Delaware River Basin Commission

Water Quality Management Programs

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OUTLINE

- Water Quality Standards
- Monitoring Programs
  - Special Protection Waters Monitoring Program
  - Boat Run Program
  - PCB TMDLs Monitoring Program
  - Special Monitoring Program
  - USGS Gages supported by DRBC


Photo: David B. Soete

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Water Quality Standards

What does the Compact cover?

- Article 4 – Water Supply
- Article 5 – Pollution Control
- Article 6 – Flood Protection
- Article 7 – Watershed Management
- Article 8 – Recreation
- Article 9 – Hydroelectric Power
- Article 10 – Regulation of Withdrawals & Diversions
- Article 11 – Intergovernmental Relations
- Article 12 – Capital Financing

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Water Quality Standards

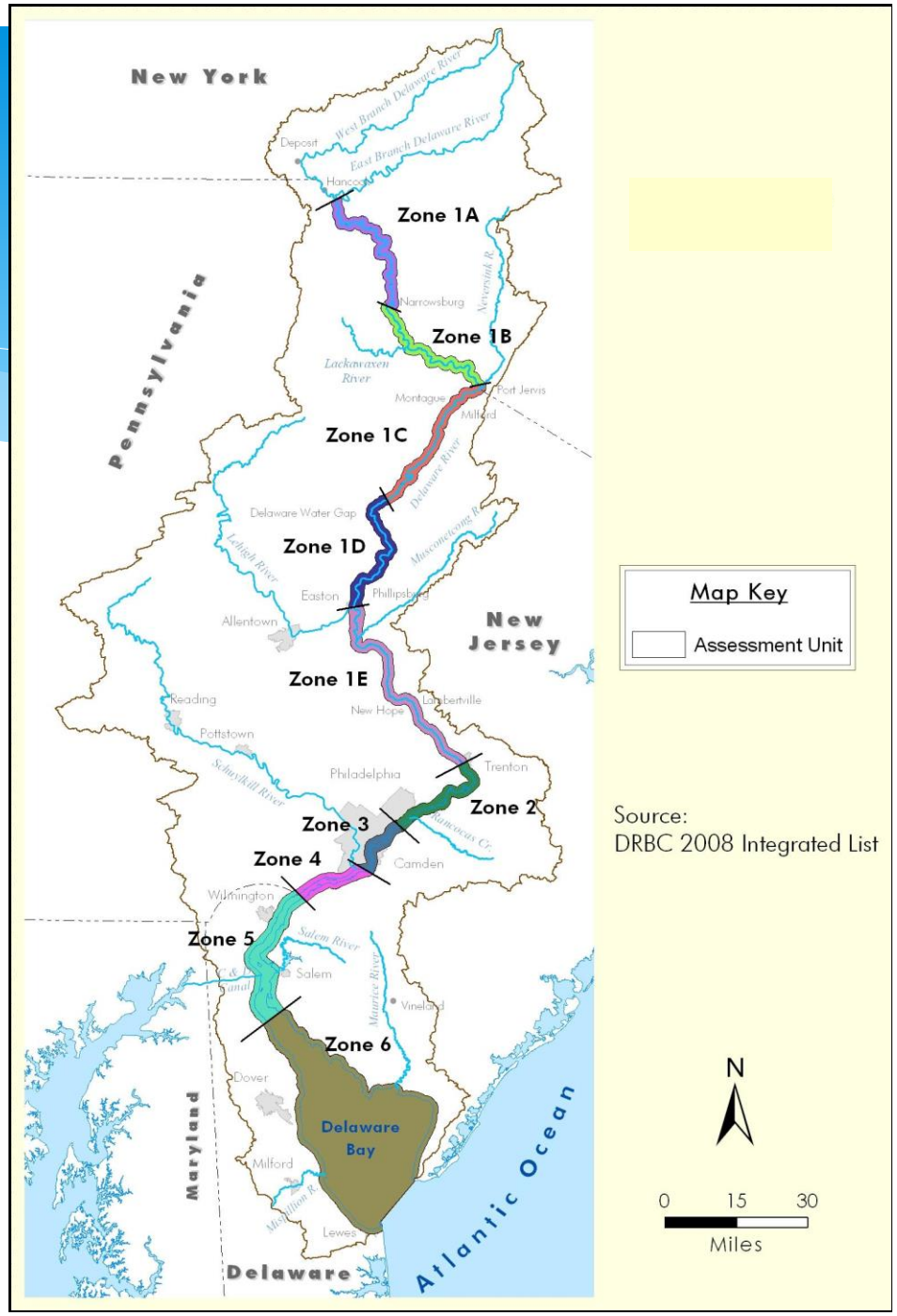
- **Designated Uses**: e.g., water supply, protection and propagation of aquatic life, recreation in and on the water.

- **Criteria**: numeric and/or narrative parameters to protect the designated uses.

- **Antidegradation Policy And Procedures**: to maintain and protect existing water quality.

DRBC's Water Quality Standards

- From 1962, Commission adopted Water Quality Regulations pursuant to Article 5 of the Compact;
- To protect aquatic life and human health for both carcinogenic and non-carcinogenic effects.
- Updated and revised periodically to the present;
- Includes standards for mainstem Water Quality Management Zones, interstate tributaries, and some basin wide standards.



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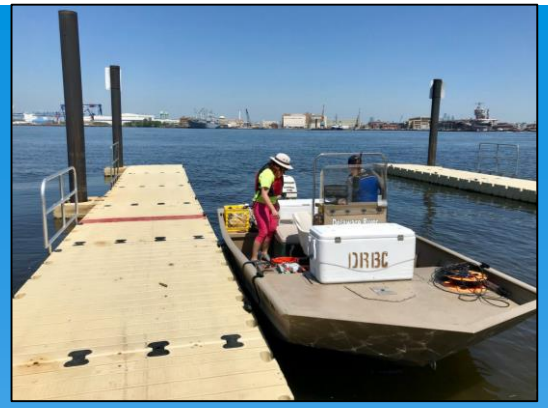

Monitoring Program

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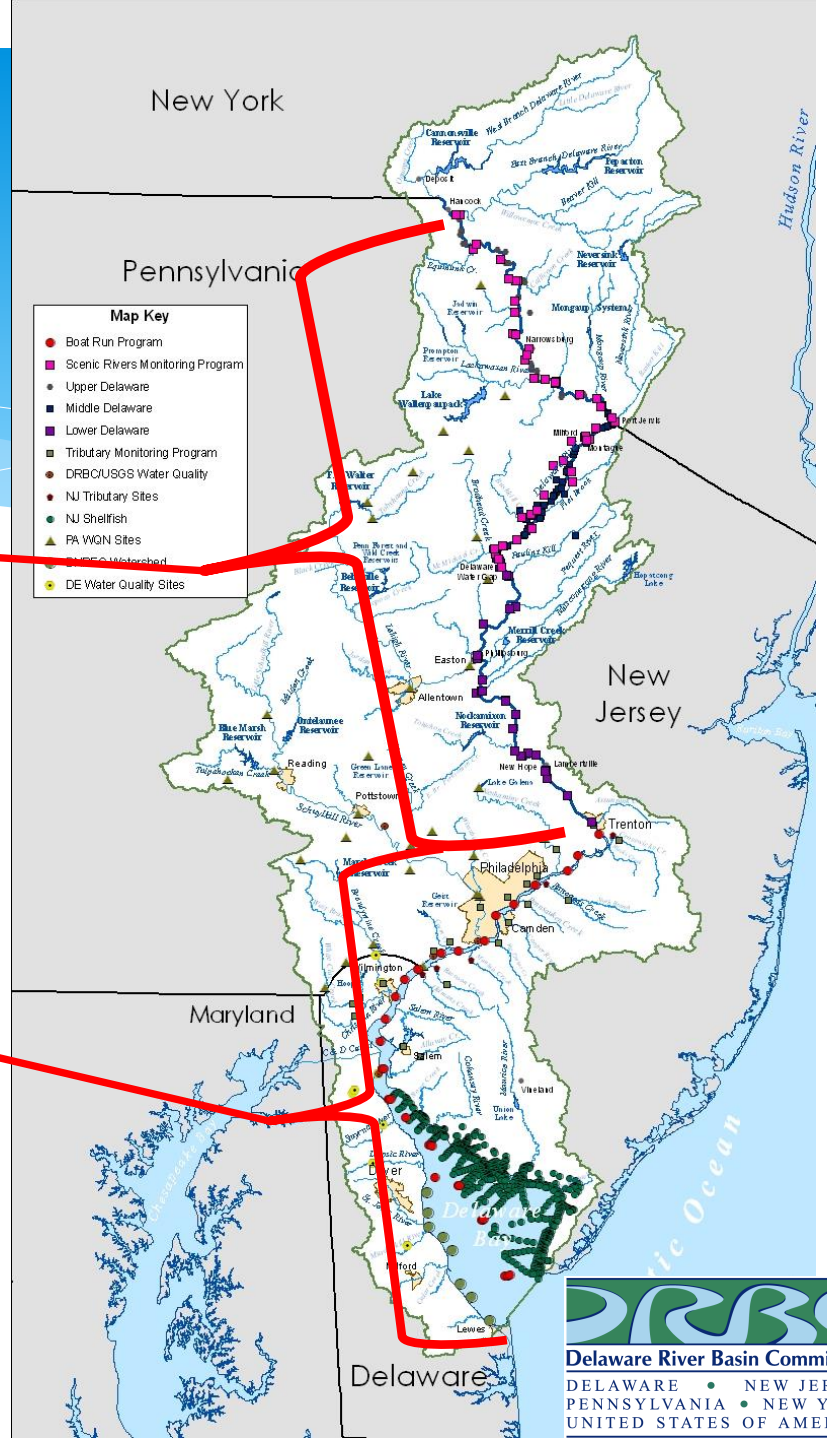
Why do we monitor?

- To assess compliance with DRBC surface Water Quality Standards (Integrated Assessment)
- To define Existing Water Quality (EWQ) at boundary and interstate control points under the Commission's Special Protection Waters (SPW) Regulations;
- To support model development; Model is used as a tool to determine
  - the total allowable loadings and to allocate allowable loadings to each source while maintaining water quality criteria [Total Maximum Daily Loads (TMDLs)]
  - No Measurable Change Evaluations
- To track the progress of WQ management programs (TMDLs, SPW)
- To track the salt front for reservoir operations;
- To identify new and emerging threats to water quality.

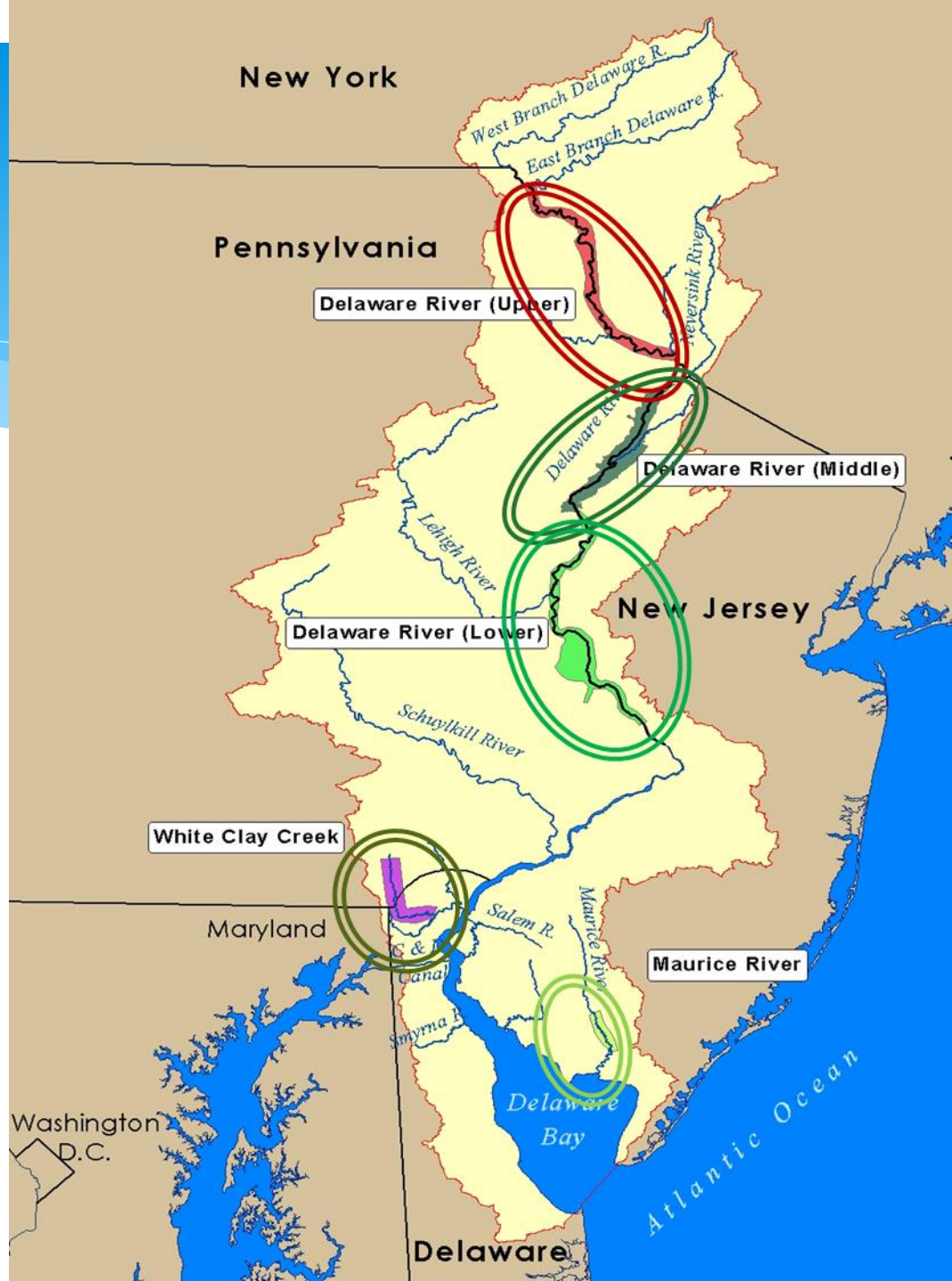
DRBC Monitoring Programs

1. Special Protection Waters Monitoring Program
   - Upper and Middle Delaware Scenic Rivers Monitoring Program
   - Lower Delaware SPW Monitoring
2. Boat Run Program
3. PCB TMDLs Monitoring Program
4. Special Monitoring Program
5. USGS Gages supported by DRBC



Special Protection Waters (SPW)

- Exceptional water quality
- High ecological diversity
- ~75% of the non-tidal river is part of the National Wild and Scenic Rivers System
- Upper and Middle non-tidal Delaware River designated SPW in 1992 (point discharges)
- Non-point source requirements adopted in 1994
- Lower Delaware permanently designated July 2008



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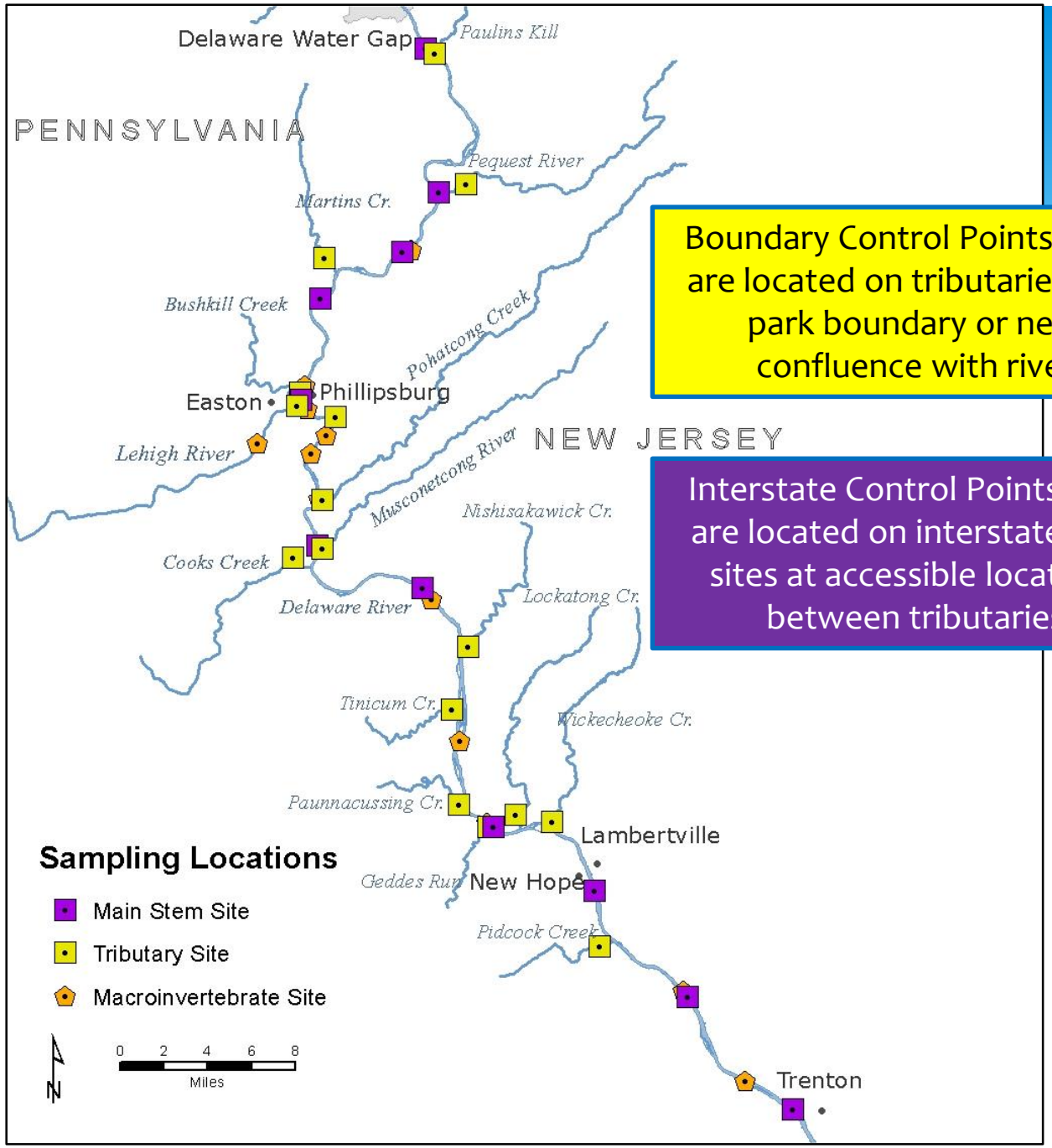
Lower Delaware (LDEL) Sites



Boundary Control Points (BCP) are located on tributaries near park boundary or near confluence with river

Interstate Control Points (ICP) are located on interstate river sites at accessible locations between tributaries

Designated as Significant Resource Waters in 2008

EWQ established for BCPs and ICPs based on data 2000-2004 (n=40-50)

Assessment 1: 2009-2011 (n=15-30)

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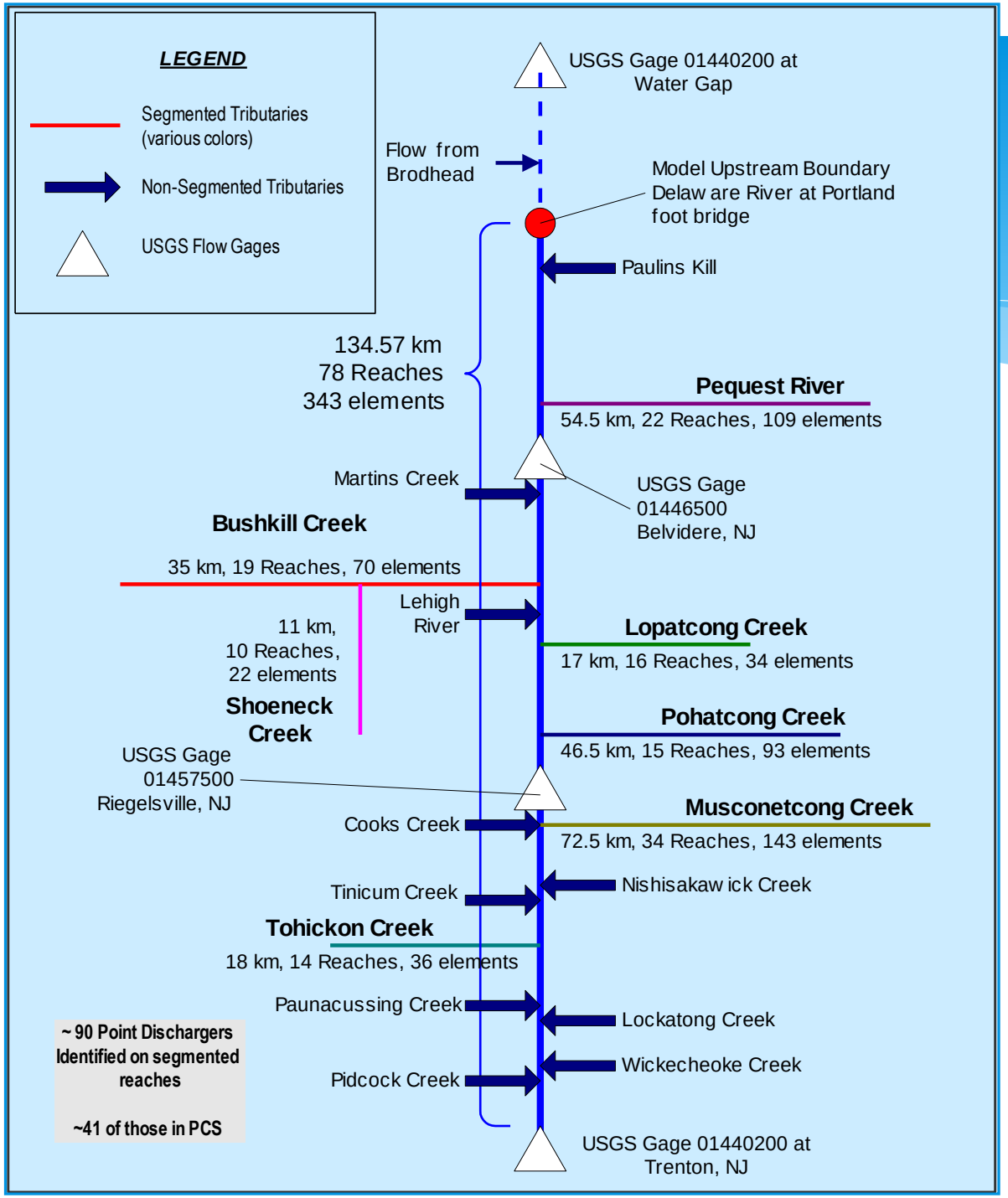
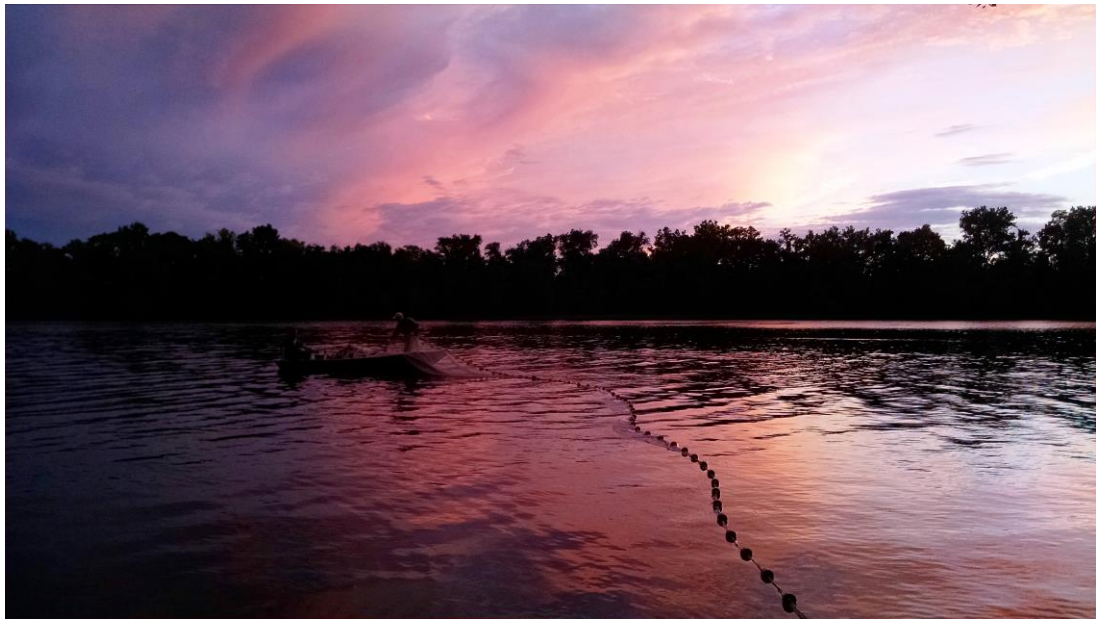
Schematic Diagram for the Lower Delaware River Model





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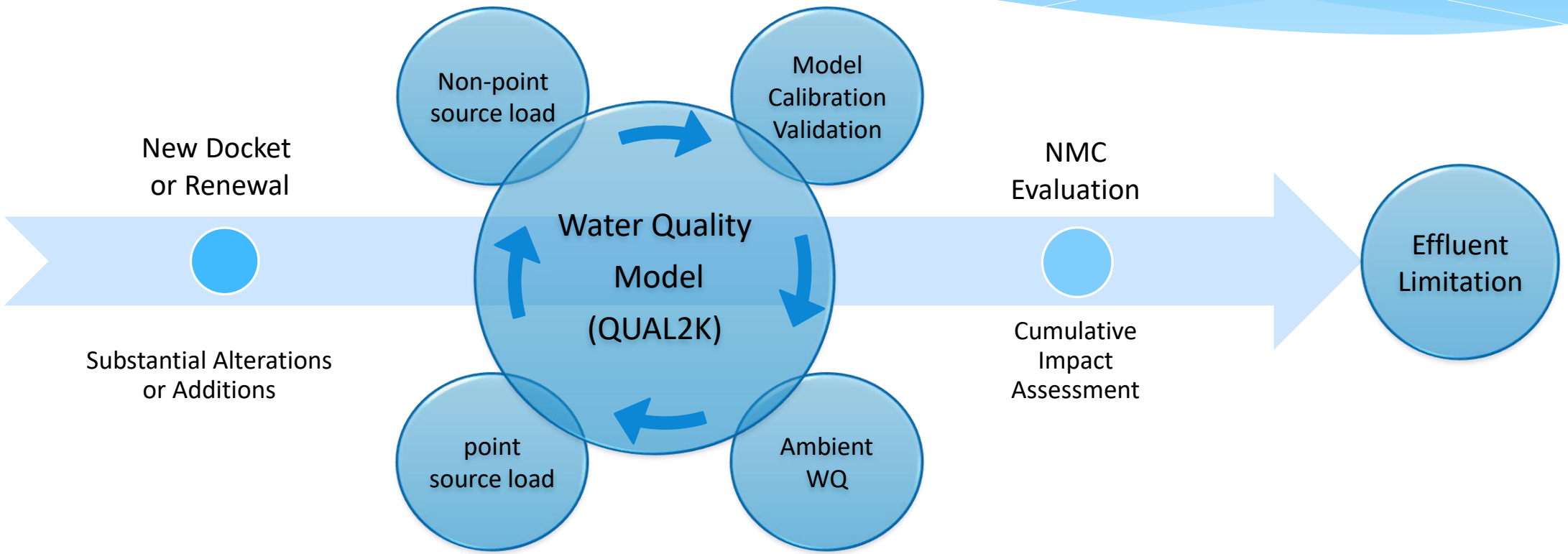
No Measurable Change Evaluation

for Docket holders



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Summary Matrix of Measurable Changes: LDEL 440 Within-Site Comparisons at a Glance

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Summary Matrix of Water Quality Changes at Lower Delaware Control Points: 2000-2004 Baseline vs. 2009-2011 Assessment Round 1

Site Color Key: Dark Blue = Interstate Control Point (ICP); Dark Red = Pennsylvania Tributary Boundary Control Point (BCP); Dark Green = New Jersey Tributary Boundary Control Point (BCP)

	Parameter / Site--->	Del. River at Trenton	Del. River at Washngtn Crossing	Pidcock Creek, PA	Delaware River at Lambrtvlle	Wicke-cheoke Creek, NJ	Lockatong Creek, NJ	Delaware River at Bulls Island	Pauna-cussing Creek, PA	Tohickon Creek, PA	Tinicum Creek, PA	Nishi-sakawick Creek, NJ	Del. River at Milford	Cooks Creek, PA	Musco-netcong River, NJ	Del. River at Rieglsvll	Pohat-cong Creek, NJ	Lehigh River, PA	Del. River at Easton	Bushkill Creek, PA	Martins Creek, PA	Pequest River, NJ	Del. River at Belvidere	Paulins Kill River, NJ	Del. River at Portland
	Site Number--->	1343 ICP	1418 ICP	1463 BCP	1487 ICP	1525 BCP	1540 BCP	1554 ICP	1556 BCP	1570 BCP	1616 BCP	1641 BCP	1677 ICP	1737 BCP	1746 BCP	1748 ICP	1774 BCP	1837 BCP	1838 ICP	1841 BCP	1907 BCP	1978 BCP	1978 ICP	2070 BCP	2074 ICP
Field	Dissolved Oxygen (DO) mg/l											~													
	Dissolved Oxygen Saturation %																								
	pH, units																								
	Water Temperature, degrees C																								
Nutrients	Ammonia Nitrogen as N, Total mg/l																								
	Nitrate + Nitrite as N, Total mg/l																**								
	Nitrogen as N, Total (TN) mg/l																**								
	Nitrogen, Kjeldahl, Total (TKN) mg/l																								
	Orthophosphate as P, Total mg/l																								
	Phosphorus as P, Total (TP) mg/l																								
Bacteria	Enterococcus colonies/100 ml	~			~																				
	Escherichia coli colonies/100 ml	**	**	**	**	**	**			**	**	**													
	Fecal coliform colonies/100 ml																								
Conventionals	Alkalinity as CaCO3, Total mg/l																								
	Hardness as CaCO3, Total mg/l											~													
	Chloride, Total mg/l			**		**	**	**	**	**		**	**	**	**	**	**	**	~	**	**	**	**		**
	Specific Conductance µmho/cm			**		**	**	~	**	**	**	**	**	**	**	~	**	**	~	~	~	**	~		
	Total Dissolved Solids (TDS) mg/l																								
	Total Suspended Solids (TSS) mg/l																								
	Turbidity NTU																								

KEY: (blank) = No indication of measurable change to EWQ; ** = Indication of measurable water quality change toward more degraded status; ~ = Weak indication of measurable water quality change toward more degraded status

Mostly Good News:
88% of water quality tests showed no degradation

Boat Run Monitoring Program

Where:

- Delaware Estuary (mainstem);

Parameter Groups:

- Nutrients, DO and other conventionals, solids, VOCs, bacteria, heavy metals and chlorophyll a

How Often:

- 22 sites, 8 times per year, ongoing

Purpose:

- Integrated Assessment
- Special studies for toxics, ambient toxicity, emerging contaminants

Shinyapps

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PCB Monitoring Program

Where:

- ❑ Tidal and non-tidal Delaware River (mainstem)
- ❑ Water, sediment, fish and air

Parameter Groups:

- ❑ PCBs for all 209 congeners
- ❑ Dioxin Furans, OC pesticides

How Often:

- ❑ Every 3~5 years, ongoing

Purpose:

- ❑ Integrated Assessment
- ❑ Special studies for tracking PCB TMDLs
- ❑ Supporting states fish consumption advisories

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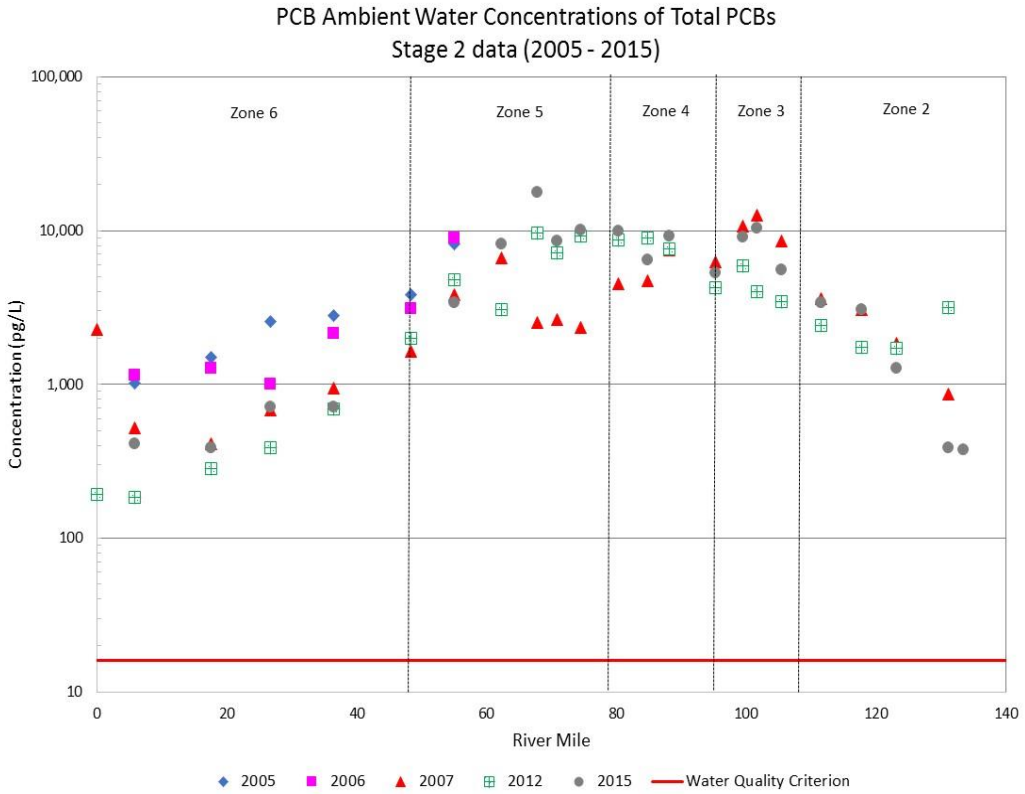
Why PCB TMDLs needed for the Delaware Estuary?

- Production of PCBs banned in 1970s but
  - Active sources – aging transformers, electrical equipment, hydraulic equipment, paint, caulk
  - Inadvertent production of PCBs
- Fish consumption advisories for the entire Estuary and Bay issued by all three states.
- Listed as "impaired" by all three states in 1990s.
- PCB levels in ambient water are 100s to 1000s times greater than the WQ criterion.



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Use of Monitoring Data in the Delaware Estuary

1) Fish Tissue
2) Ambient Water
3) Sediment
4) Atmosphere
5) Point Sources

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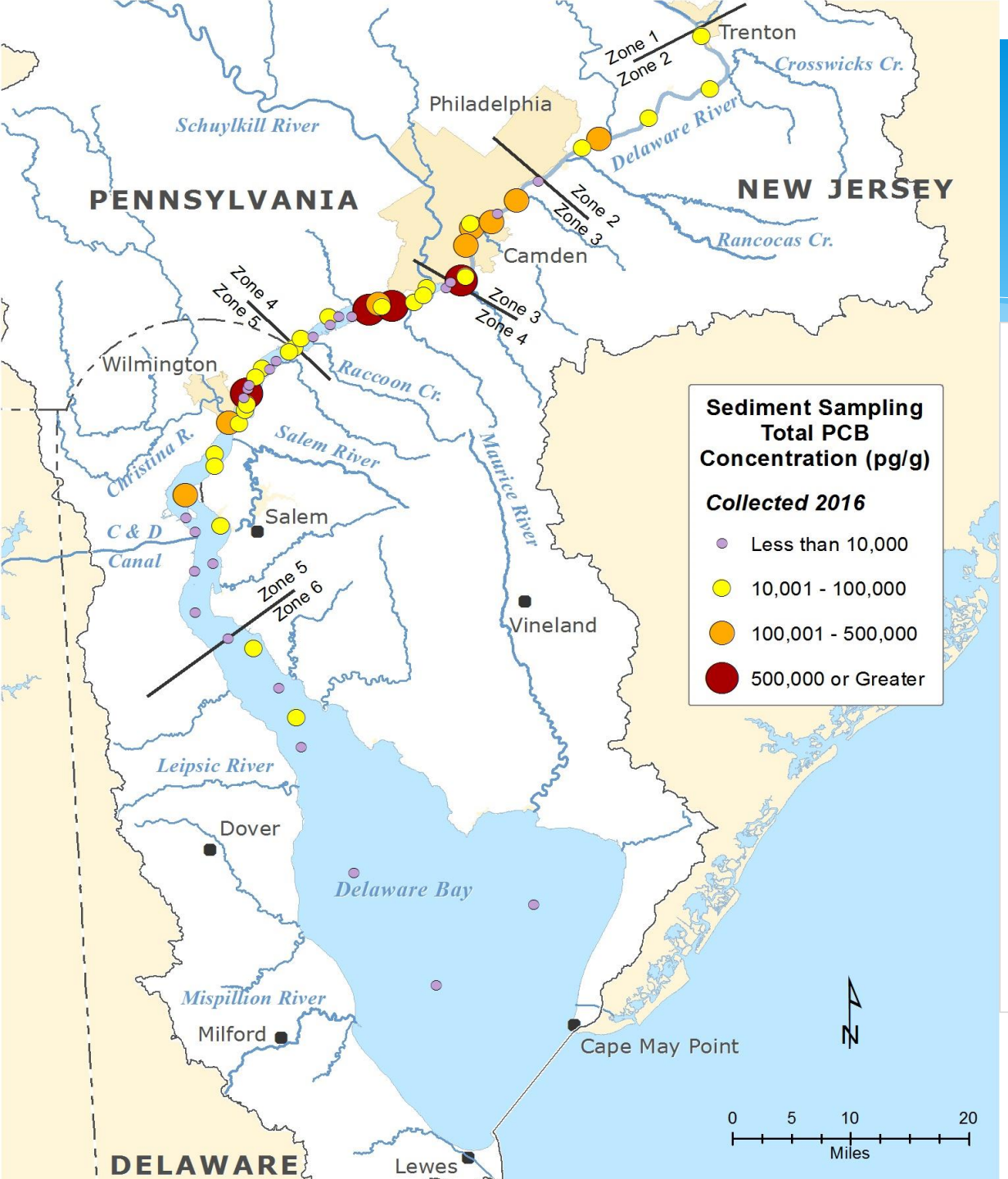
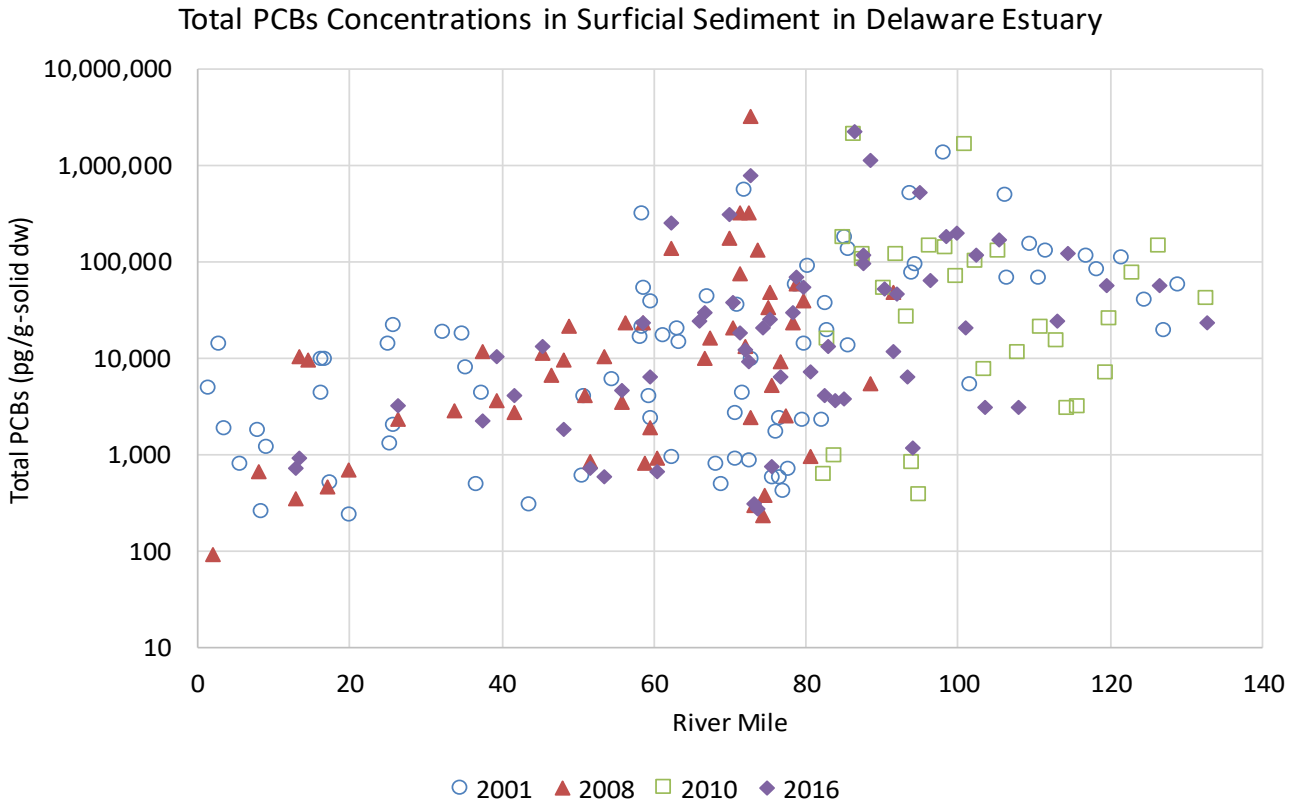
Sediment Surveys 2000 and 2016





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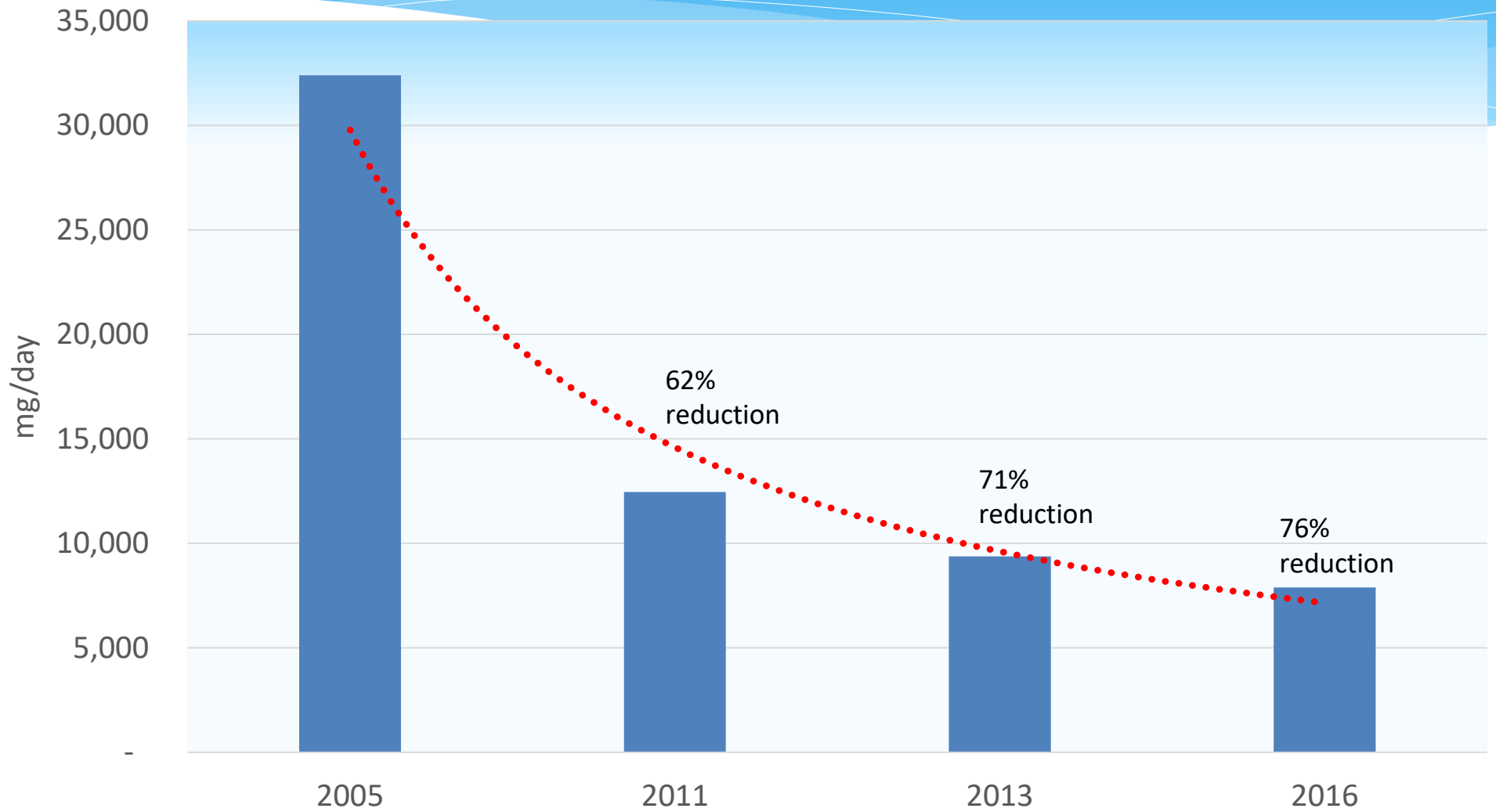
PCB Loadings Top Ten Point Source Dischargers (mg/day)



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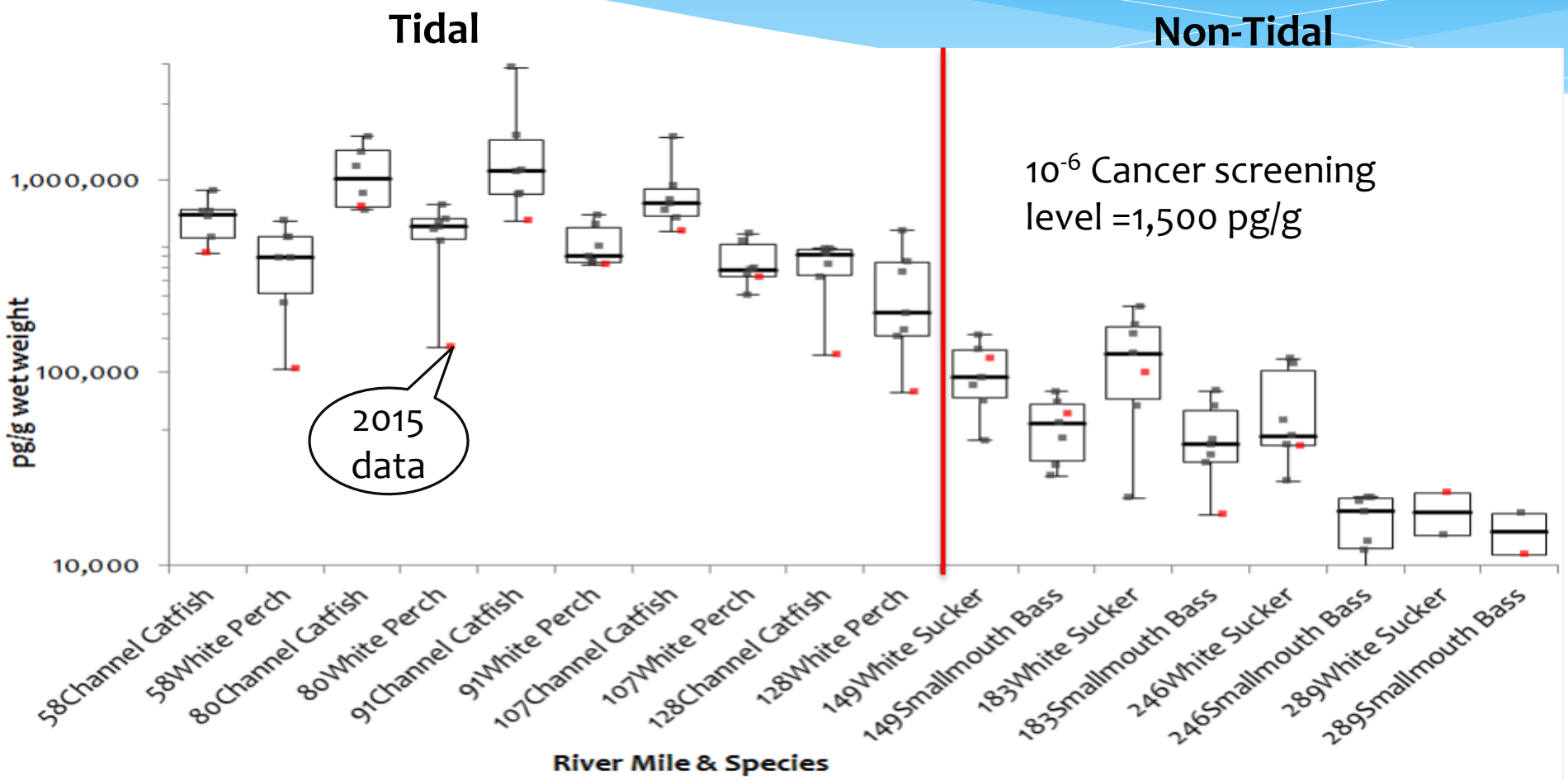
tPCB Concentrations 2004-2015



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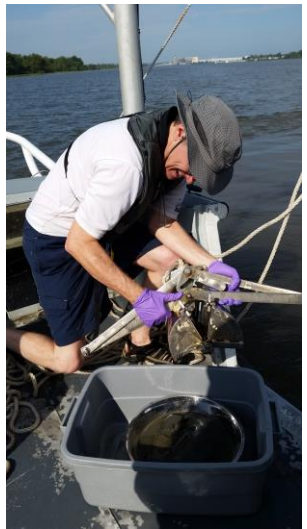
Summary

- PCB loadings into the Delaware River Estuary have been identified and reduced since the Stage 1 PCB TMDLs
- Lesser levels of fish consumption advisories
- Still, long ways to go.



Special Monitoring Program

Where:

- ❑ Tidal and non-tidal Delaware River (mainstem)

Parameter Groups:

- ❑ Aquatic life designated use (eutrophication model)
- ❑ Ambient toxicity
- ❑ Emerging contaminants (PFAS)
- ❑ Bio-monitoring

How Often:

- ❑ Infrequent, ongoing

Purpose:

- ❑ Integrated Assessment
- ❑ Special studies for toxics, ambient toxicity, emerging contaminants

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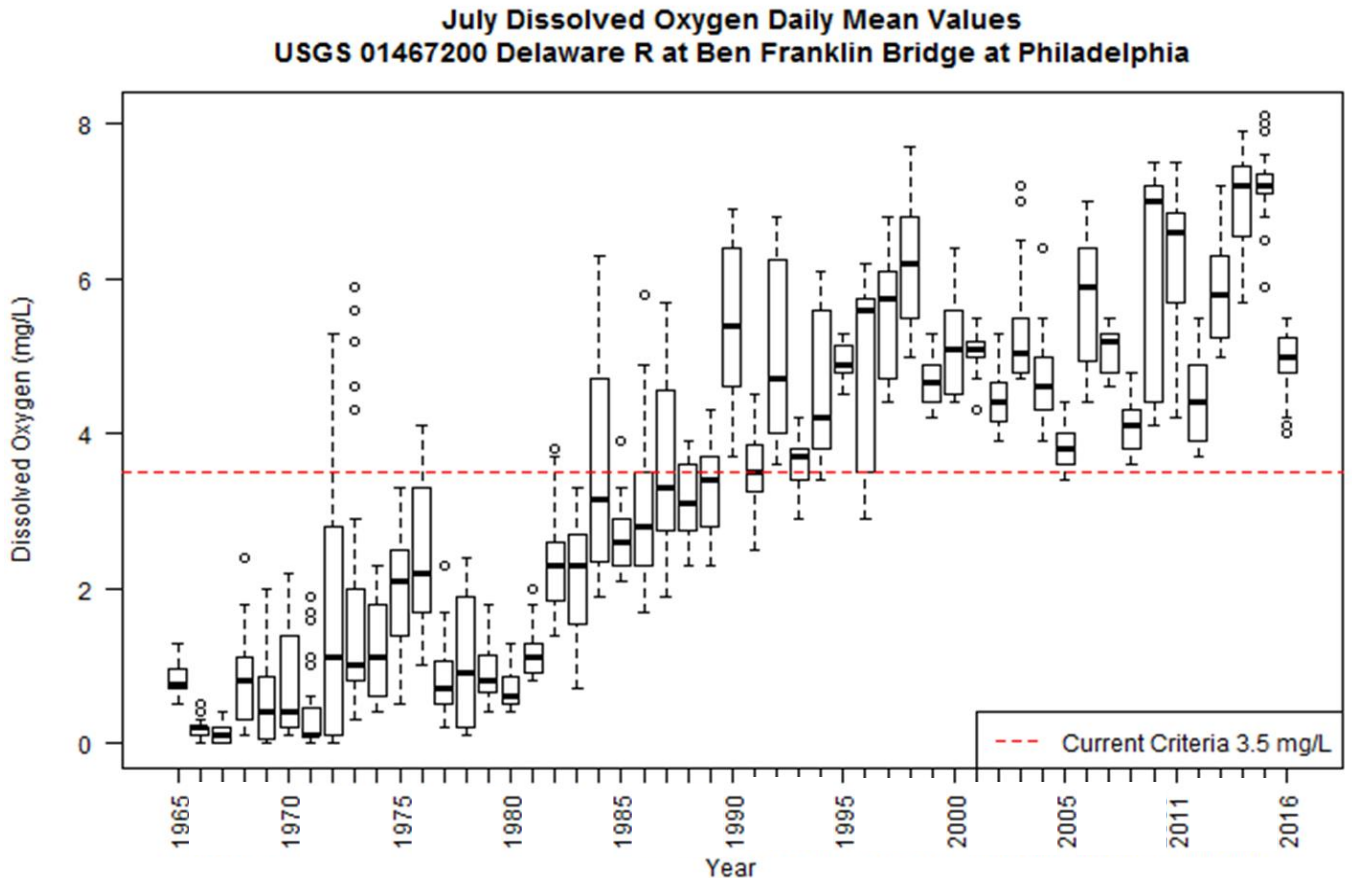
What's Next?



Daily Mean Dissolved Oxygen in July

USGS 01467200 Delaware R. at Ben Franklin Bridge at Philadelphia

What should be the next generation dissolved oxygen water quality criteria for the urban portions of the Delaware River Estuary to properly protect aquatic life use?

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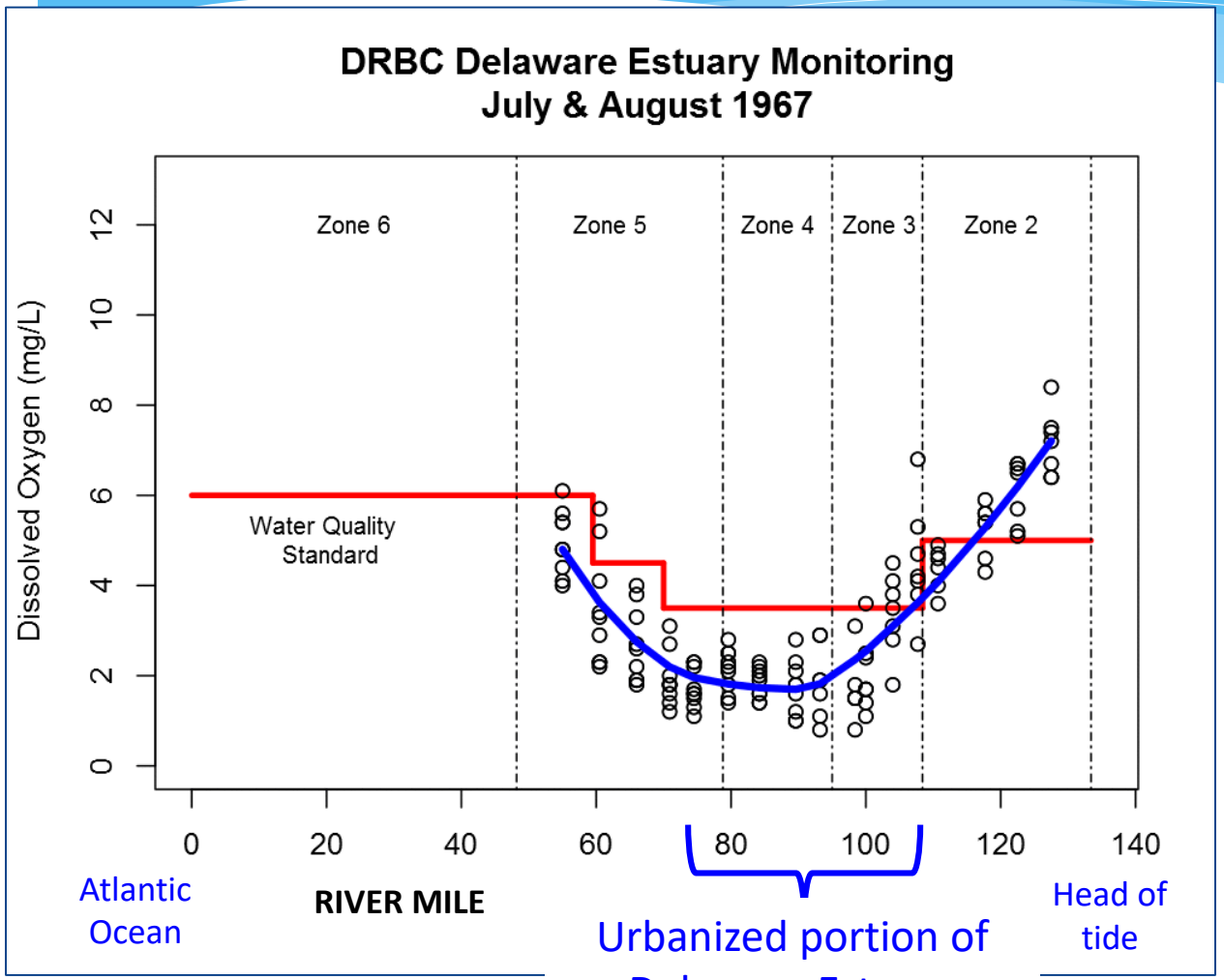
Dissolved Oxygen



- DRBC issued CBOD wasteload allocations (WLAs) for Zones 2 – 5 in 1968
- Implementation of CBOD WLAs
  - Via DRBC's dockets (equivalent to NPDES permit)
  - Over 70 point source dischargers get CBOD effluent load limits
  - Minimum required CBOD percent reduction
  - Secondary treatment added at wastewater treatment plants 70's & 80's – funding CWA
- By 2000's D.O criteria is nearly always met

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Monitoring in Support of Eutrophication Model Development

Delaware at Trenton & Schuylkill at Philadelphia

* Twice per month

Tributary Monitoring

* 25 tributaries
* Once per month

Point Discharge Monitoring

* Res. for minutes, Sept. 2017
* Tier 1 (12 facilities) weekly
* Tier 2 (19 facilities) monthly

Primary Productivity in Upper Estuary

* 2 sampling events in 2018 (completed)
* 2 anticipated for 2019

Light Extinction Studies

* 3 events in 2018 (60 each) & 3 in 2019
* TSS, chl-a, turbidity, CDOM, secchi depth

Phytoplankton ID and enumeration

* Anticipated 2019

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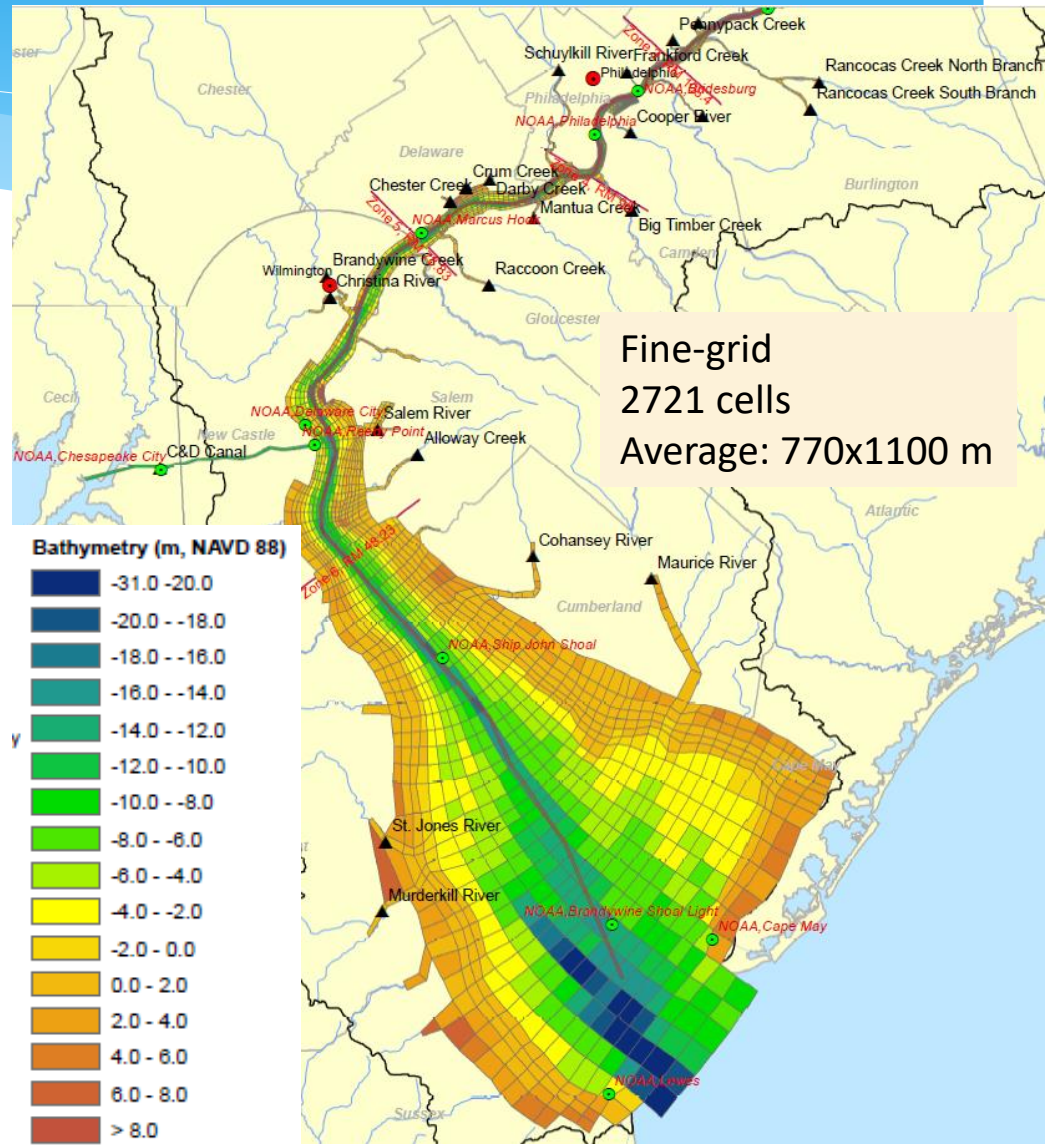
Next Steps: Linked EFDC – WASP8 Model

- Refine grid resolution
  - Better delineation of navigation channel
  - 8~10 vertical layers
  - Increase computational time step ~20 seconds
- Implementation of GVC hybrid grid
- Link 3-D fine grid EFDC and WASP8
- Initiate model calibration using 2017 – 2018 data sets



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Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Toxicity

EPA HA PFOS & PFOA 70 ng/L, NJDEP MCL PFNA 13 ng/L

* Scientific understanding is evolving

Human Health Effects

* Detected in blood serum (bind to protein)
* Association with liver damage, increased cholesterol, thyroid disease, decreased response to vaccines, asthma, decreased fertility and birth weight, pregnancy–induced hypertension/pre-eclampsia

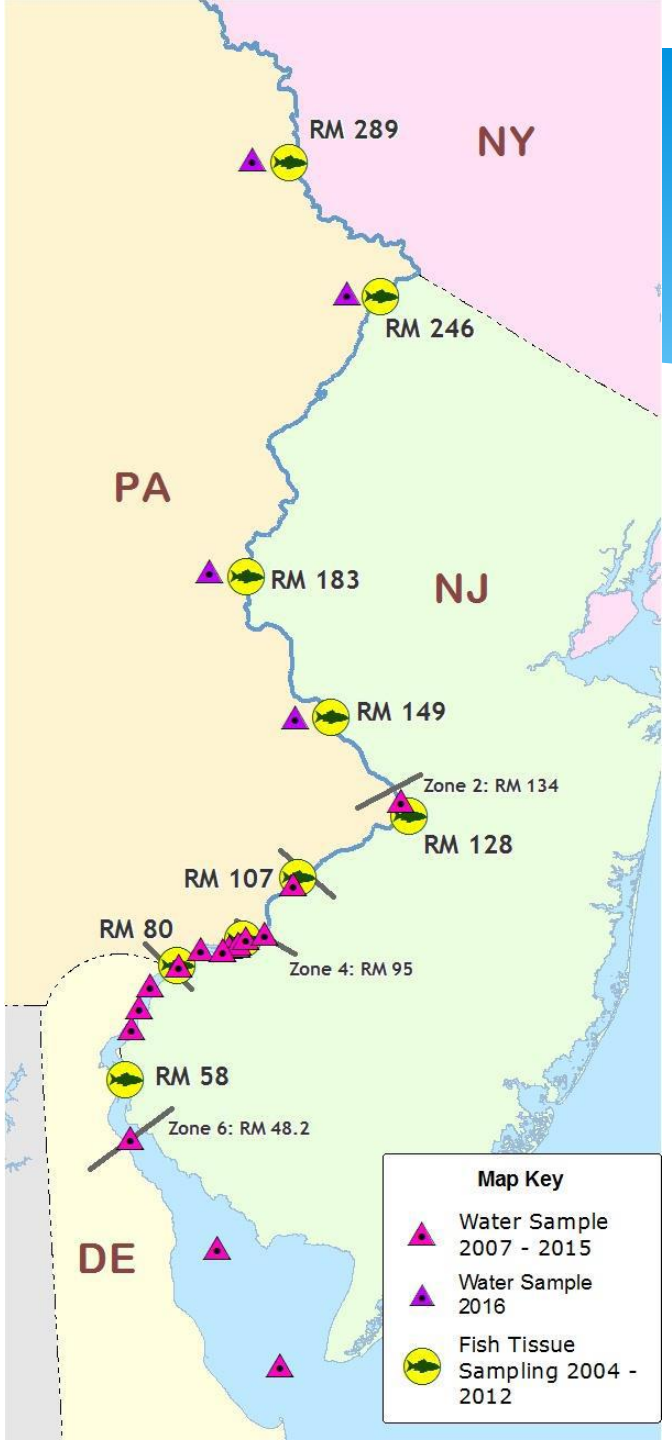
Laboratory Animal

* Primary effects in lab animals are liver, developmental and immune toxicity

Ecological Effects

* National WQC for aquatic life not derived
* Long chain PFAS bioaccumulate and biomagnify
* Many PFAS are persistent (short and long chain)
* Moderately acute and slightly chronically toxic to aquatic organisms (survival, growth and reproduction)
  * PNEC for PFOS 0.6 to 6.6 ug/L (Qi et al. 2011)
  * PNEC for PFOA 1,250 ug/L (Hoke et al. 2015)
  * PNEC for PFHxA 199 ug/L (Hoke et al. 2015)
* Sublethal effects observed (e.g., histopathology and endocrine function)

PFAS Monitoring



- Surface water samples
  - Six sites in tidal for 2007, 2008, 2009
  - Fifteen sites in tidal for 2015
  - Four non-tidal in 2016
- Fish Species samples
  - Nine sites in tidal and non-tidal in 2004 ~ 2015
- Sediment samples
  - Thirty sites in 2016

For surface water

- Longer Chain
  - C11, C10 and C9 decreasing
- Shorter Chain
  - C7 and C6 decreasing
  - C6 and C5 highest PFAS conc. In 2015

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Questions?

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