UPDATE OF BALTIMORE REGION TOXICS WORKSHOP (Aug 3)

AND

REGIONAL CASE STUDIES OF NOVEL PCB REMEDIATION

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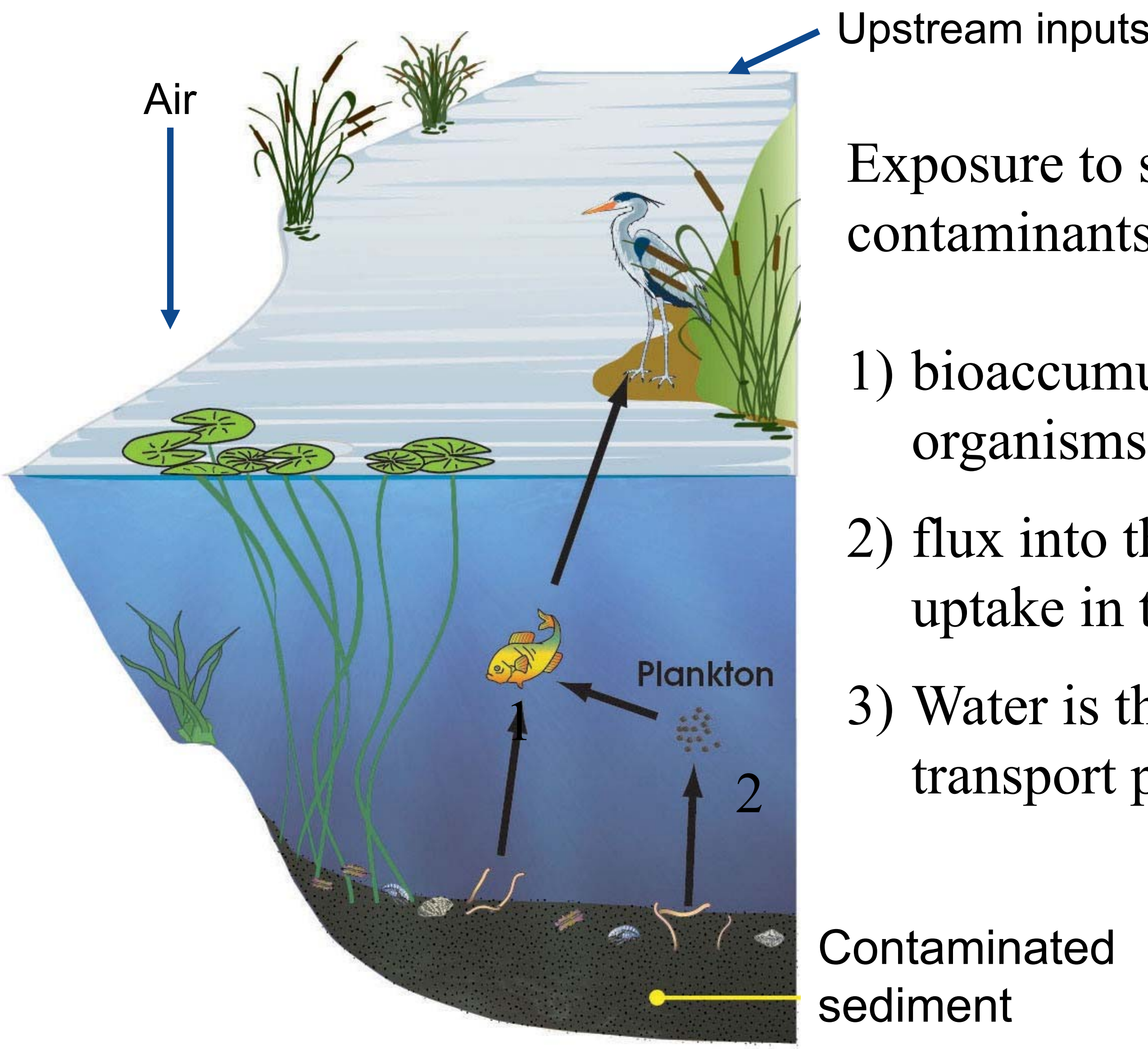
BALTIMORE REGION TOXICS WORKSHOP

August 3, 2017 USGS Office at University of Maryland Baltimore County, 5522 Research Park Drive

POC: Emily H. Majcher, P.E. Hydrologist, USGS MD-DE-DC Water Science Center: emajcher@usgs.gov

Time	Topic	Presenters/Facilitators	Presenter Organization
9:00 am	Introductory remarks	Steve Stewart and Robert Shedlock	Baltimore County USGS MD-DE-DC Water Science Center
9:15 am	The Toxics TMDL Process and TMDL Monitoring for Toxics	Len Schugam	Maryland Department of Environment, Science Services Administration
9:45 am	The Dilemma of the Jurisdictions	Steve Stewart	Baltimore County Dept of Environmental Protection and Sustainability
10:15 am	Activities of EPA Chesapeake Bay Program Toxics Workgroup	Greg Allen	EPA Chesapeake Bay Program
10:45 am	BREAK		
11:00 am	Monitoring in support of TMDL for PCBs in the Delaware Estuary and Bay	Dr. Thomas Fikslin	Delaware River Basin Commission
11:25 am	Implementation of the PCB TMDL for the Delaware Estuary and Bay	Greg Cavallo	Delaware River Basin Commission
11:50 am	LUNCH		
12:35 pm	Review of relevant research in monitoring and remediation	Emily Majcher Bob Summers	USGS Maryland WSC KCI
12:50 pm	Monitoring and Cleanup of an Industrial Site in the Baltimore region Contaminated with PCBs: A Case Study	Dr. Upal Ghosh	University of Maryland Baltimore County (UMBC)
1:20 pm	Innovations in monitoring for PCB's and PAH's	Dr. Michael Unger Dr. Upal Ghosh Dr. Charles Walker	Virginia Tech UMBC USGS MD-DE-DC Water Science Center
2:20 pm	BREAK		
2:35 pm	Treatment Remediation: what can be done and where	Dr. Allen Davis Dr. Staci Capozzi Dr. Kevin Sowers Dr. Michelle Lorah Dr. Neal Durant	University of Maryland University of Maryland University of Maryland USGS MD-DE-DC Water Science Center Geosyntec Consultants
4:10 pm	Summary Discussion and potential next steps	Select representatives from the BUWP Actionable Science Workgroup	various

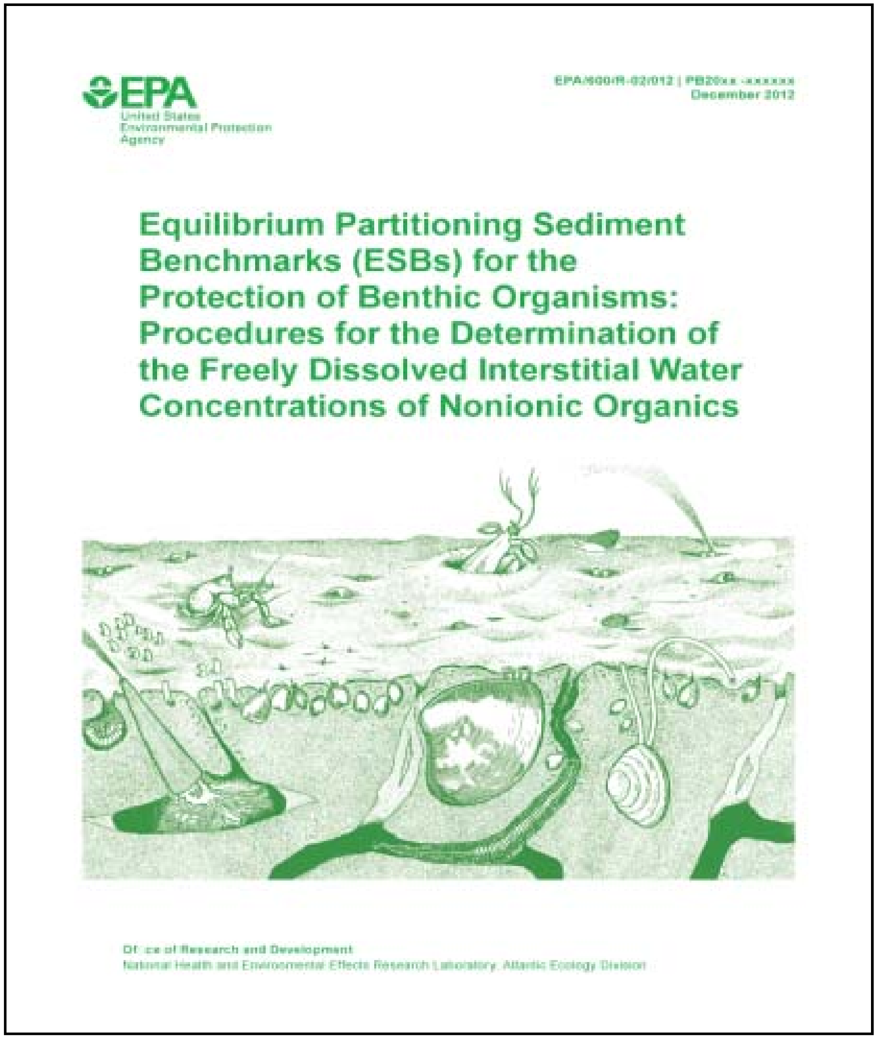
FREELY DISSOLVED CONCENTRATIONS: Critically important to describe pollutant exposure

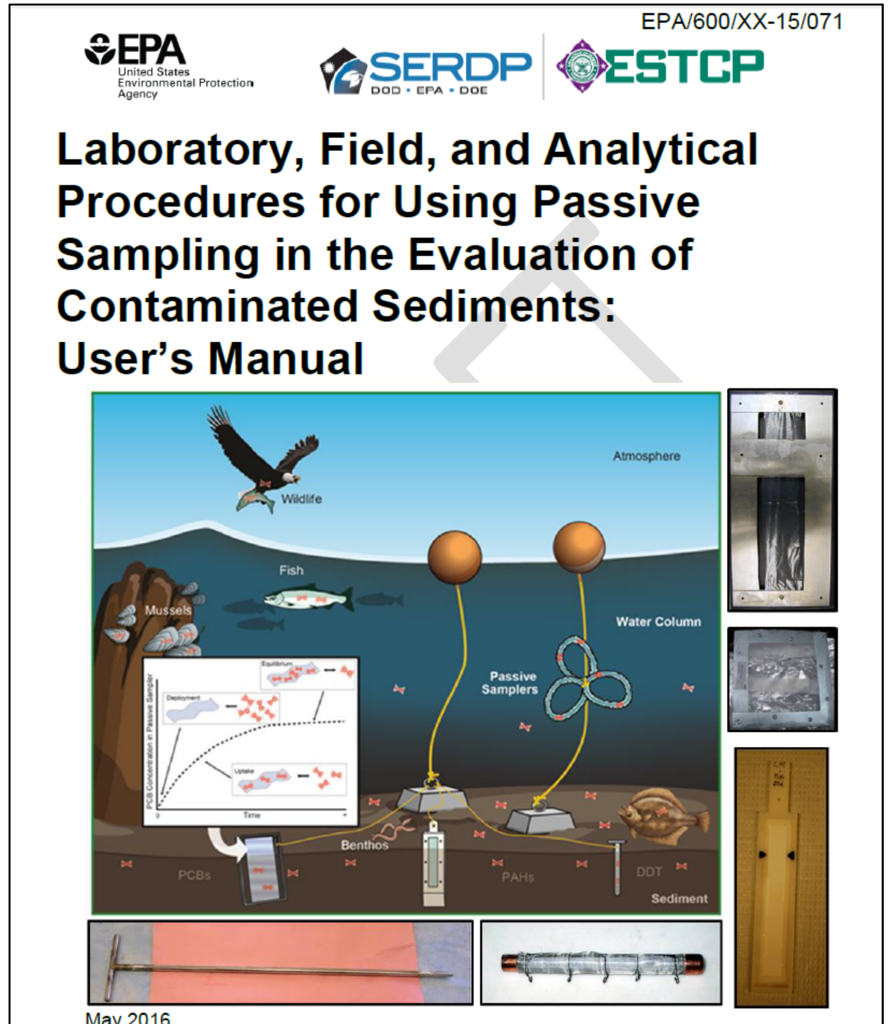


Exposure to sediment contaminants through:

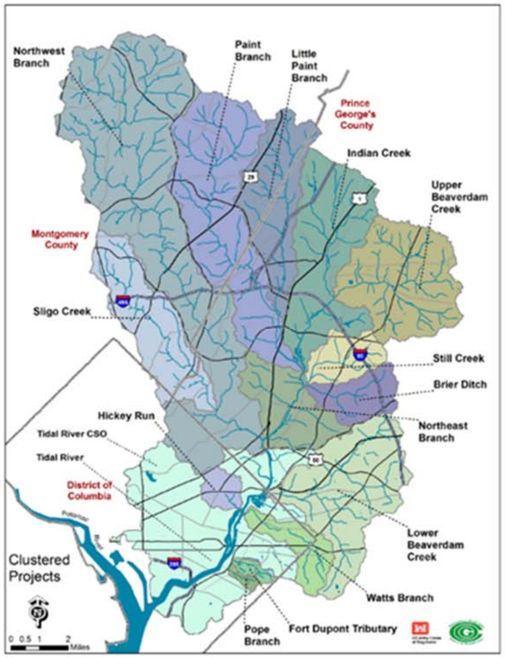
1) bioaccumulation in benthic organisms
2) flux into the water column, and uptake in the pelagic food web.
3) Water is the medium for major transport processes

USEPA GUIDANCES ON DISSOLVED CONCENTRATIONS

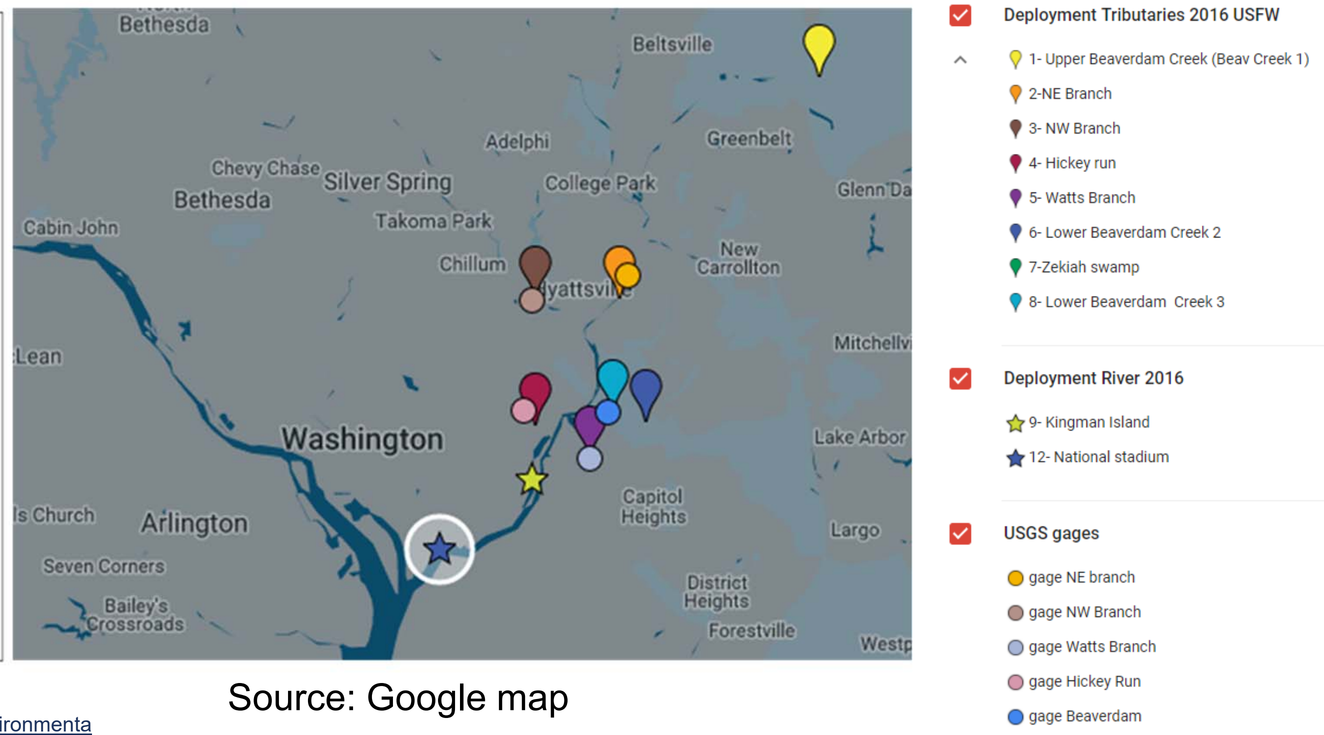




LOCAL CASE STUDY: ONGOING WORK AT ANACOSTIA RIVER AND TRIBUTARIES



Source: USACE
http://www.nab.usace.army.mil/portals/63/docs/Environmental/Anacostia/Anacostia2.pdf



Source: Google map

- o Ongoing Remedial Investigation of Anacostia River
- o Need quantitative understanding of ongoing inputs:
  - Tributaries
  - Flux from bed sediments
  - Air-water mass transfer
- o Measurement of freely dissolved concentration of pollutants to assess fluxes
- o Uptake in benthic organisms

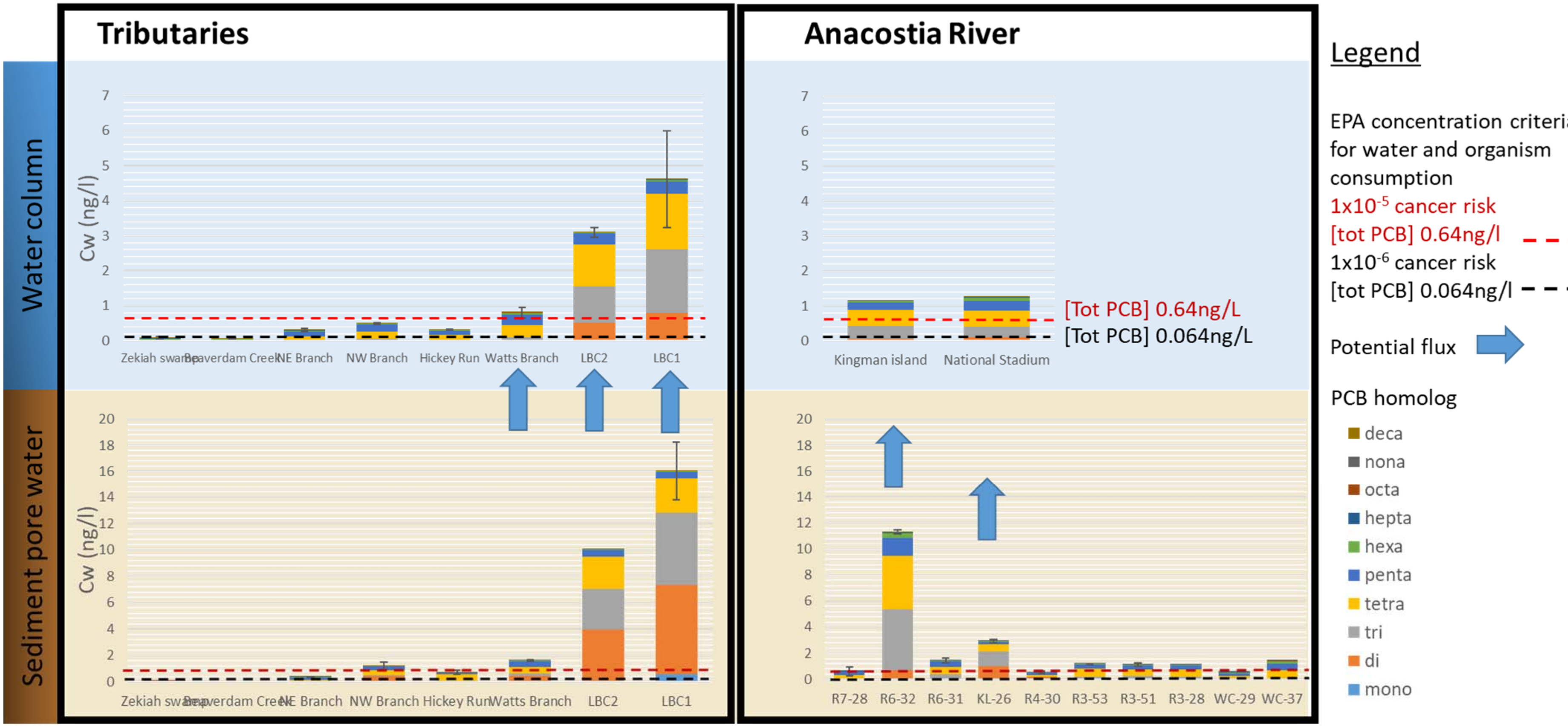
FIELD DEPLOYMENTS

Deployed in cinderblock for water column measurement

Passive samplers in frames for insertion in sediments

Air passive samplers

PRELIMINARY DATA: PCBS IN OVERLYING WATER AND PORE WATER

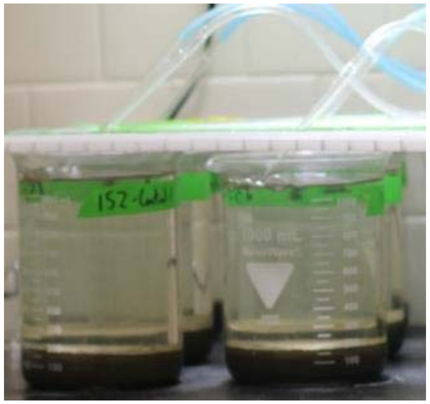


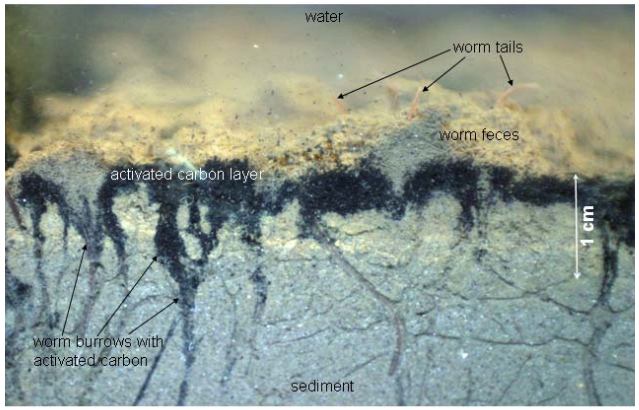
→ PCB levels <0.1ng/l at Upper Beaverdam and Zekiah swamp
→ Low PCB concentration at NE branch
→ Lower Beaverdam Creek (LBDC) sites show the highest levels of PCBs
→ Potential flux from the sediments into water at several locations

MANAGING EXPOSURE FROM HISTORIC DEPOSITS OF CONTAMINATED SEDIMENTS

- Contaminated sediment sites are large
- How do you clean up an ecologically sensitive site without destroying it?
- Current technologies are expensive and disruptive
- Need for innovative techniques that reduce risks

STRONG SORPTION REDUCES PCB UPTAKE IN WORMS






Environmental Science & Technology

FEATURE

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In-situ Sorbent Amendments: A New Direction in Contaminated Sediment Management†

Upal Ghosh*

University of Maryland Baltimore County, Baltimore, Maryland 21250, United States

Richard G. Luthy

Stanford University, Stanford, California, United States

Gerard Cornelissen

Norwegian Geotechnical Institute, Oslo, Norway, University of Life Sciences, Ås, Norway; Stockholm University, Stockholm, Sweden

David Werner

Newcastle University, Newcastle upon Tyne, United Kingdom

Charles A. Menzie

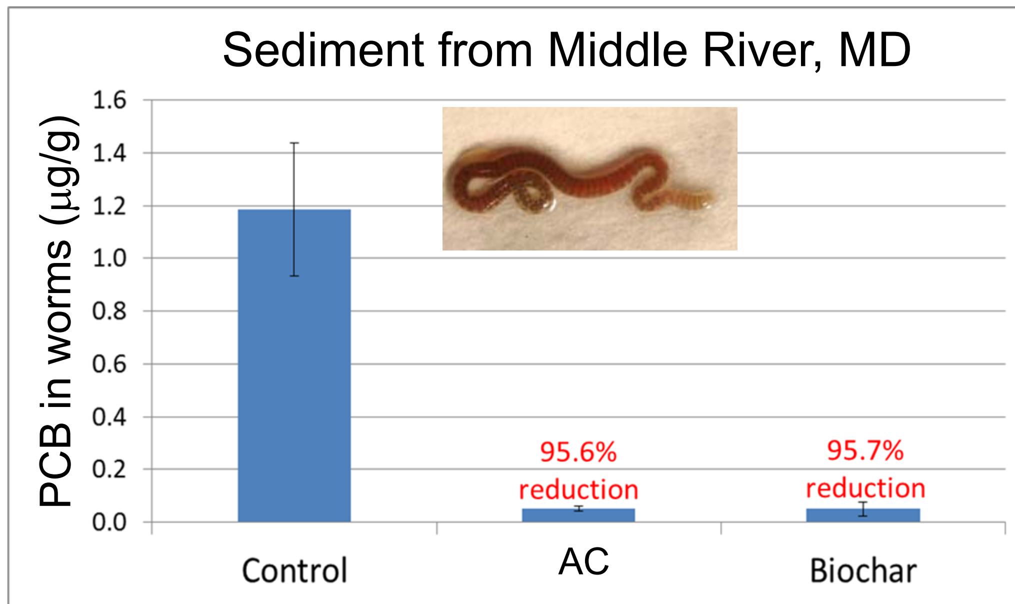
Exponent, Alexandria, Virginia, United States

Initial laboratory studies demonstrated reduction of PCB biouptake after AC or biochar amendment

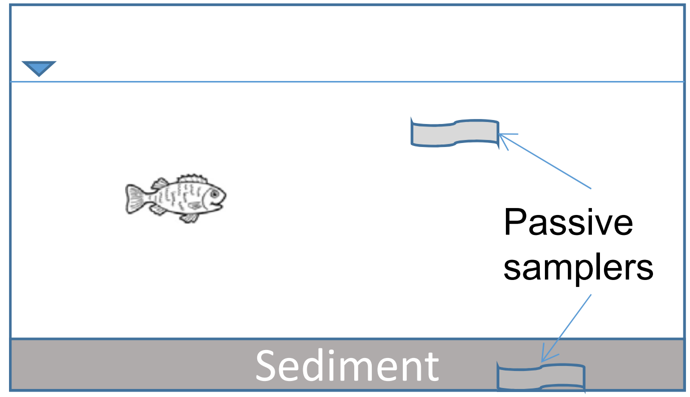
Surface application is worked into sediments through bioturbation

Led to several pilot-scale demonstrations

Zimmerman et al. ES&T 2003
Sun & Ghosh, ES&T 2007
Ghosh et al. ES&T 2011

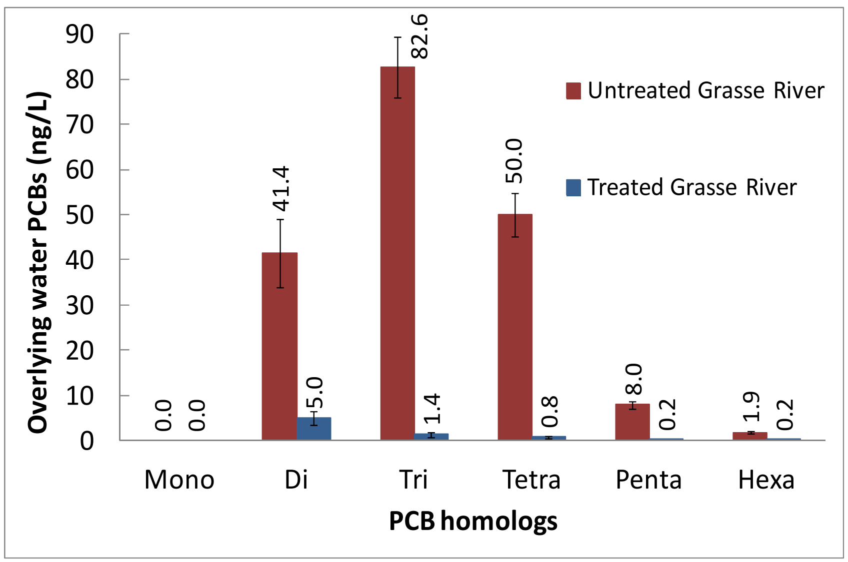


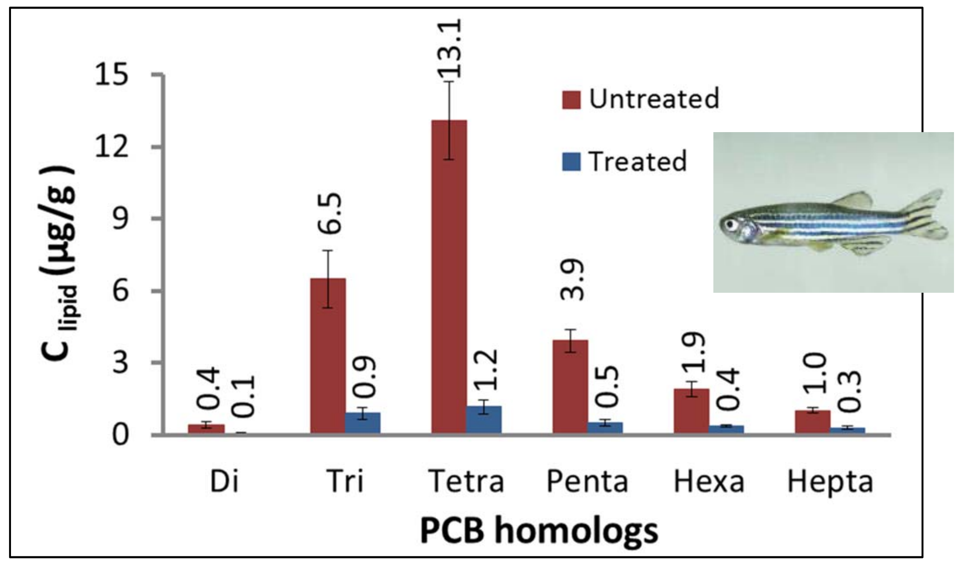
DO BENTHIC EXPOSURE REDUCTIONS TRANSLATE TO REDUCED PCBs IN FISH?



Components in each aquaria

NIH R01: 2011-15



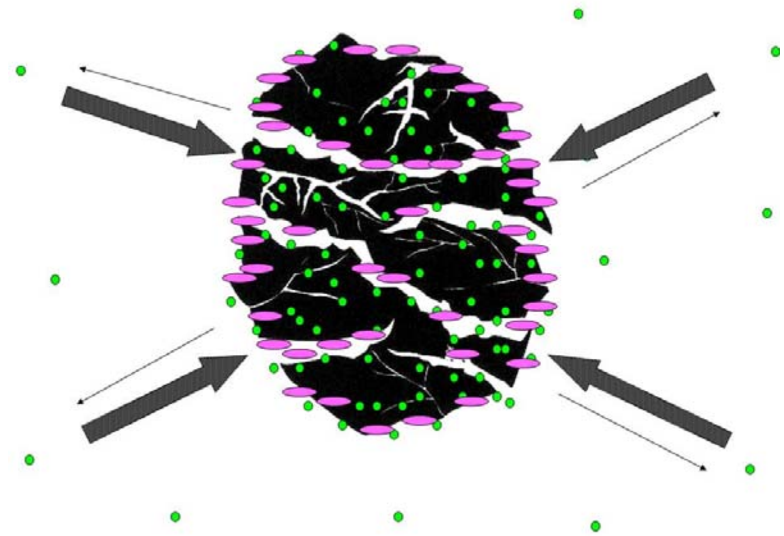


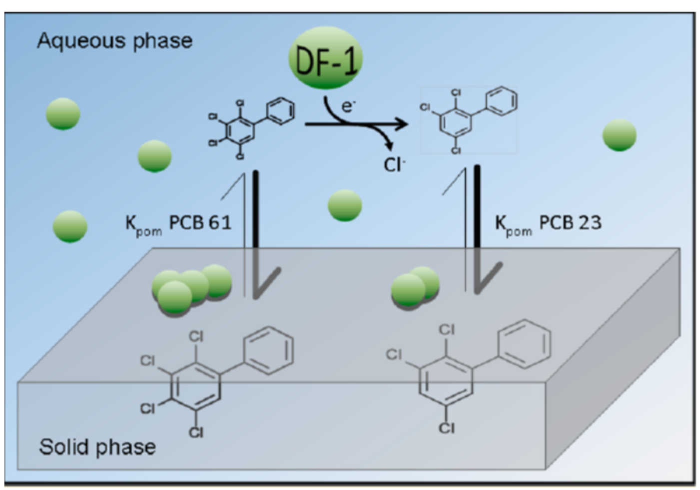
- PCBs in water reduced by **> 95%** upon amendment with AC.
- The AC amendment reduced the PCB uptake in fish by **87%**
- **Need solid mechanistic understanding of processes to scale up and translate to the field**

ACTIVATED CARBON AS SUBSTRATE FOR BIOAUGMENTATION
Collaboration with Dr. Kevin Sowers, UMBC-IMET

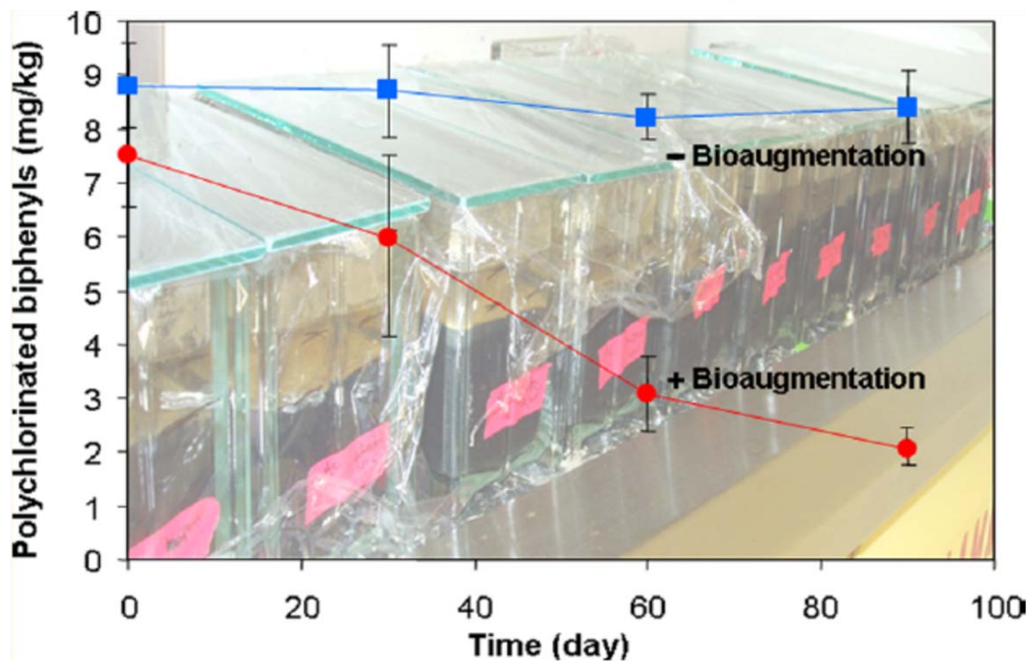
Role of AC in promoting activity

- AC appears to stimulate PCB dechlorination
- Mechanism not fully understood – ongoing research
- Concurrently sequesters PCBs from the aquatic food chain
- Focus of two ongoing SERDP and ESTCP funded projects



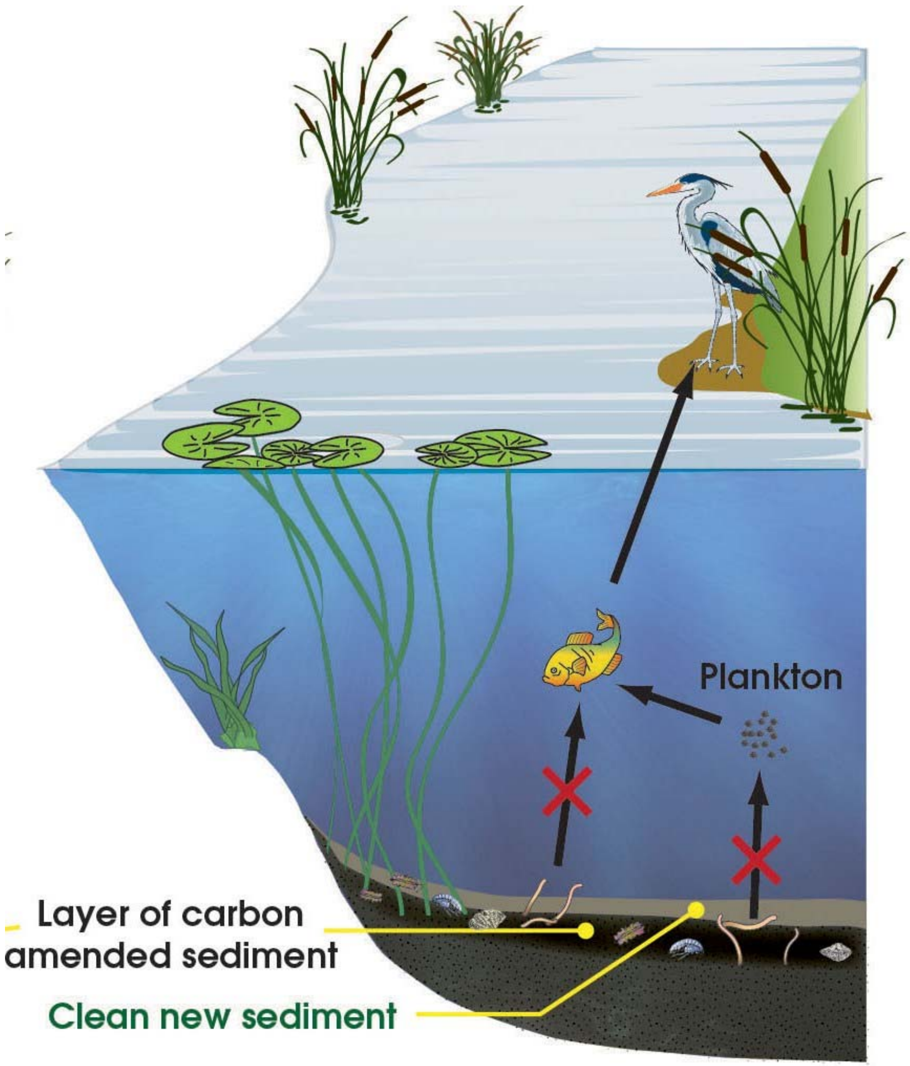


Lombard et al. ES&T 2014



Payne et al. Environ. Sci. Technol. 2013

CONCEPTUAL MODEL OF IN-SITU TREATMENT WITH AC

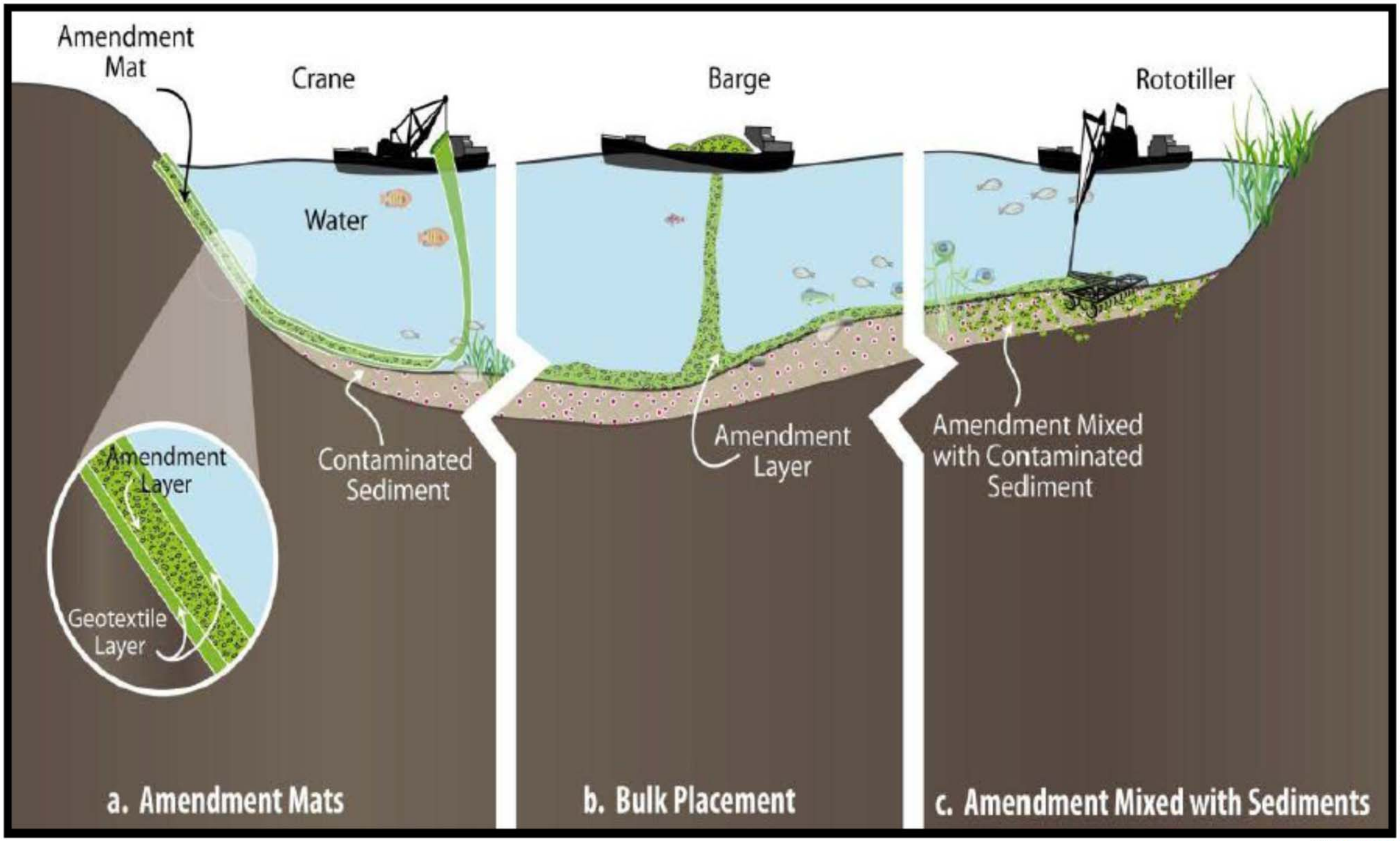


AC amended reduces exposure to food chain through:

1) Reduced bioaccumulation in benthic organisms
2) Reduced flux into water column and uptake in the pelagic food web.
3) In the long-term, the carbon amended layer is covered with clean sediment.
4) Each process needs to be described quantitatively for scale-up
5) How do we engineer to the field?

USE OF AMENDMENTS FOR IN-SITU REMEDIATION OF SUPERFUND SEDIMENT SITES

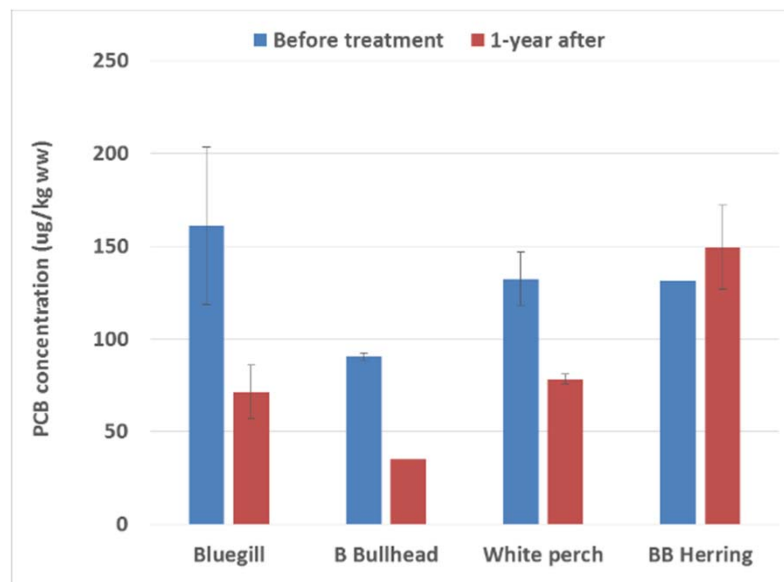
USEPA OSWER Directive 9200.2-128FS; April 2013



FULL-SCALE REMEDIATION OF A LAKE

- 5-acre lake
- Target dose of 3 – 5% met
- 1-year results already showing reductions in PCBs in resident fish

http://www.youtube.com/watch?v=l88oE6aTHK8&feature=youtu.be



LOCAL CASE STUDY OF IN-SITU REMEDIATION: MIDDLE RIVER, MD

- Creek and tidally influenced estuary
- Industrial and residential area
- Recreational use
    - Boating
    - Swimming
    - Fishing
- Creek discharging into the cove
- 8 to 10 feet water depth in the cove
- PCB contamination
    - <1 – 3600 mg/kg total PCBs
- *In Situ* treatment area PCB concentrations generally < 3 mg/kg
- Silty sand sediment
- Organic carbon ~ 1 – 5.5 %

TREATABILITY STUDY: MIDDLE RIVER, MD

- Phase 1 - Initial evaluation of amendments to reduce pore water PCBs and PAHs
  - Selection of two most effective amendments

- Phase 2 – Bioaccumulation study
  - Freshwater oligochaetes
  - Reduction in bioaccumulation with the selected amendments

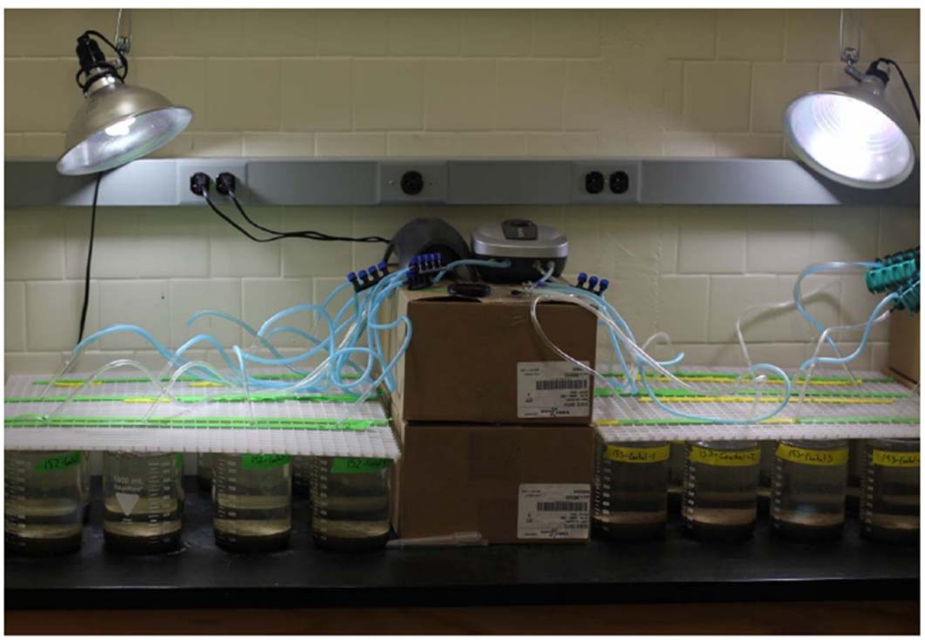
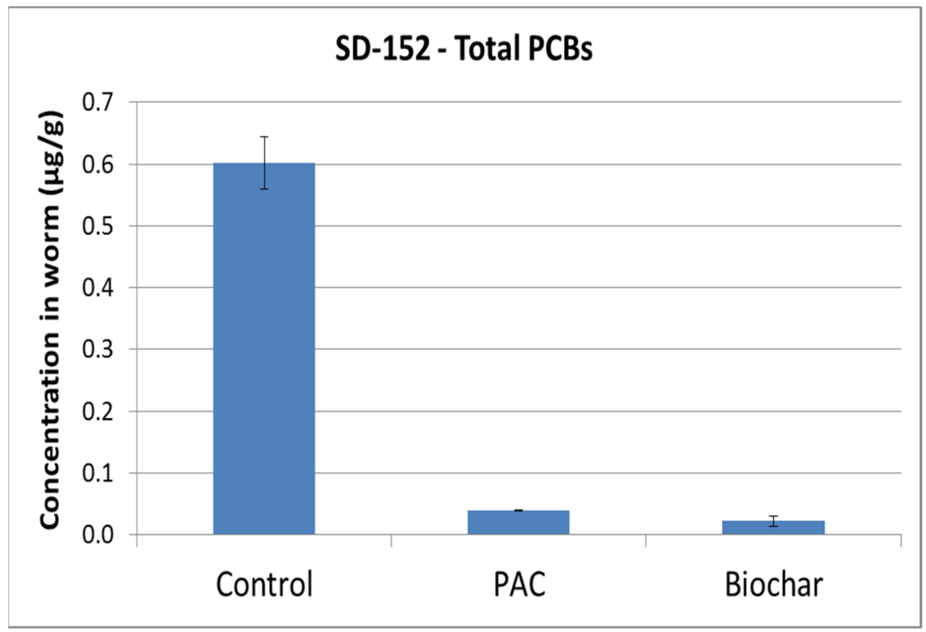
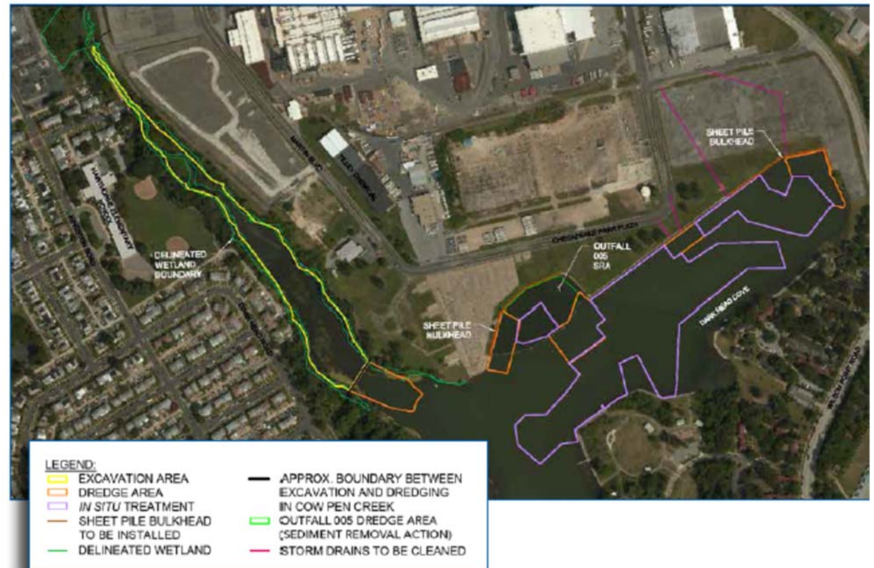


Figure 3. Laboratory bioaccumulation experiment using the freshwater oligochaete *L. variegatus*.



UPCOMING FULL-SCALE APPLICATION IN MIDDLE RIVER, MD

- Combination remedy of dredging and *in situ* treatment
- Completion of dredging followed by application of a residuals management layer
- Application of activated carbon for the *in situ* treatment
- Approximately 1/3 of the area of contaminated sediment will have dredging and 2/3 *in situ* treatment
- Long term monitoring includes sampling of the *in situ* treatment areas
- Work completed under a Risk-Based Removal Application Approval with the US EPA



Sediment Remediation Areas

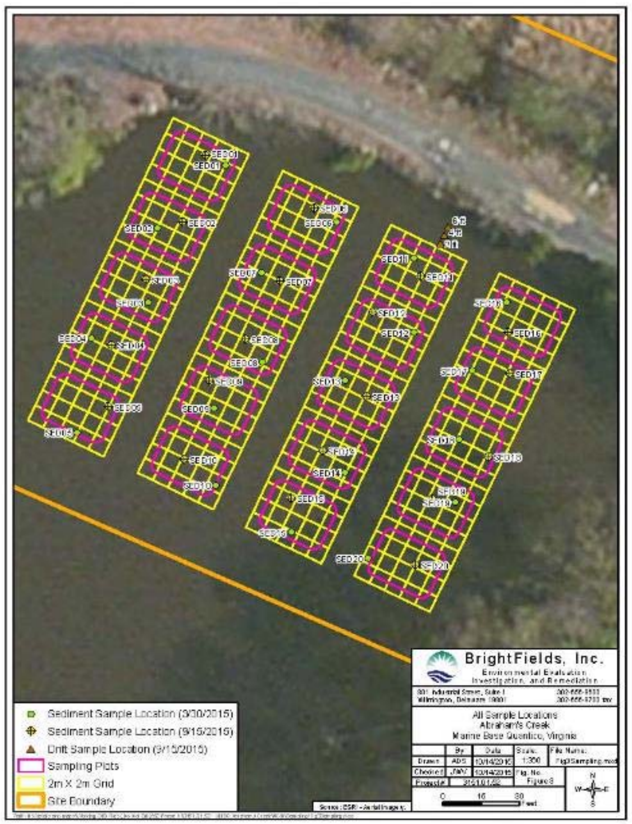
Middle River Complex and Martin State Airport Newsletter; March 2016

SEDIMENT PORE WATER SAMPLE COLLECTION – IN SITU

- Three replicates collected at each sampling site
- Deployment for 28 days
- Performance reference compounds added to the passive samplers prior to deployment
- Samples analyzed for PCB congeners

#	Average Porewater PCB (ng/L)	RSD
1	11.2	11 %
2	57.1	7 %
3	22.7	21 %
4	11.2	14 %

LOCAL CASE STUDY: PCB BIOREMEDIATION DEMONSTRATION AT ABHRAMS CREEK, MCB QUANTICO



DoD – ESTCP Project

- PCB impacted sediments in a 8 acre wetland
- Hybrid technology: Sequestration of PCBs on AC and microbial dechlorination
- 3000 kg bioamended SediMite deployed with air horn
- SediMite dose = 0.3g/10 g sediment
- Bioamendment dose = 10^6 cells/10 g sediment
- 50% reduction in PCBs levels in first year; no change in non-bioamended plots
- 76% reduction in porewater PCBs
- Cost of dredging and off-site disposal: $25M

IMET Institute of Marine and Environmental Technology

ACKNOWLEDGMENTS

- Funding support from NIEHS, SERDP/ESTCP, DOEE, MDE, DNREC, Dow,
- Graduate students and post docs at UMBC