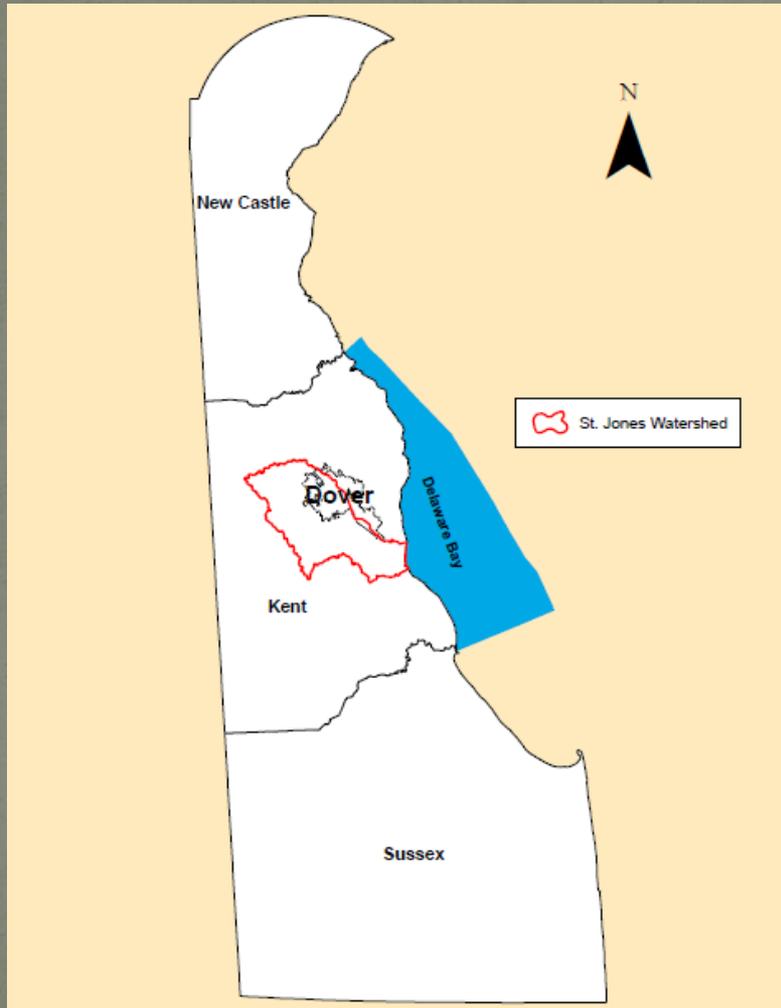


# Mirror Lake Remediation & Restoration – The First Full-Scale Application of Activated Carbon - Dover, Delaware



2016 Delaware Wetlands Conference  
February 3, 2016  
John G. Cargill, IV, P.G. – Delaware DNREC

# Introduction



- Mirror Lake is located at the gateway to historic Dover, DE. It has been 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)



# Introduction (continued)

- 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*
  - *Lacked 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

- 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. Restoration plan included construction of an intertidal wetland, flow diversion, bank stabilization, and native plants.

# 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



Telebelt

Air Horn from Land



Air Horn from Boat



Air Horn at Low Tide



# SediMite™ Application Methods



**Telebelt with Chute**



**Vortex Machine**

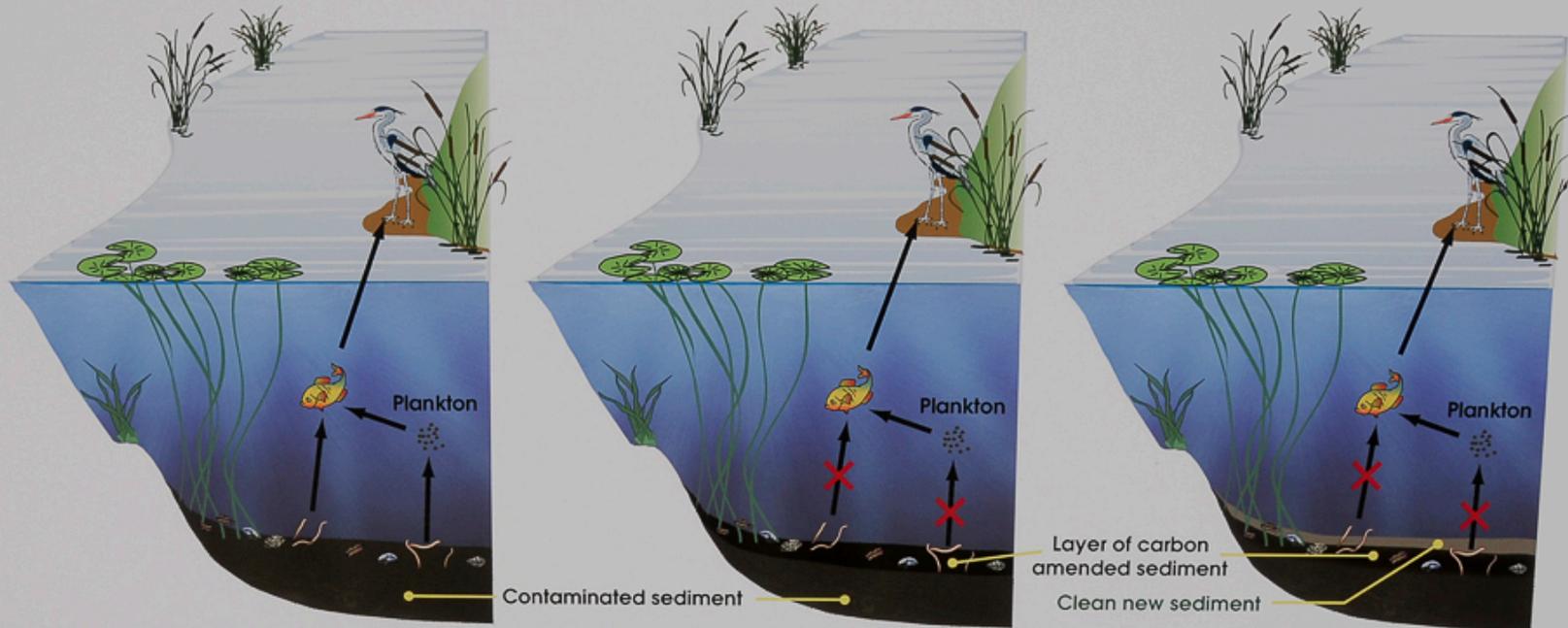


**Hand Broadcast**



**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

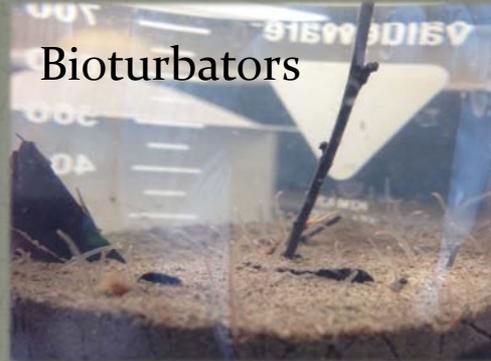


Reduced Bioaccumulation

# Monitoring Included...

- Bulk Sediment
- Passive Samplers – Sediment Pore Water & Water Column
- High Vol Water (XAD<sub>2</sub> and Filters)
- Sediment Bioaccumulation Study
- Fish Tissue
- Shallow Sediment Cores

# Sediment Cores



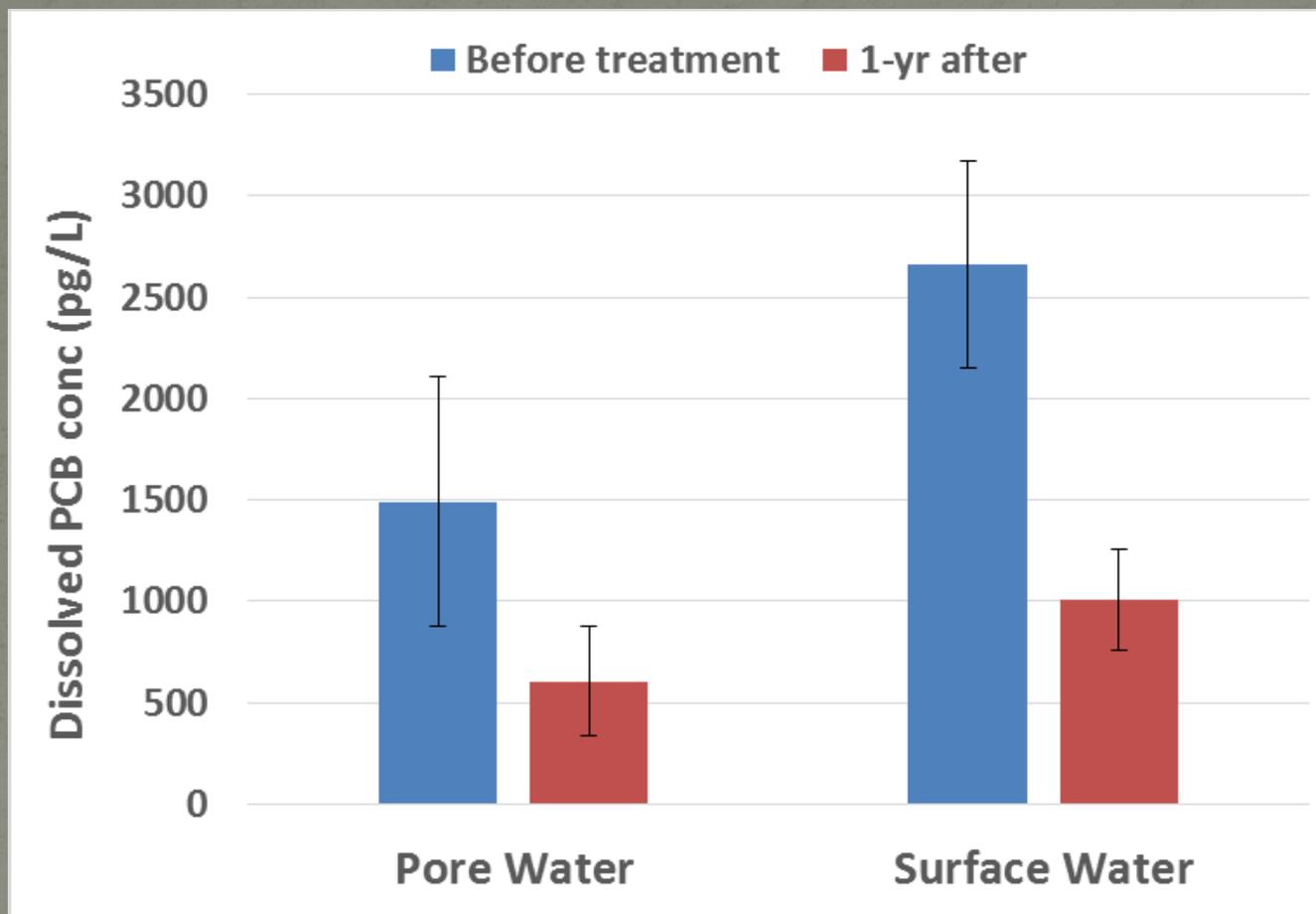
# Passive Sampler Deployment



# Passive Sampler Retrieval



# Mirror Lake PCB – Passive Samplers



~70% reduction in porewater and water column.

# Fish Tissue Sampling



Largemouth Bass



Brown Bullhead



White Perch



Bluegill

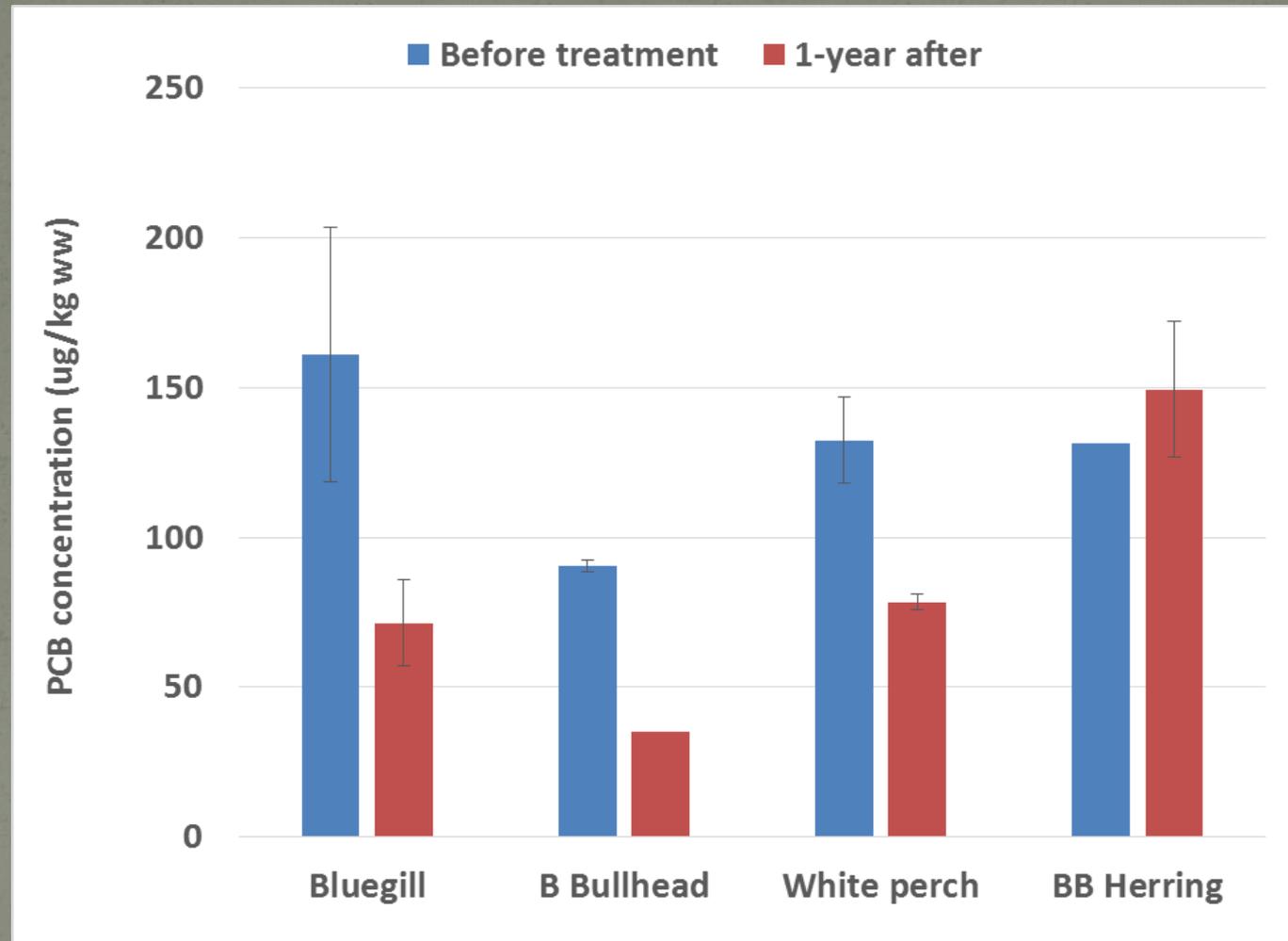


Golden Shiner



Blueback Herring

# PCB in Fish Tissue



~60% reduction in resident fish; ~40% reduction in migratory fish

# Wetland Restoration at Mirror Lake

- Removed invasive plant species from perimeter of lake.
- Placed 967 cubic yards of fill on top of existing sand bar, creating new intertidal wetland.
- Lower elevation was matted & planted fall 2013. Upper elevations planted in April 2014 and April 2015.
- Installed 2 rock vanes (62 tons) to protect new intertidal wetland and direct flow into the thalweg.
- Installed 760' of 16" diameter coir logs, double stacked, on west bank of the lake to prevent erosion.
- DNREC planted a native buffer upstream of Mirror Lake for improved habitat and water quality.

# Building the Intertidal Wetland

Placing fill between  
MLW and MHW



Laying coir matt



Planting



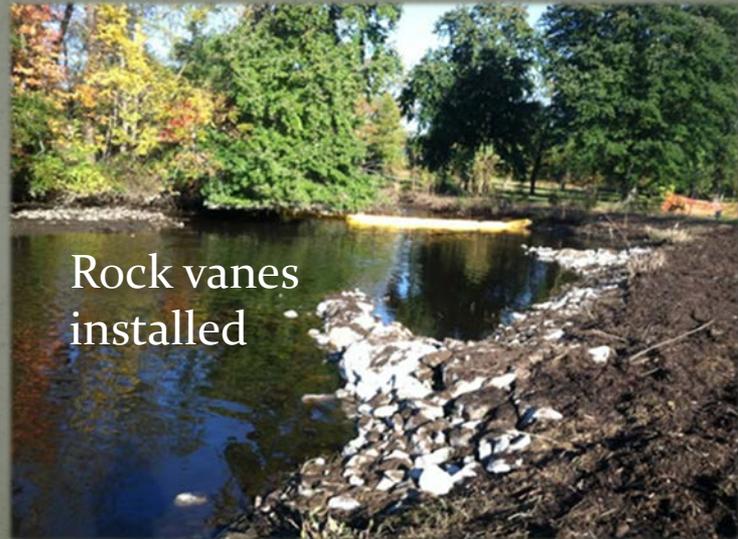
# Coir Logs & Rock Vanes



Coir logs delivered



Coir logs installed



Rock vanes installed

# Follow-Up Restoration Activities

- April 22, 2014 and 2015: Balance of planting on the intertidal wetland, plus on the west side. **Happy Earth Day !**



# Intertidal Wetland After 1 Year



09.08.2014

# Restoration Monitoring

- Invasive plant species continue to be removed from perimeter of lake.
- Marked reduction in resident nuisance waterfowl.
- 80% survival rate of plants, with supplemental planting ongoing.
- Monitoring of coir logs on west bank led to supplemental planting of plugs directly into coir log in 2015.

# 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.

# Acknowledgements

Professor Upal Ghosh, University of Maryland Baltimore County  
Dr. Rick Greene, DNREC, Watershed Assessment Section  
Mark Biddle, DNREC, Watershed Assessment Section

- 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/gplVEo7eUq4>
- Mirror Lake Results: <http://youtu.be/l88oE6aTHK8>

# Questions ?

