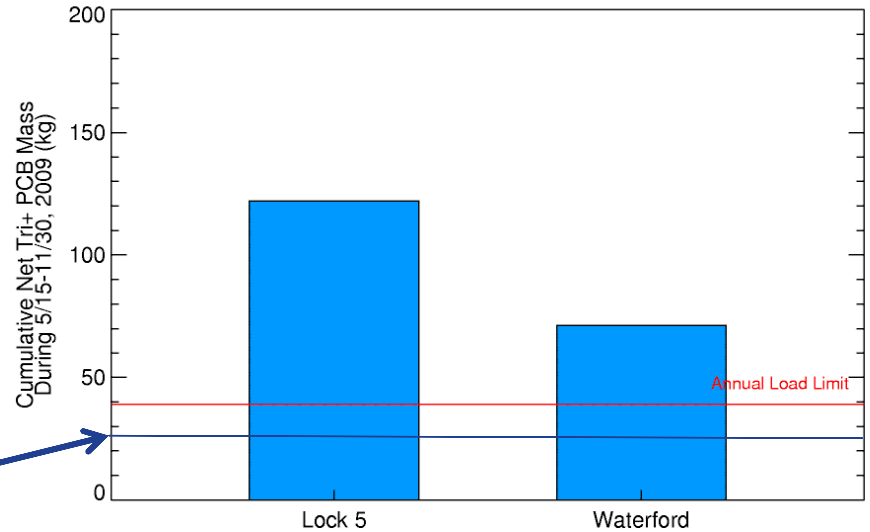
Cumulative Net PCB Load May-December

Total PCB



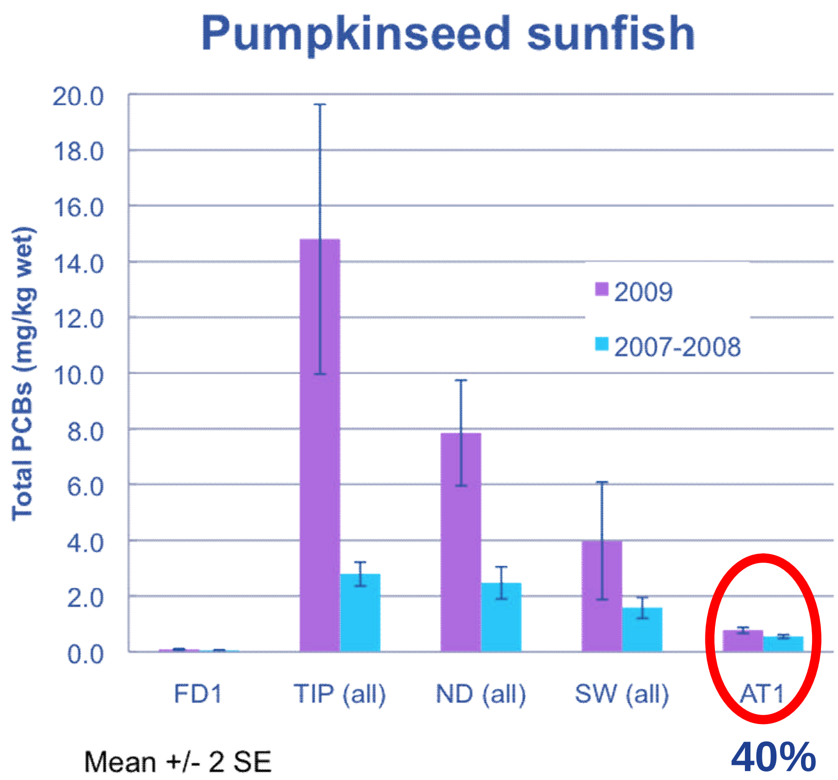
EPA-determined allowable
<u>TOTAL PROJECT</u>
resuspension at
Thompson Island

Tri+ PCB

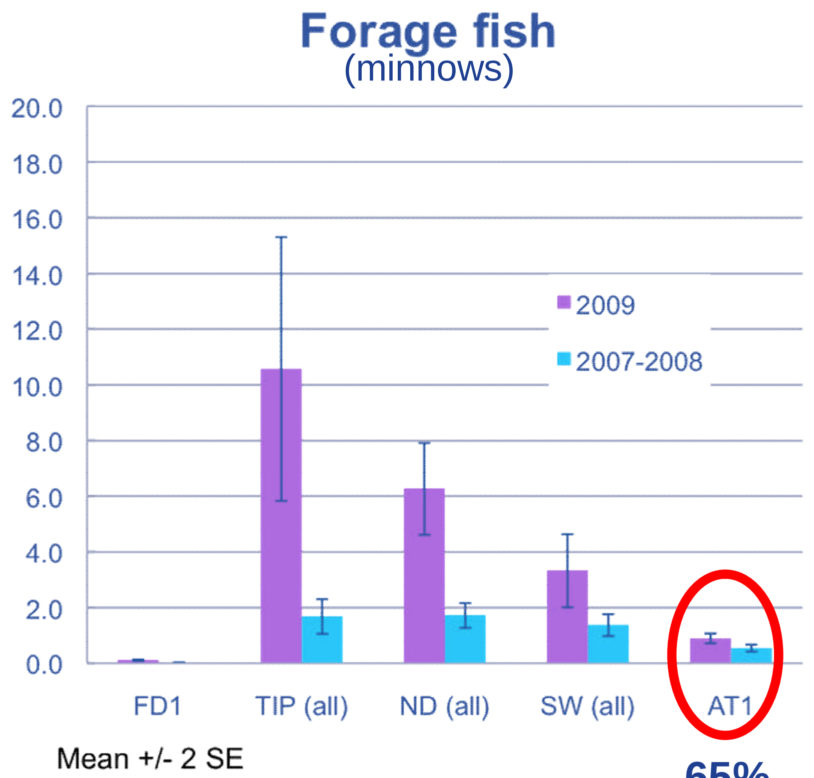


Limit Based on Actual Fraction of Project Mass Removed

PCB levels in Fish Spiked (September data)



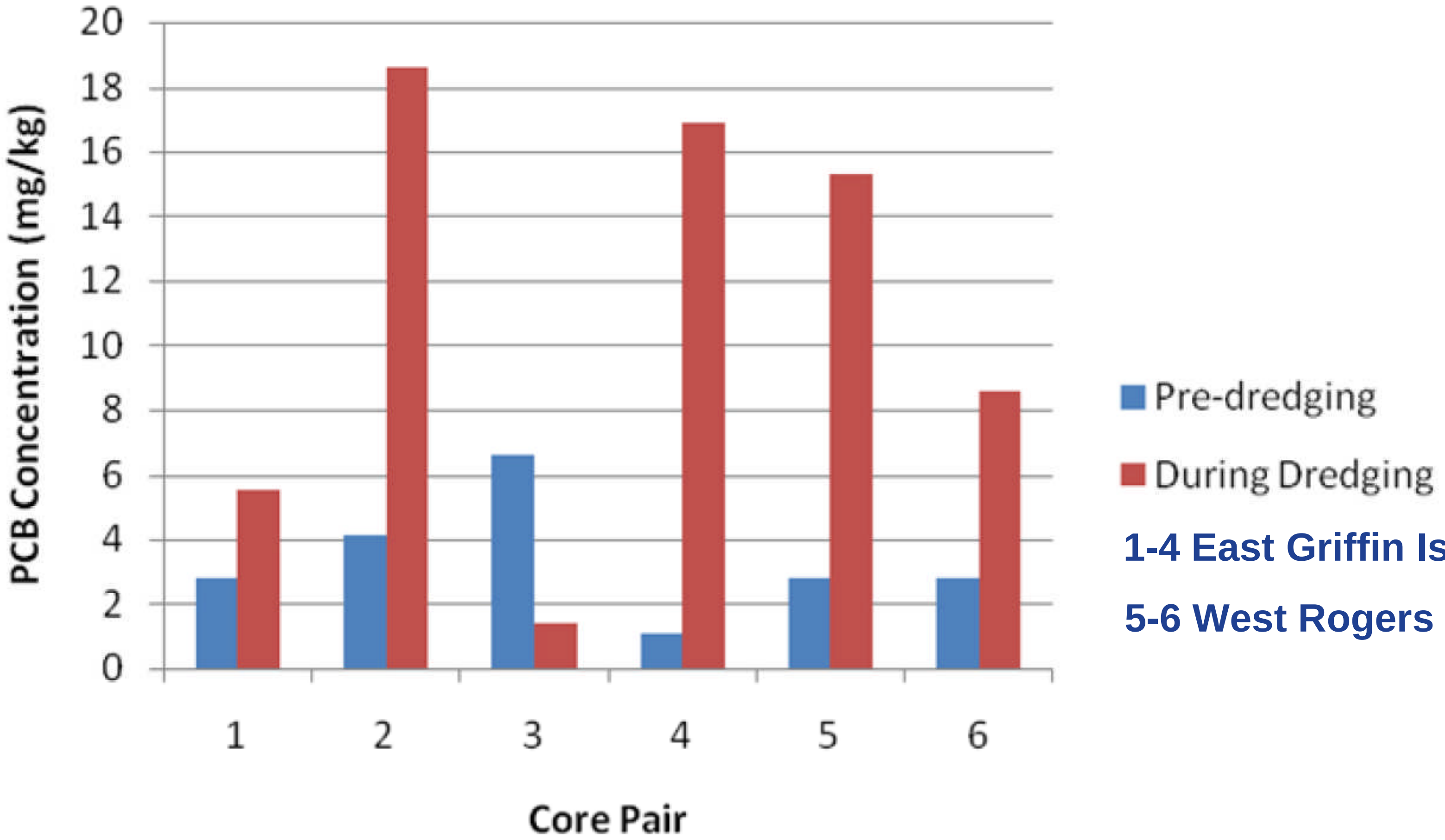
40% increase



65% increase

5-fold increase in Thompson Island Pool –
decreasing impact with distance downstream, though statistically significant through Albany

Surface Sediment (0-5 cm) PCBs at Locations Downstream of Phase 1 Dredge Areas



1-4 East Griffin Island

5-6 West Rogers Island

Example Sediment Trap PCB Levels

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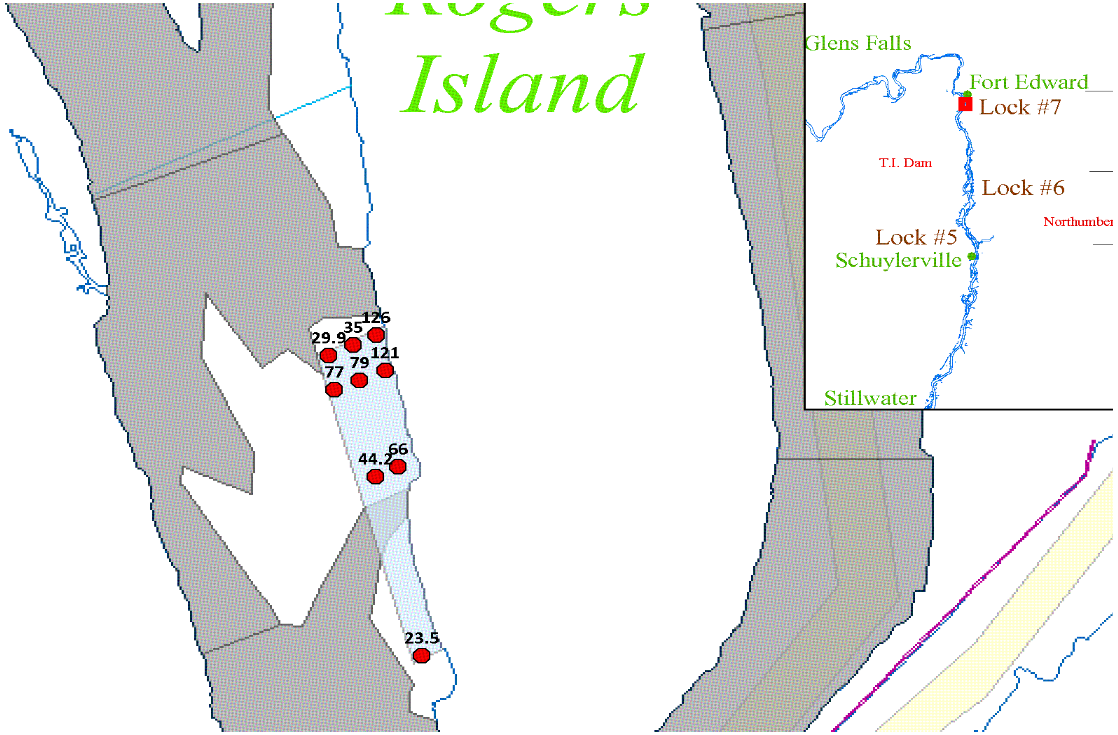
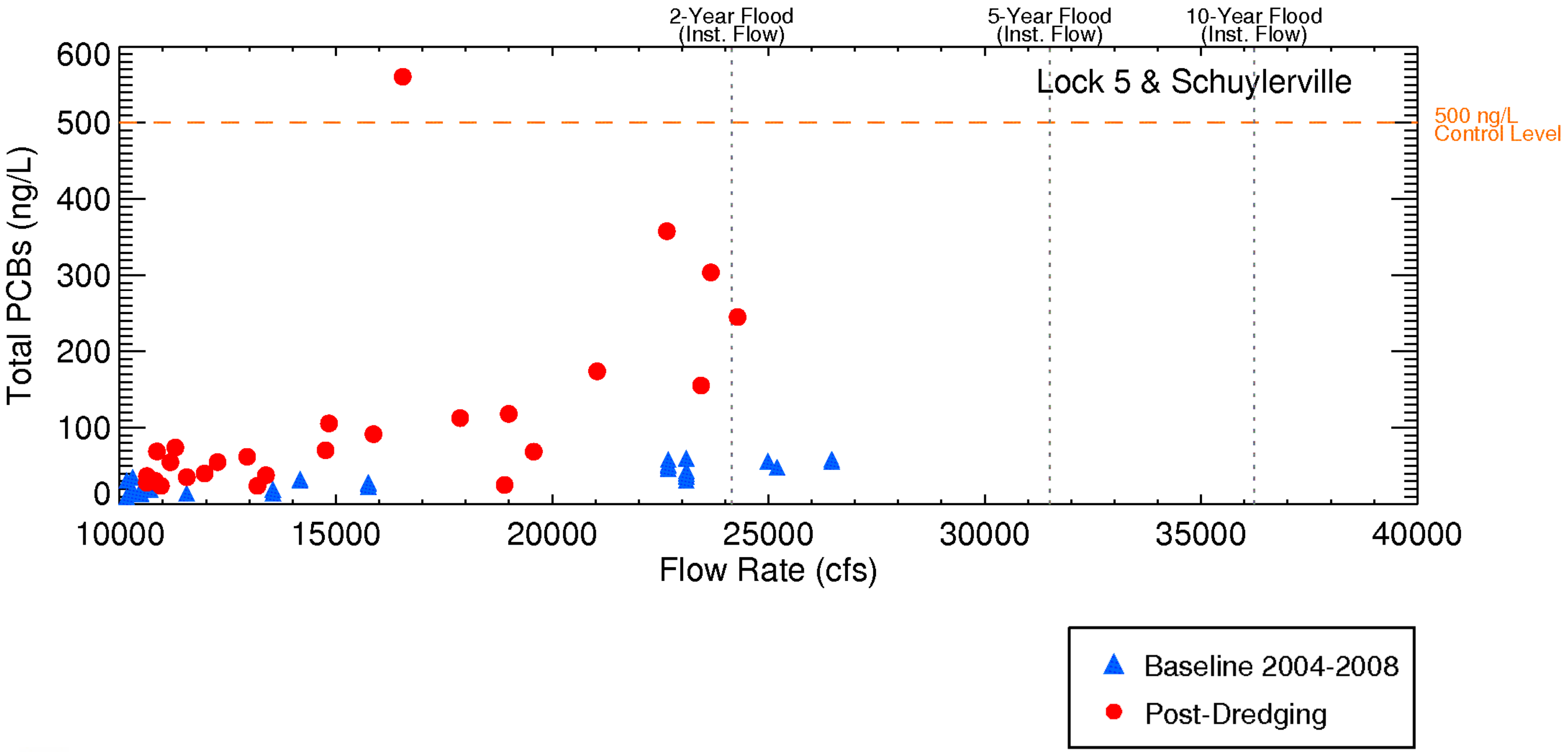


Study Area	Sediment Trap Deployment Time	Minimum PCB Conc. (mg/kg)	Maximum PCB Conc. (mg/kg)	Average PCB Conc. (mg/kg)	Pre-Dredging (0-2 in.) Average PCB Conc. (mg/kg)
EGIA	Jul. 8 - Aug. 18	30	121	72	22
Rogers Island West Channel	Aug. 20 - Sept. 16	24	126	67	5
Lock 7	Sept. 18 - Oct. 20	28	51	38	0.6
EGIA	Oct. 15 - Oct. 22	37	90	64	22

March-April High Flow Monitoring at Schuylerville



Numerous Steps to Control Resuspension

- Rock wall in East Channel
- Flow-related restrictions in West Channel
- Sheetpiling wall at Griffin Island
- Limitations on tug operation in shallow areas
- Use of smaller scows in shallow areas
- Prohibition on bucket decanting
- Alternated dredging areas
- Sheen containment around all dredges

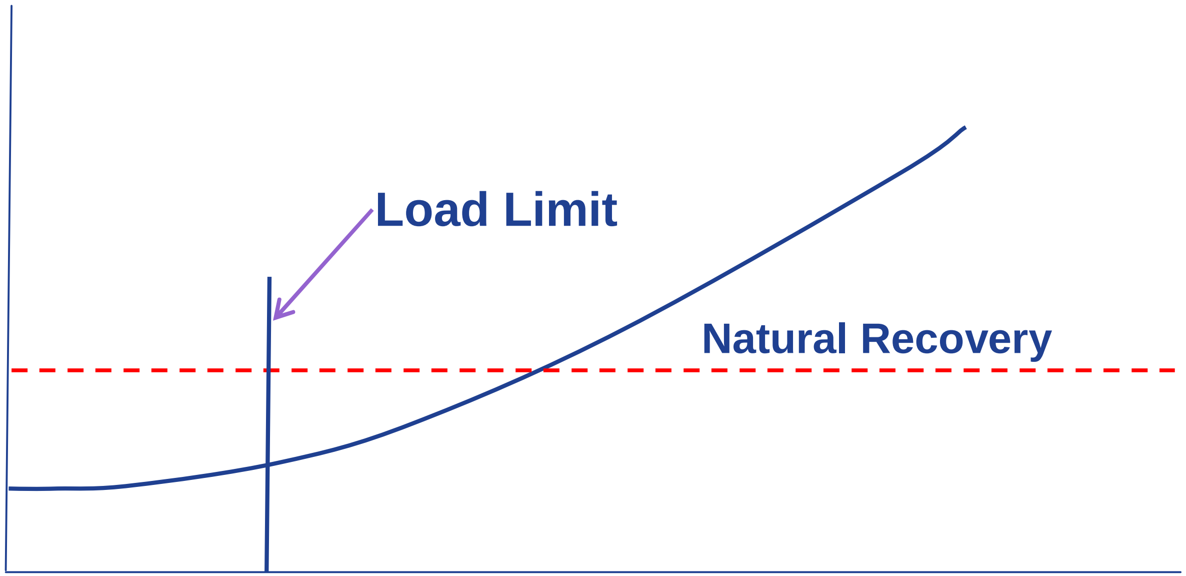
Resuspension is Critical Determinant

- For dredging project to achieve EPA goals, resuspension must be reduced
- GE recommends using updated computer model to evaluate how much resuspension can be permitted before benefits of dredging are compromised
- Establishing limits on quantity of PCBs dredging is permitted to resuspend
- Apply limits to both Upper and Lower Hudson to protect water quality and fish

Limiting Resuspension Preserves Benefit to Upper Hudson

- Use model projections of PCB levels in fish to relate resuspension and reductions in PCB levels in fish

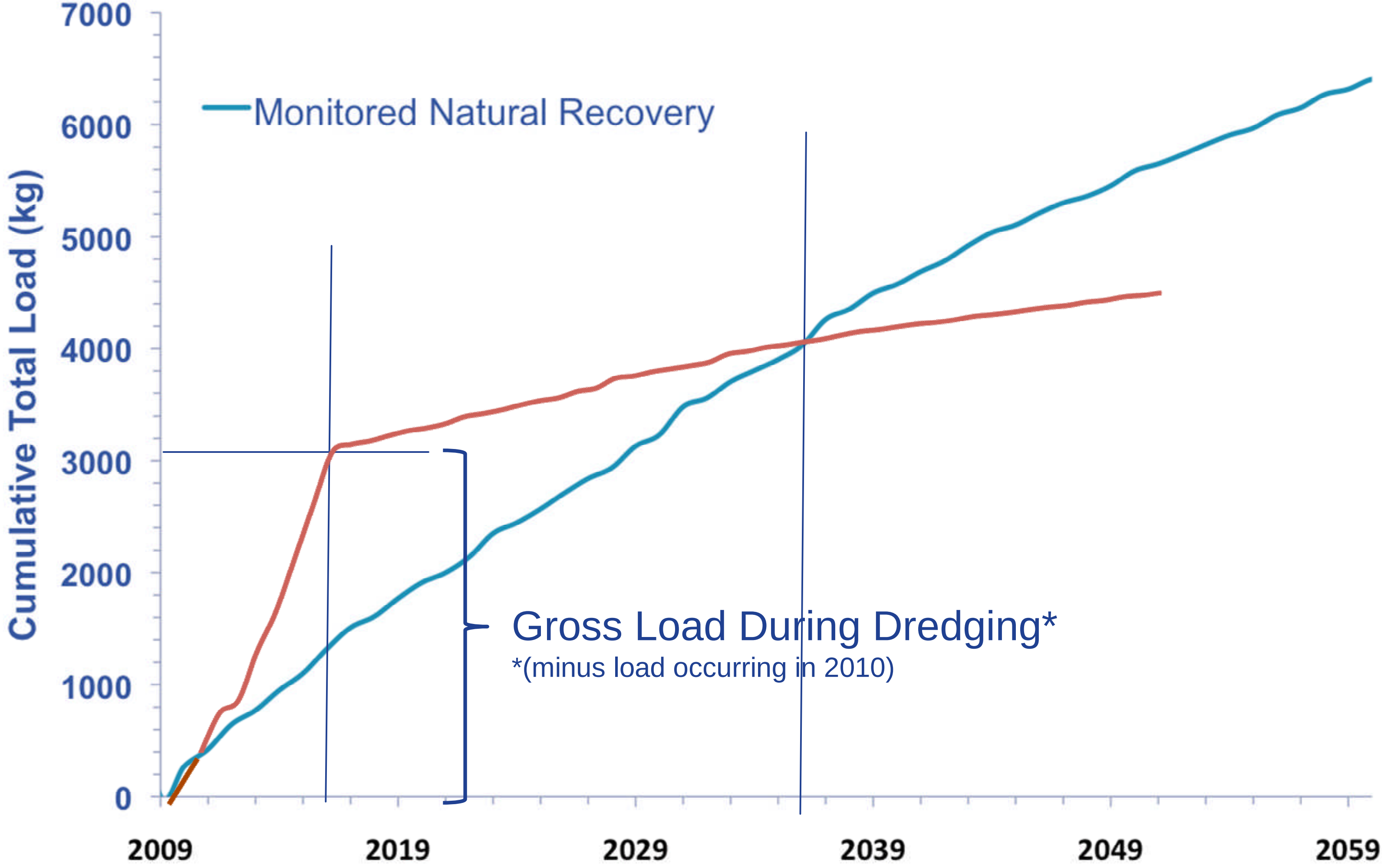
2009 – 2060
Avg. Fish PCB
Concentration
(mg/kg)



Near-Field Resuspension Load (kg)

Dredging Project That Accrues a Benefit by 2036

Assuming No Re-deposition of PCBs



Conclusions

- Set limits on resuspension to protect Upper and Lower Hudson
- Prioritize dredge areas based on contribution to PCBs in fish and load to river; identify “high value” deposits for removal
- Remove these deposits first to achieve maximum possible reduction in PCB levels while minimizing downstream impacts

Residual Standard: Lessons Learned

- 90% of the PCB mass was removed in the 1st two dredge passes
- Areas defined by “high confidence” cores accurately depicted vast majority of PCB mass
- Meeting residual standard left CUs open for more than three months, impeding productivity and increasing resuspension

Proposed Changes to the Residuals Standard

- Make dredging more efficient
  - Better balance equipment workload
  - Simplify previously complex decisions
- Keep dredge areas open minimal time to limit resuspension
- Avoid inefficient dredging
  - Stop dredging when clay or shale is encountered

Productivity Standard: Limited by Resuspension

- Increase in PCB removal resulted in resuspension shutdown
  - Complete shutdown eliminates minimum of 2 dredging days; indirect productivity impact even greater
- Structural controls
  - Sheeting installation and removal reduced productivity but did not substantially reduce resuspension
  - Other controls (e.g., flow-related restrictions, restricted equipment operations, alternating dredge areas, etc.) reduced productivity

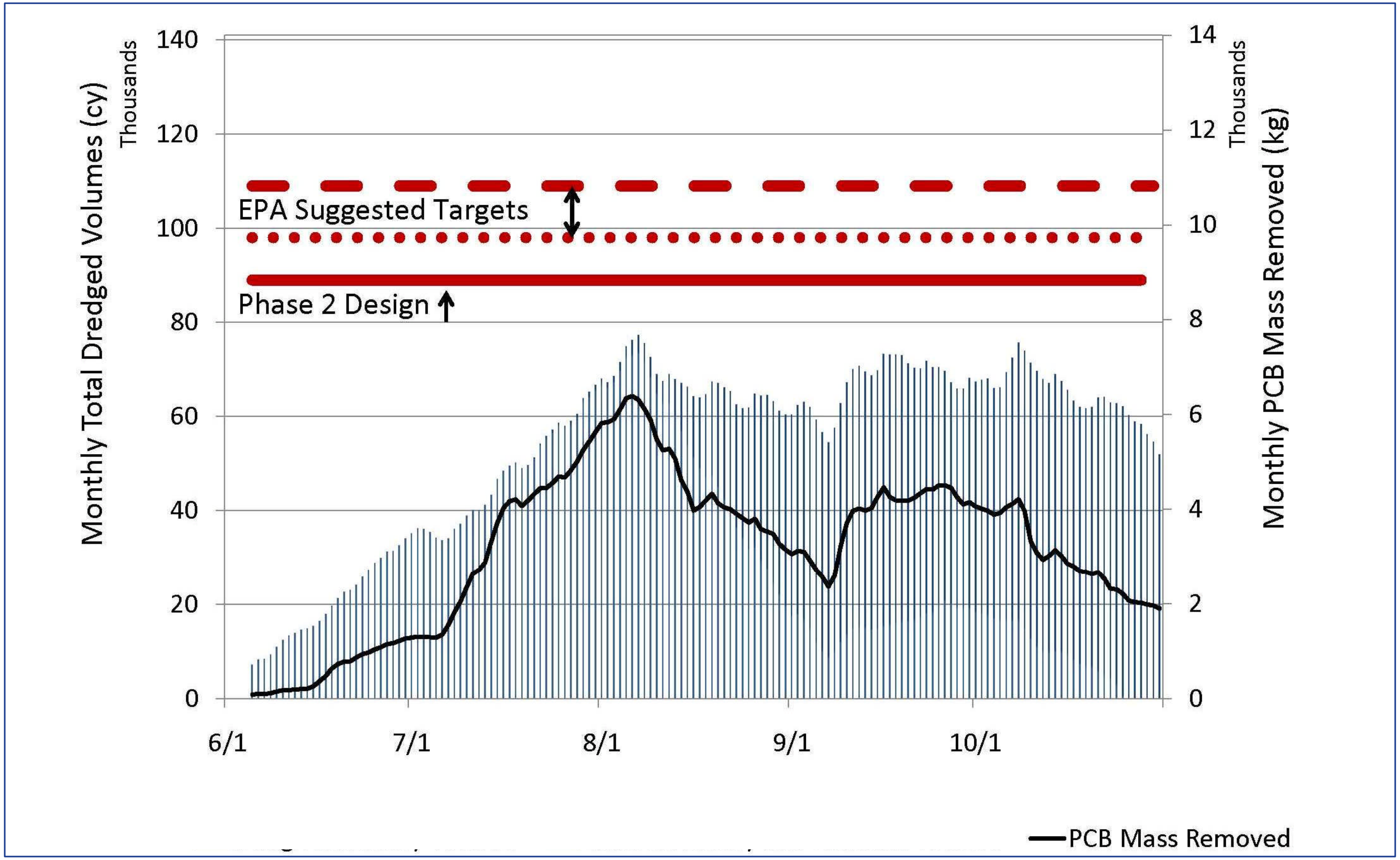
Continual Redredging Limited Productivity

- Significant re-dredging needed in all CUs
- Longer than anticipated CU acceptance process exacerbated problem
- Non-productive dredging in bedrock and cobble areas
- Dredging of clay material which has no PCBs
  - Creates processing bottlenecks
  - Cascading impact on logistics

Efforts to Meet Air Quality Standard Reduced Productivity

- Mitigation implemented to reduce standard exceedances included:
  - Adding water to barges
  - Topping barges with low PCB sediment
  - Sheen mitigation
  - Attempts at tarping mini hoppers
  - Sequencing requirements (limiting dredging in "hot" areas)
- Efforts had limited effectiveness but significantly impacted productivity

Phase 1 Monthly Productivity



Conclusions

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- Clear relationship between productivity and resuspension
- Based on Phase 1 experience, EPA's productivity target cannot be met in Phase 2
- Phase 1 suggests we can dredge/process 75,000 to 100,000 CY/month; **but** resuspension will prevent achieving this dredge rate
- Balancing these standards will preserve the environmental benefits of project

CONCLUSIONS

Guiding Principles for Phase 2

- Keep standards but modify them based on Phase 1 experience:
  - Ensure EPA's goals are met: Reduced PCB levels
  - Address the conflicts among standards
  - Be practicable
  - Complete project in five years so benefits to river begin sooner

Conclusions

- EPA and GE agree standards must be modified
- Set limits on resuspension to protect Upper and Lower Hudson
- Prioritize dredging to achieve maximum PCB reduction while minimizing resuspension
- Eliminate inefficient re-dredging to get residuals
- Get project done in five years