Remediation & Restoration of Mirror Lake, Dover, Delaware

Battelle Conference on Remediation and Management of Contaminated Sediments

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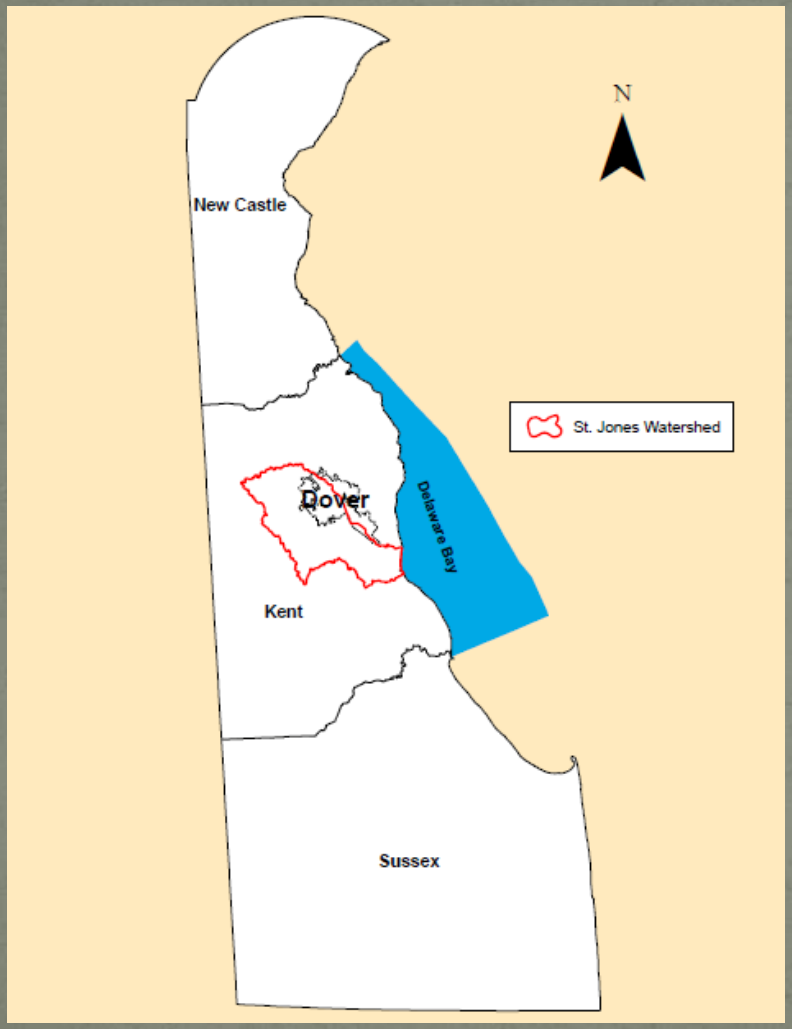
John G. Cargill, IV, P.G. – Delaware DNREC

Introduction



- Mirror Lake is located at the gateway to historic Dover, DE. It is impacted by sedimentation, stormwater runoff, chemical contaminants, excess nutrients, invasive plant species and bacteria.

- Mirror Lake (~3.5 acres, 3' deep) is part of the Saint Jones watershed (empties to the Delaware Bay).

Introduction (continued)

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- Mirror Lake/St. Jones River COCs include PCBs, dioxins & furans, OC pesticides, mercury and PAHs.
  - *Fish advisories have existed in this area of the St. Jones River since 1988*
  - *Lacks ecological diversity and functionality*
  - *Contaminated sediments impeded an ecological restoration project by DNREC*
- DNREC, in cooperation with several partners, implemented the Mirror Lake Remediation & Restoration Project in the fall of 2013.

Project Goals & Remedial Approach

- Remediate the sediments in place to prevent contaminants from entering the food chain, allowing the fish advisory to be lifted or reduced in a matter of years, not decades. Activated carbon (SediMite™) was chosen as the preferred remedial alternative.

- Restore habitat and improve the visual appeal of the lake. Not discussed in this presentation.

Planning/Permits

- Approximately 1 year of project planning
  - *Multiple project partners (most planning meetings included 15-20 stakeholders)*
  - *Constructability review*
  - *Included permitting agencies (DNREC and USACOE)*
- Numerous Public Outreach Efforts
  - *Dover Parks Meetings and Silver Lake Commission Meetings*
  - *Public Information Meetings*
  - *Door-to-door and flier update at residential properties nearby*
  - *Press releases*
- Permits/Agreements
  - *US Army Corps of Engineers Nationwide Permits (NWP 27 and 38)*
  - *DNREC Subaqueous Lands Permit*
  - *DNREC Erosion and Sediment Control Permit*
  - *Access Agreements from all adjacent property owners*

Sediment Remediation at Mirror Lake

- SediMite™ is a pellet made up of activated carbon (binds contaminants), sand (aids sinking), and clay (temporarily holds the pellet together).
- 79 tons of SediMite™ were incorporated into 5 acres of lake bottom and downstream channel sediments over 10 days. Three main application methods were used.
- This was the largest application of SediMite™ anywhere in the U.S.
- This was the first State-led project of its kind in the nation.

SediMite™ Application Methods

Air Horn from Land

Air Horn from Boat

Air Horn at Low Tide

SediMite™ Application Methods

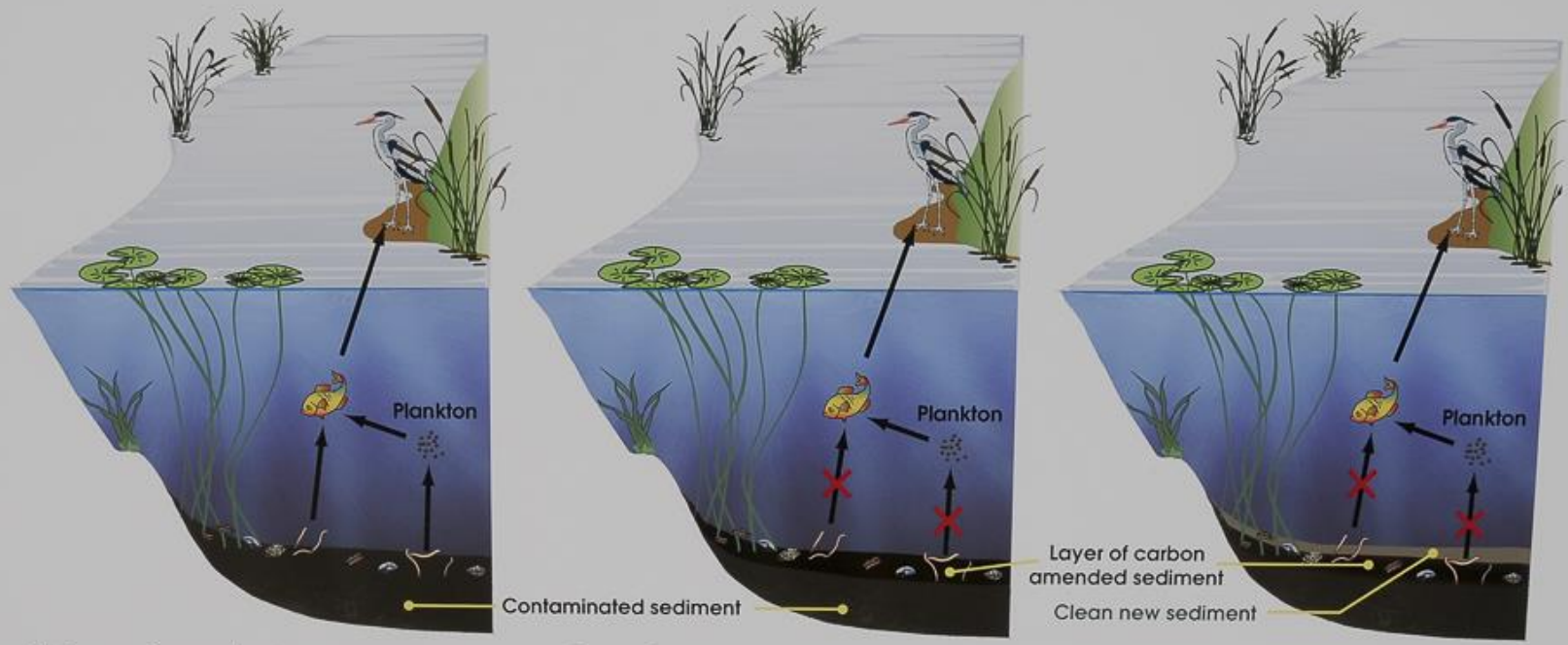
Telebelt with Chute

Vortex Machine

Hand Broadcast

Ceremonious Last Bucket

How the Process Works:



Prior to Remediation
Old contaminants in sediment accumulate in fish and other organisms.

Remediation
A layer of activated carbon pellets holds contaminants tightly so they are no longer available to fish and other organisms.

After Remediation
In the long term (5+ years), the carbon layer is covered with clean new sediment.

Bioaccumulation → Application of AC → Reduced Bioaccumulation

Cost

- Total = $0.94 million (includes planning, design, construction, and monitoring for 3 years)
  - $0.68 million from State HSCA program
  - $124.6K (local legislators, transportation funds)
  - $73.8K Fed NPS grant for restoration activities
  - $63K DNREC to develop plans & specs
- Labor was largely volunteer and included:
  - 61 total volunteers from DNREC, Brightfields, AmeriCorps, Delaware Boot Camp, and the Interfaith Mission.
  - 551 hrs contributed from DNREC; 770 hrs from others.

Monitoring Included. . .

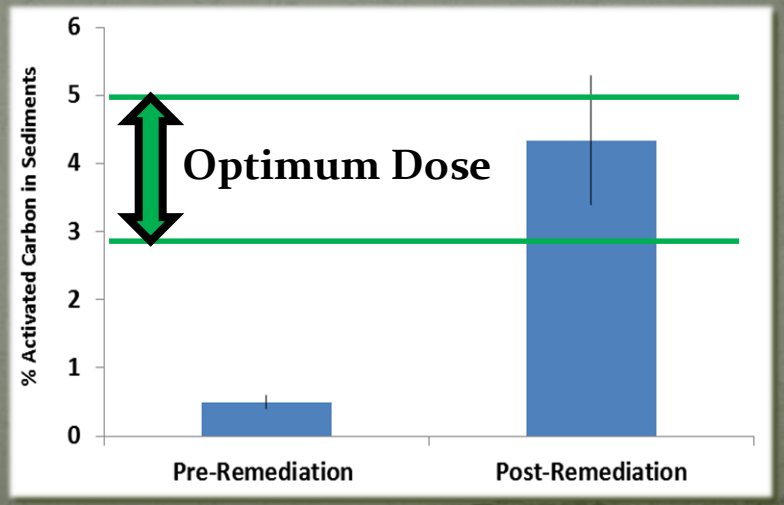
- Bulk Sediment
- Passive Samplers – Sediment Pore Water & Water Column
- High Vol Water (XAD2 and Filters)
- Sediment Bioaccumulation Study
- Fish Tissue
- Shallow Sediment Cores

Sediment Cores

Activated Carbon in Sediments

Carbon in sediment during low tide

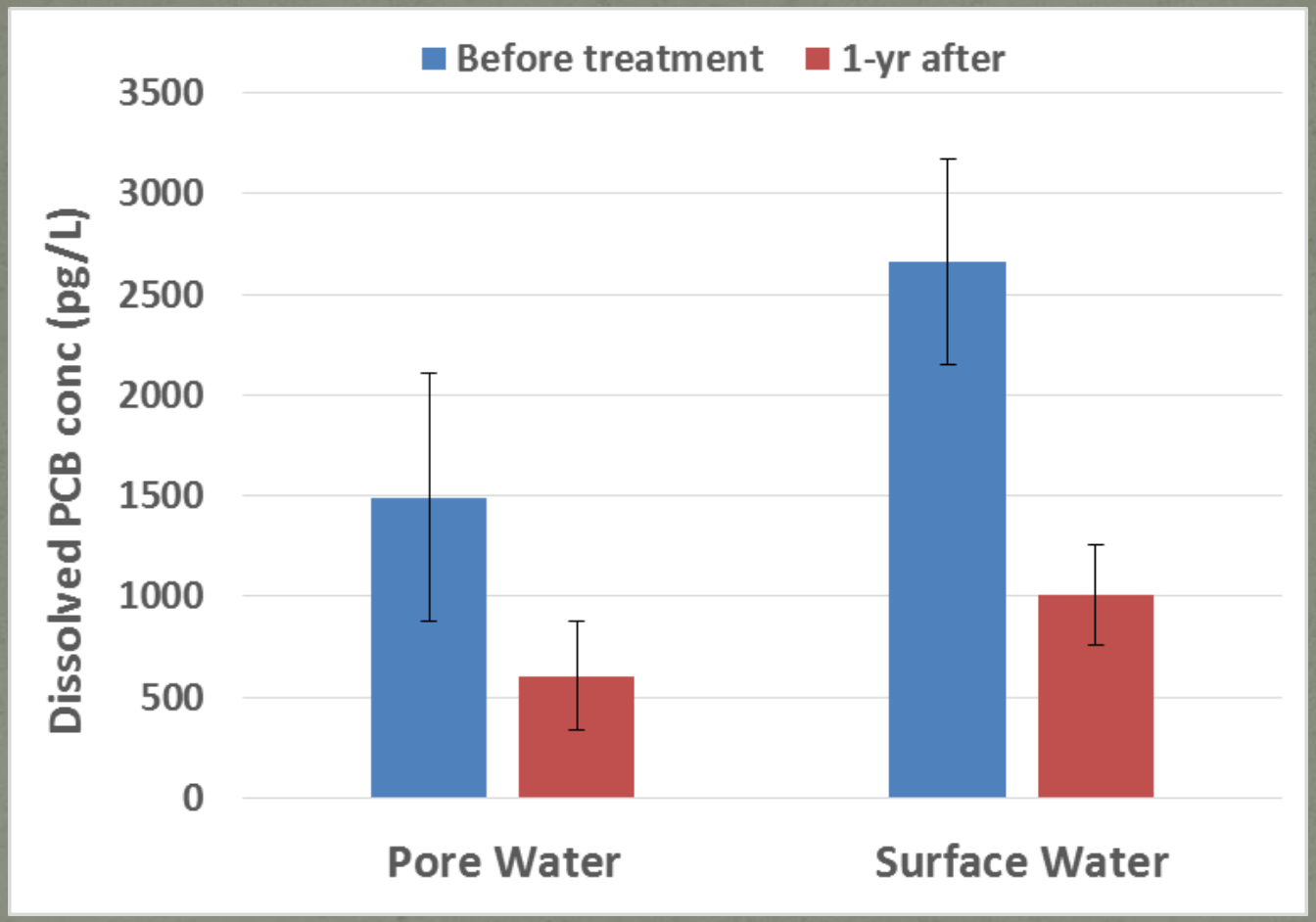
- Optimum dose of 3 – 5% met
- 70 – 90% reduction in contaminant bioavailability expected.



Passive Sampler (POM & PE) Deployment

Passive Sampler Retrieval

Mirror Lake PCB – Passive Samplers



60% reduction in porewater and 62% in water column.
NOT corrected for non-equilibrium thru PRC loss.

Fish Tissue Sampling


Largemouth Bass


Brown Bullhead

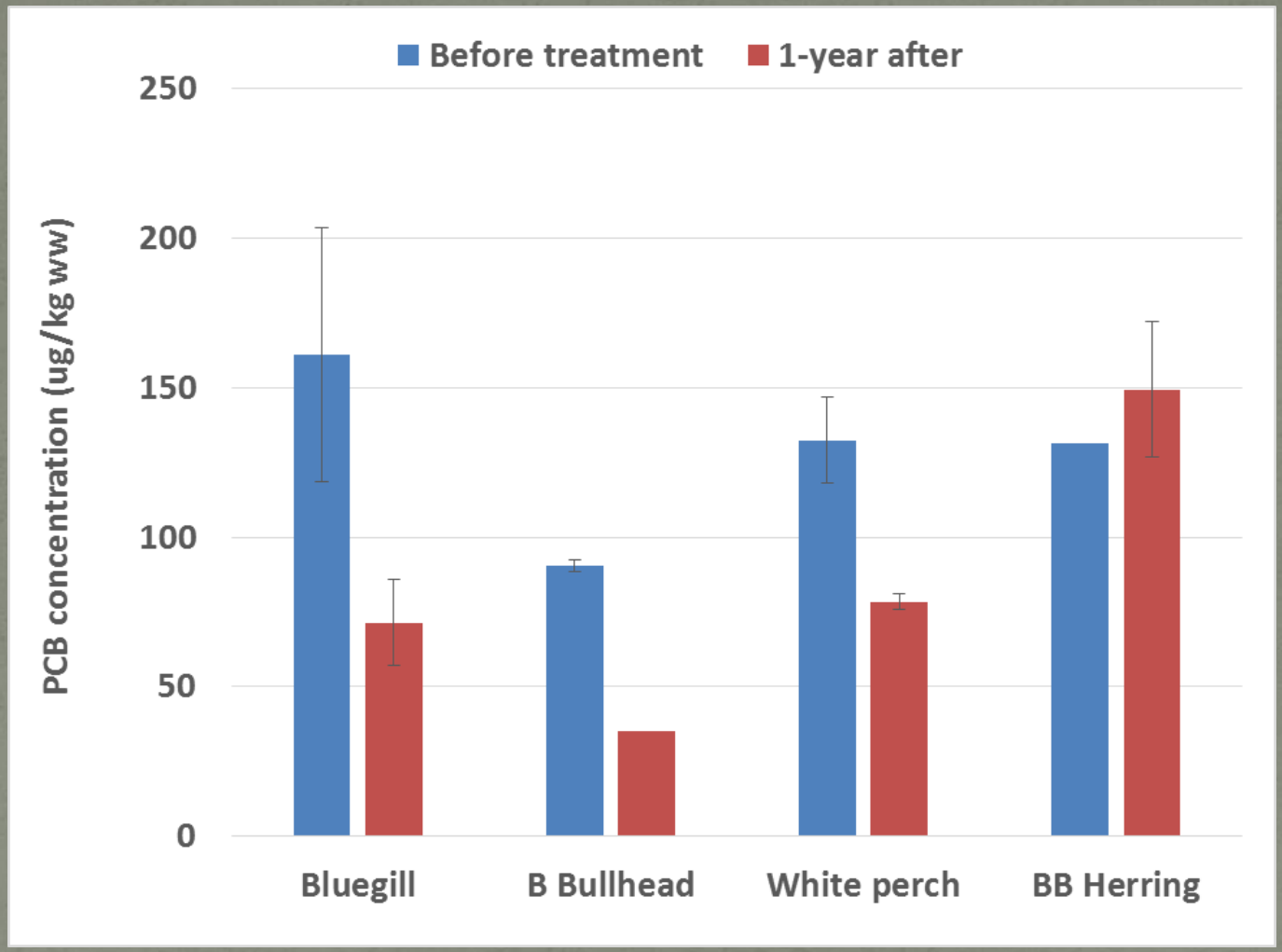

White Perch


Bluegill


Golden Shiner


Blueback Herring

PCB in Fish Tissue



56 - 61% reduction in resident fish; 0 -41% reduction in migratory fish

Summary

- % reduction in porewater and water column dissolved phase PCB (60% and 62%, respectively) is very similar to % reduction in PCB in resident fish species (56% to 61%).
- % reduction was slightly less than anticipated (70% - 90%). This is likely due to residual transport of PCB into Mirror Lake from upstream and downstream (under investigation).
- Project still considered a success overall.
- Monitoring will continue for several additional years.

Acknowledgements

Professor Upal Ghosh, University of Maryland Baltimore County
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- AmeriCorps
- Biohabitats
- Brightfields
- City of Dover
- Colonial Investment & Management Company
- Delaware National Estuarine Research Reserve
- Delaware Office of Management and Budget
- Delaware Representative Darryl Scott
- Delaware Senator Brian Bushweller
- DNREC Office of the Secretary
- DNREC Division of Fish & Wildlife
- DNREC Division of Parks & Recreation
- DNREC Division of Waste & Hazardous Substances
- DNREC Division of Water
- DNREC Division of Watershed Stewardship (esp. the Shoreline and Waterway Section)
- Energizer Personal Care
- Frazier's Restaurant
- Interfaith Mission
- Meadville Land Services, Inc.
- Pinelands Nursery, Inc.
- Portadam, Inc.
- Ransome Rents
- Sediment Solutions
- Silver Lake Commission
- Sussex County Conservation District
- Sussex County Correctional Boot Camp
- US Army Corps of Engineers
- VOLUNTEERS, VOLUNTEERS, VOLUNTEERS!
- Wistar Equipment, Inc.

References

- Biohabitats. 2013. Mirror Lake Remediation and Restoration, 100% Design Plans and Specifications, dated 31 July, 2013. Prepared by Biohabitats for the Delaware department of Natural Resources and Environmental Control and the City of Dover.
- Brightfields. 2014. Construction Completion Report, Mirror Lake, Dover, Delaware, dated March 2014. Prepared by Brightfields for the Delaware Department of Natural Resources and Environmental Control.
- DNREC. 2013. DNREC's remediation and restoration of Mirror Lake in Dover gets underway, Innovative project will significantly improve health of the lake. News Release dated November 6, 2013, Vol. 43, No. 428.
- Ghosh U. and Greene R. 2012. In-Situ Treatment of Mirror Lake Sediments to Reduce Uptake of Pollutants in the Food Chain. Proposal dated May 7, 2012.

Web links:

- Restoring Mirror Lake: http://youtu.be/gplVE07eUq4
- Mirror Lake Results: http://youtu.be/l880E6aTHK8

Questions ?