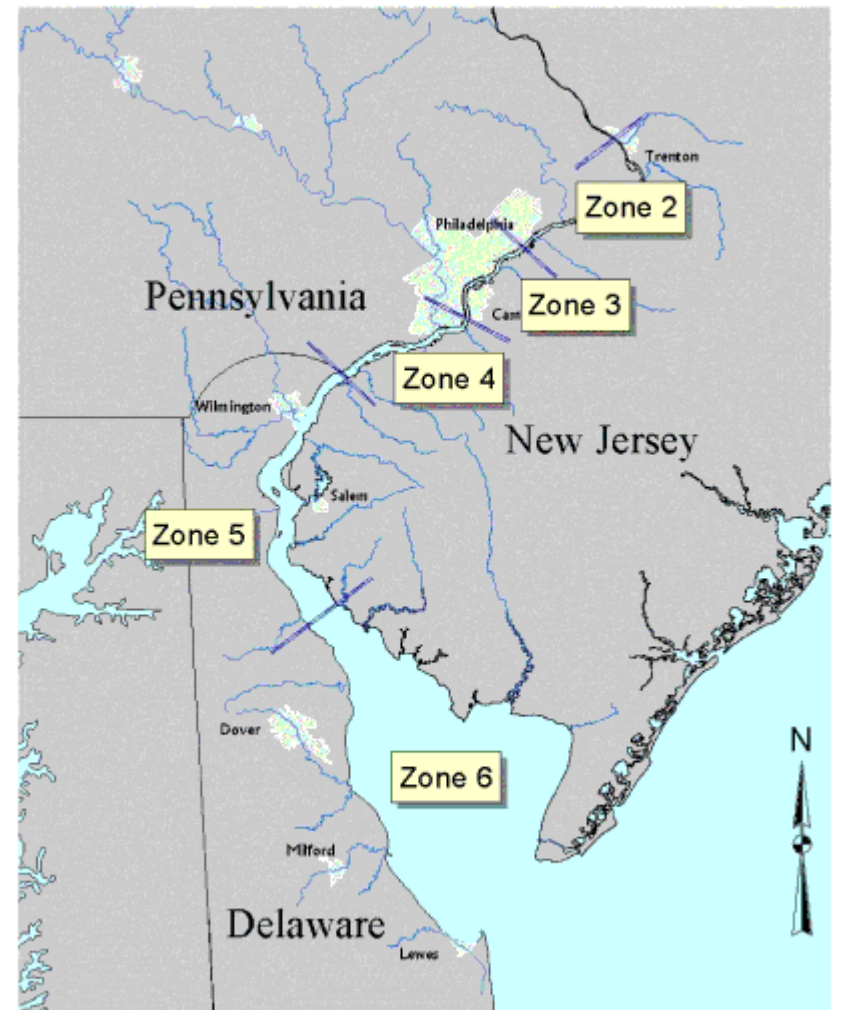
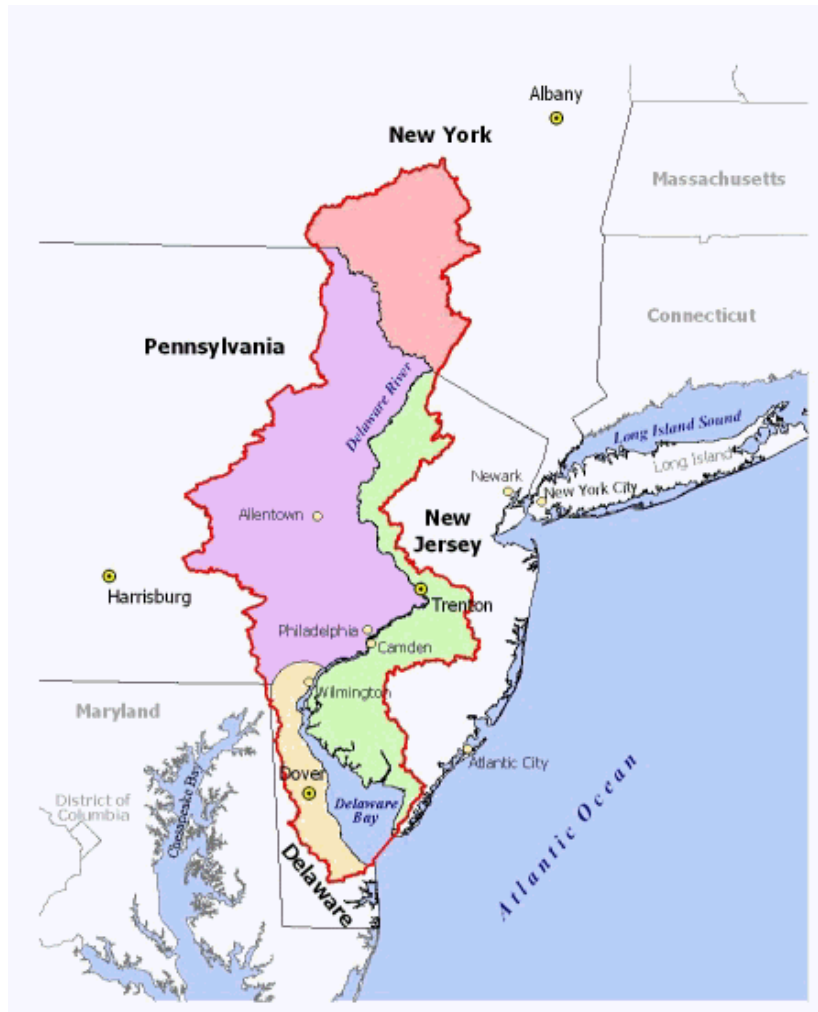


TMDLs for PCBs for the Delaware River Estuary

Thomas J. Fikslin, Ph.D., Manager
Modeling, Monitoring and Assessment Branch



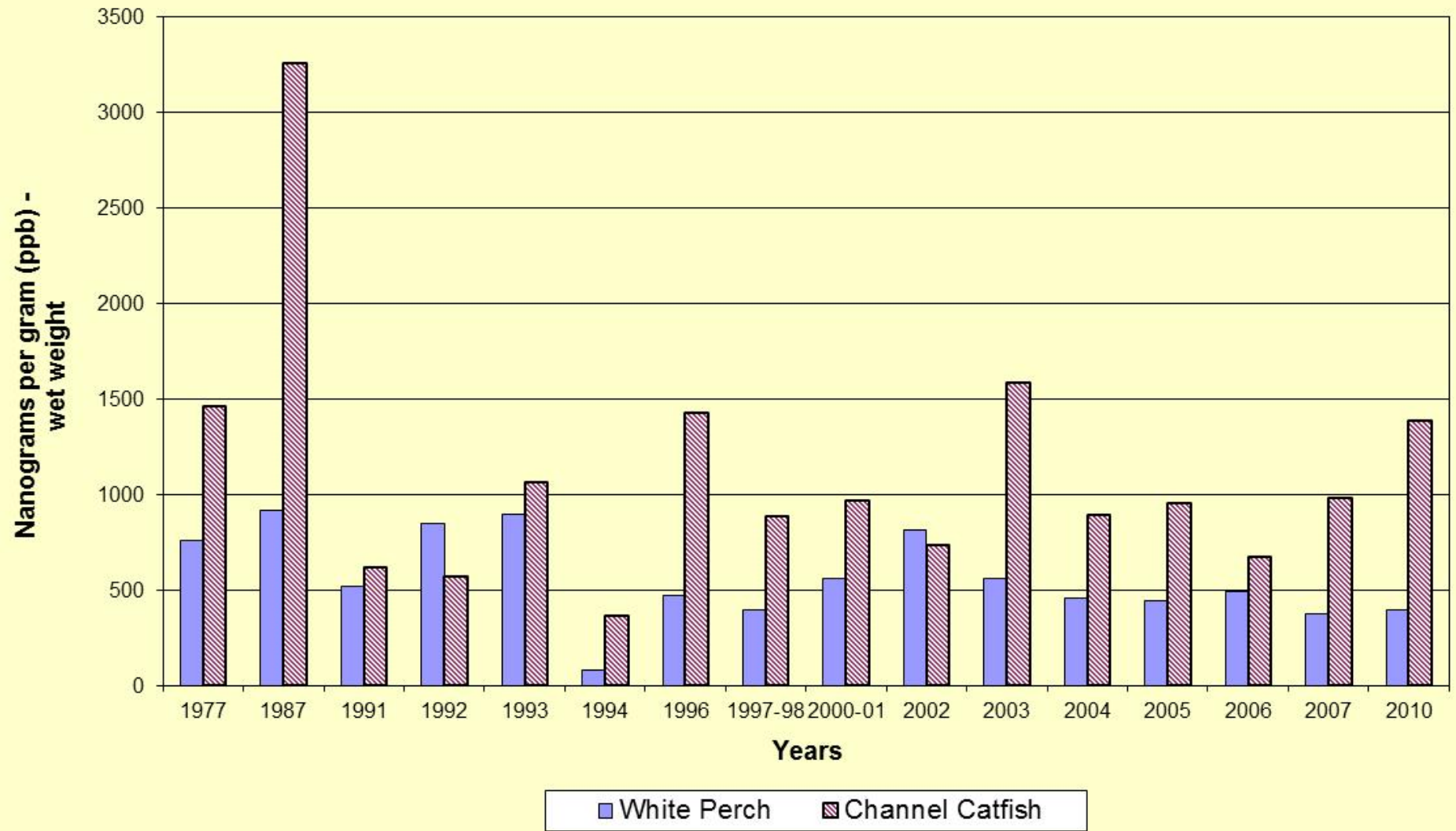
Delaware Estuary



Background

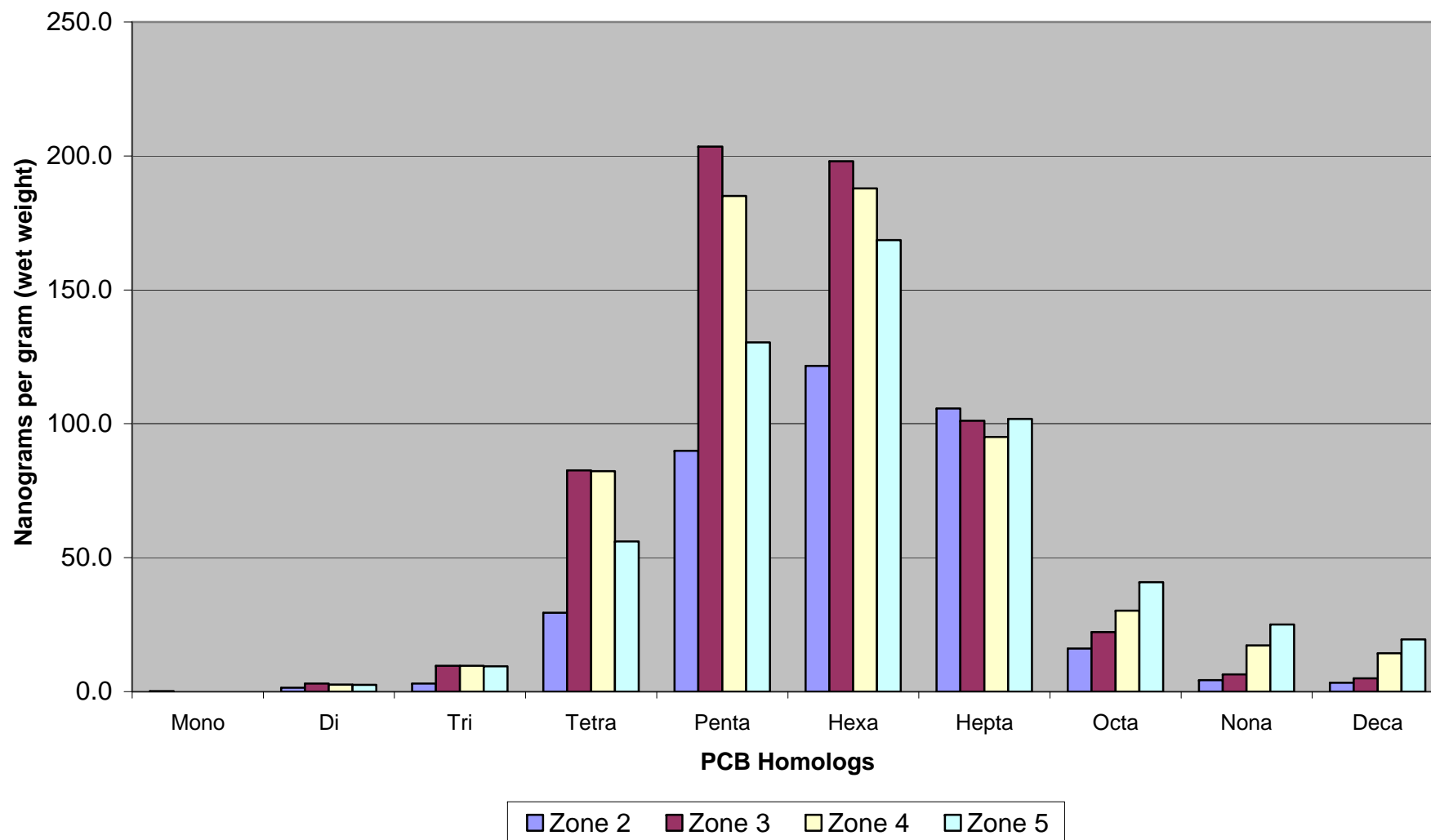
- ❑ Delaware Estuary is 133 miles long and is bordered by DE, NJ and PA
- ❑ 1998 – All three states listed the Delaware Estuary as impaired requiring the development of TMDLs.
- ❑ Spring 2000 – DRBC designated the lead agency to develop the TMDLs for PCBs by the court-ordered deadline of Dec. 15, 2003.
- ❑ Major boundaries: Delaware River at Trenton, NJ; Schuylkill River; C&D Canal; and the Ocean.
- ❑ Point sources: 94 industrial and municipal facilities, CSOs, and MS4s.
- ❑ Tributaries: 22
- ❑ Contaminated sites: ~ 50
- ❑ Air flux and deposition.

Historical Trend in PCBs in Fish Tissue Delaware Estuary

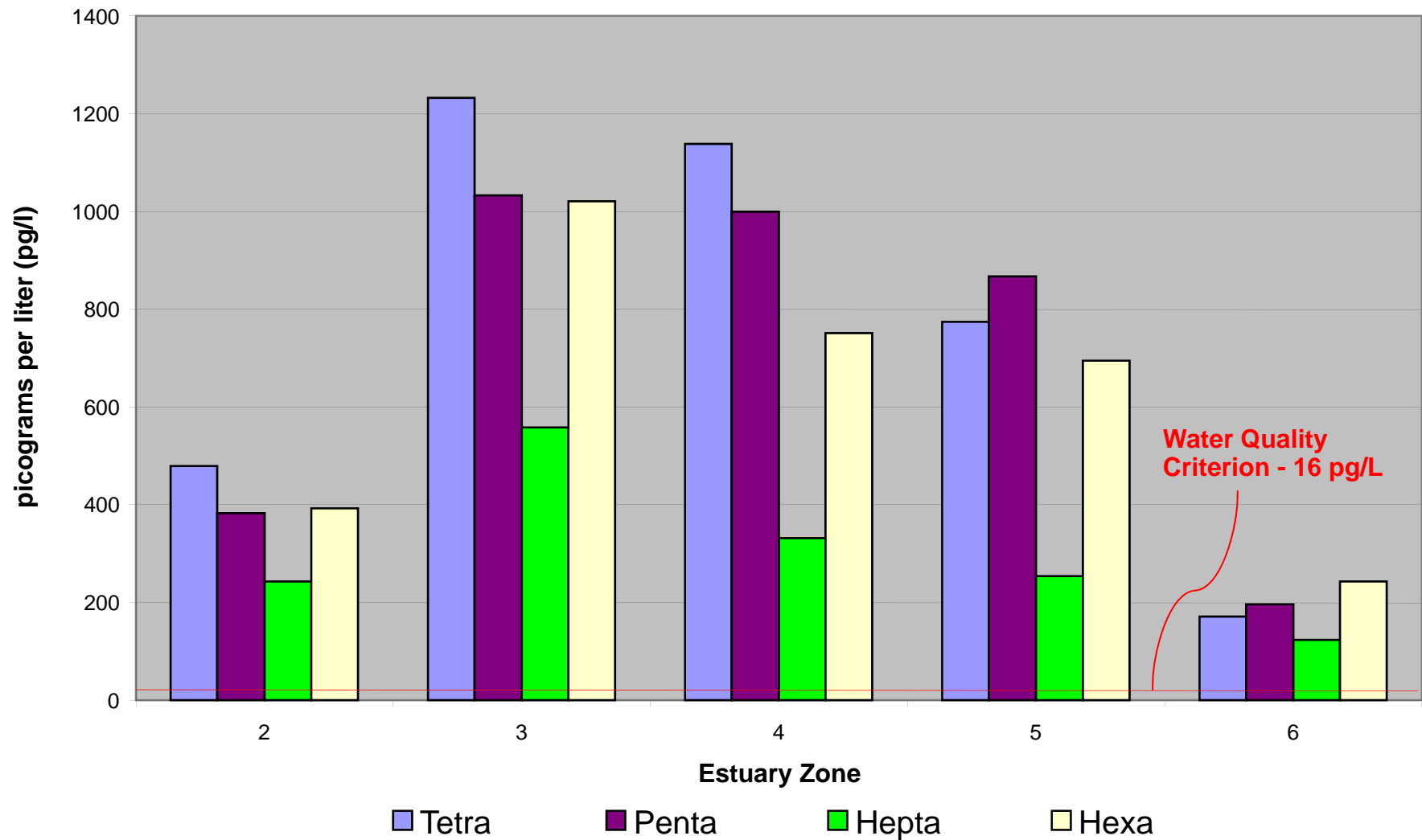


Homolog Distribution in Estuary Zones - 2003

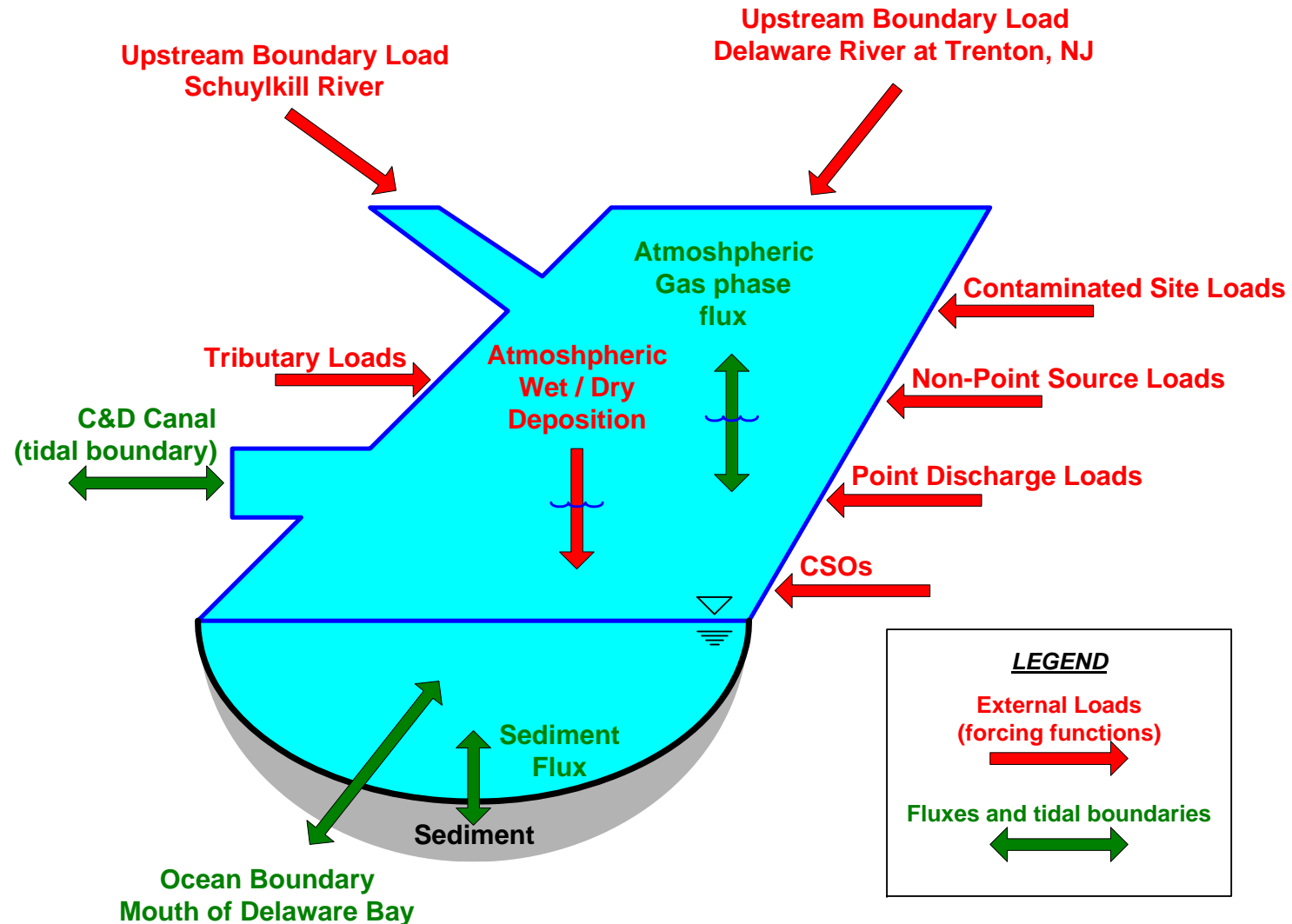
White Perch



**Median Ambient PCB Concentrations
Stage 1 - 2002 to 2003
Tetra through Hexa Homolog Distribution**



Principal Mass Loadings and Fluxes



Themes

- ✓ Importance of the Water Quality Target
- ✓ Importance of Source Identification and Quantitation
- ✓ Need for a Model
- ✓ Importance of the Sediment Reservoir
- ✓ Developing Complex TMDLs
 - Staged TMDL Development for the Delaware Estuary
 - Non-numeric permit requirements

Importance of the TMDL Target



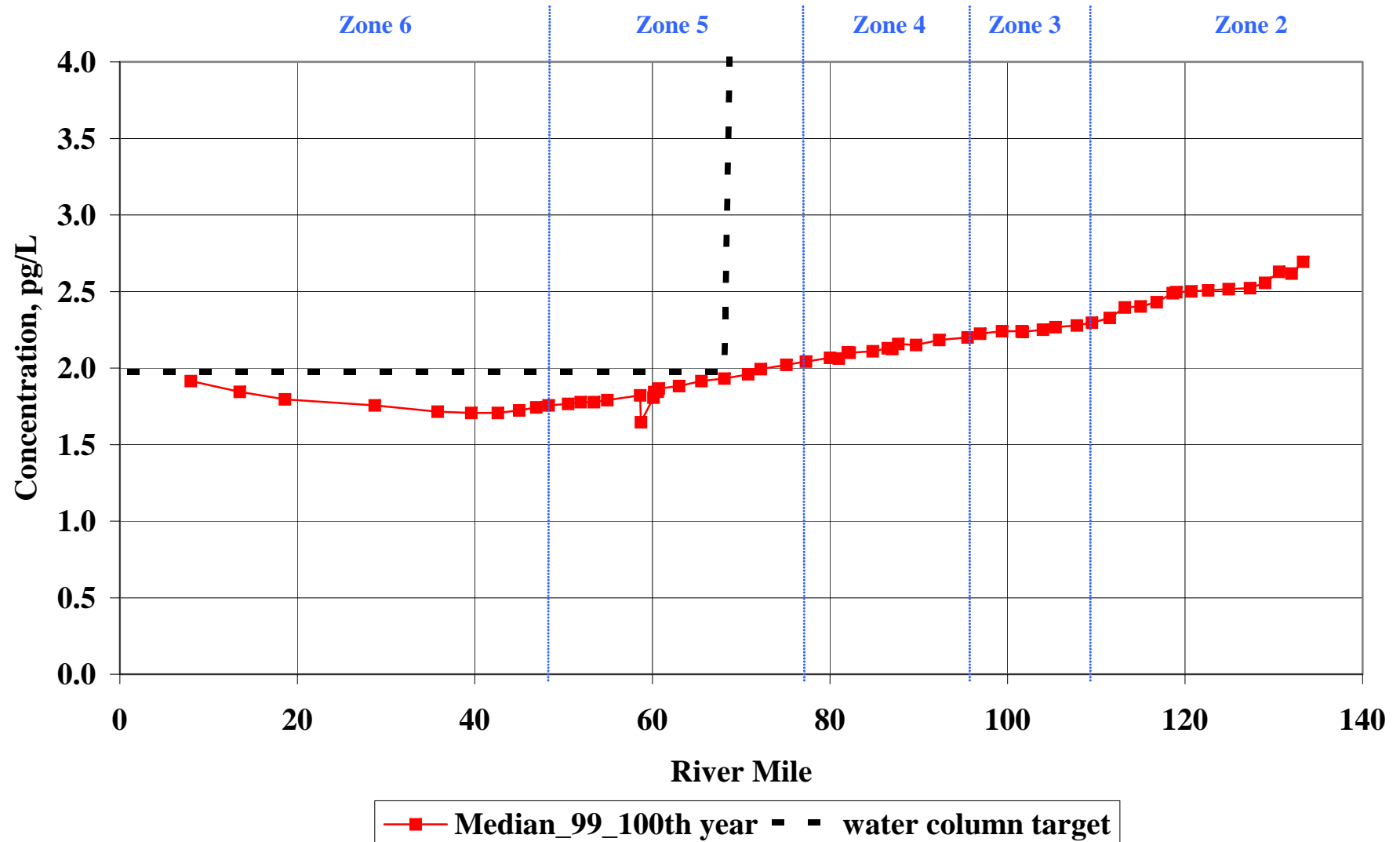
- ❑ TMDLs must be based upon the most stringent water quality criteria applicable to the receiving water in order for the designated uses of the water body to be met.
- ❑ In interstate waters like the Delaware Estuary, inconsistent uses and criteria complicate the identification of the most stringent criterion.
- ❑ In the Delaware Estuary, criteria for the protection of human health and wildlife were potentially the most restrictive.

Water Quality Criteria

- ❑ Existing PCB criteria creates a critical point in Zone 5. This has significant effects on the available assimilative capacity (the TMDLs).

	Zones 2 & 3	Zone 4 & Upper Zone 5	Rest of Zone 5
Existing DRBC Criteria	44.4 pg/l	44.8 pg/l	7.9 pg/l

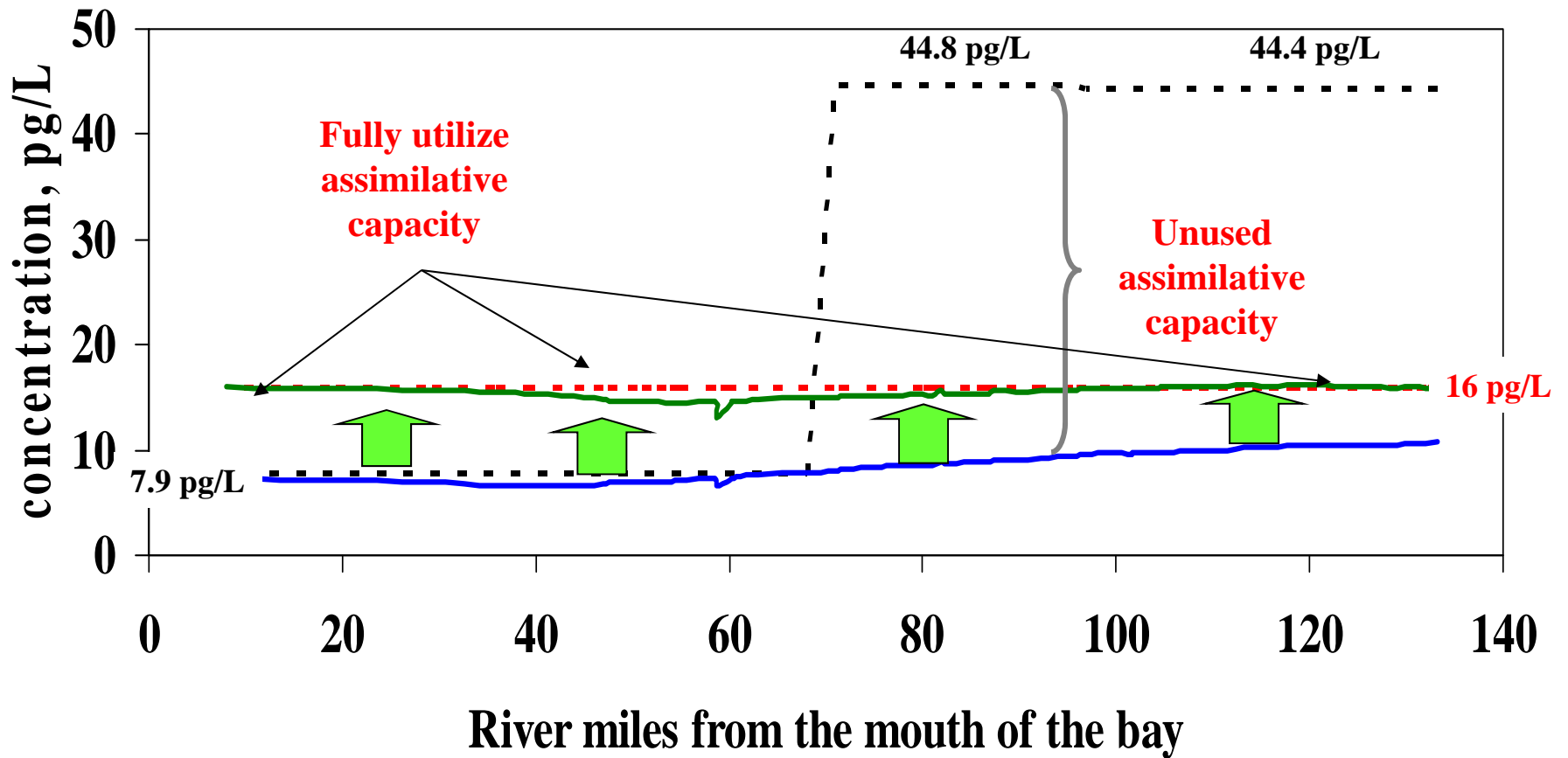
Penta-PCB Water Column Concentrations at TMDL Loads, 100 year simulation



Water Quality Criteria

- ❑ DRBC staff has developed a revised water quality criterion of 16 pg/L that is applicable to all zones.
- ❑ This criterion utilizes the 2000 U.S. EPA methodology for deriving human health criteria, and incorporates:
 - ✓ the upper bound estimate of the cancer potency factor of 2.0 (mg/KG)/day,
 - ✓ site-specific fish consumption rates, and
 - ✓ a site-specific bioaccumulation factor.

PCB Criteria and TMDLs in Delaware Estuary



- - - Existing Criteria — TMDL_Stage_1 - - - Proposed Criteria — TMDL_Stage_2(?)

Why develop a Model?

① Gain understanding:

- ✓ Determine PCB load-response relationships.
- ✓ Determine principal controlling processes.

② Address management questions:

- ✓ Determine PCB TMDL for each zone.
- ✓ Allocate TMDLs among sources.
- ✓ Assess the impact of load reduction strategies.

Delaware River PCB Model (DELPCB)



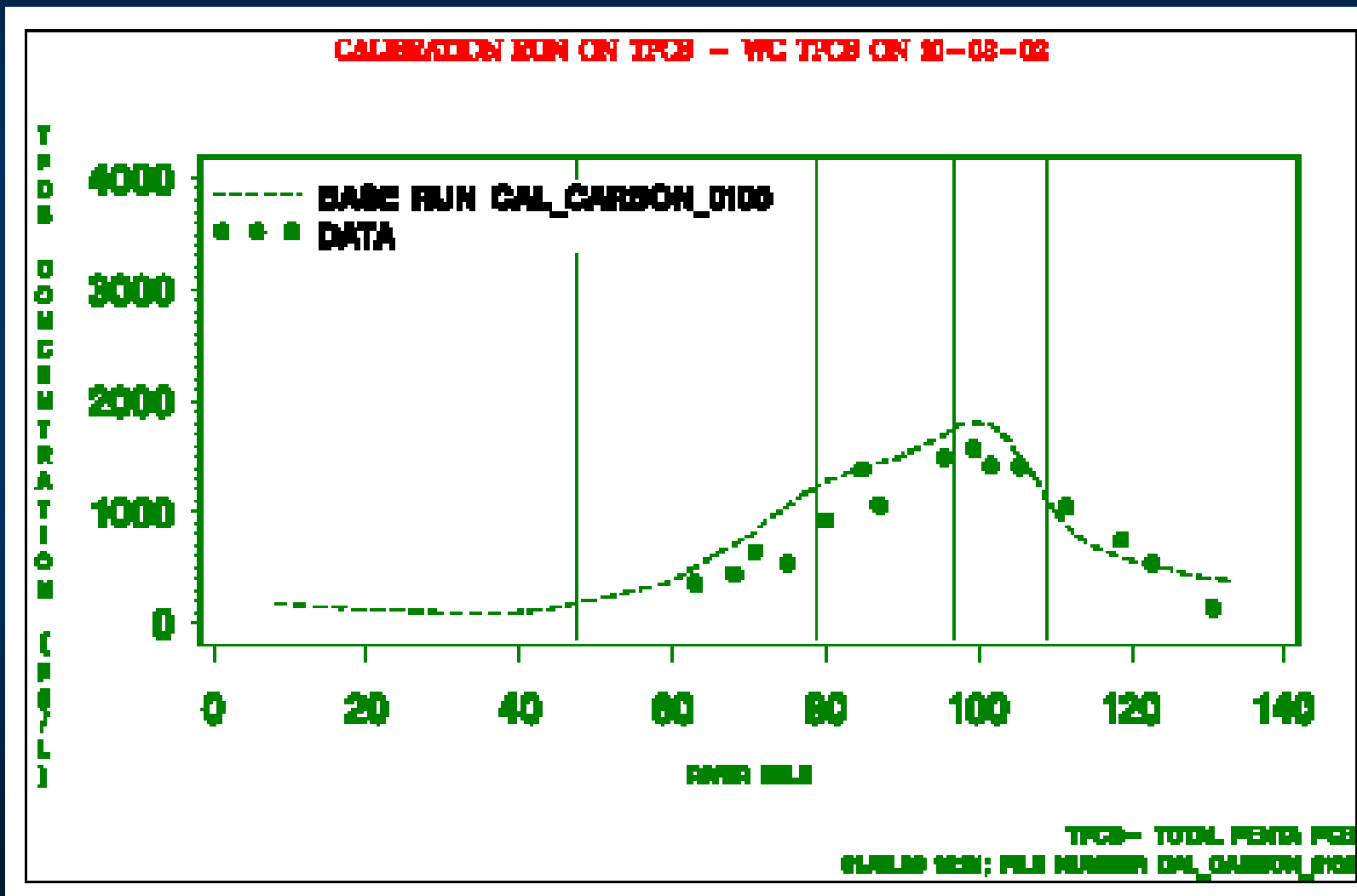
- ❑ Modified version of DYNHYD5/TOXI5
- ❑ EPA-supported and widely used for toxic chemical TMDLs and contaminated sediments.
- ❑ Model formulations/code extensively tested and assessed with observations at numerous sites.
- ❑ Builds upon modeling work at other sites:
 - ✓ Kalamazoo River RI/FS
 - ✓ New York Harbor CARP Model
 - ✓ Green Bay Mass Balance Study
 - ✓ Upper Hudson River RI/FS
 - ✓ Fox River RI/FS

Delaware River PCB Model (DELPCB)

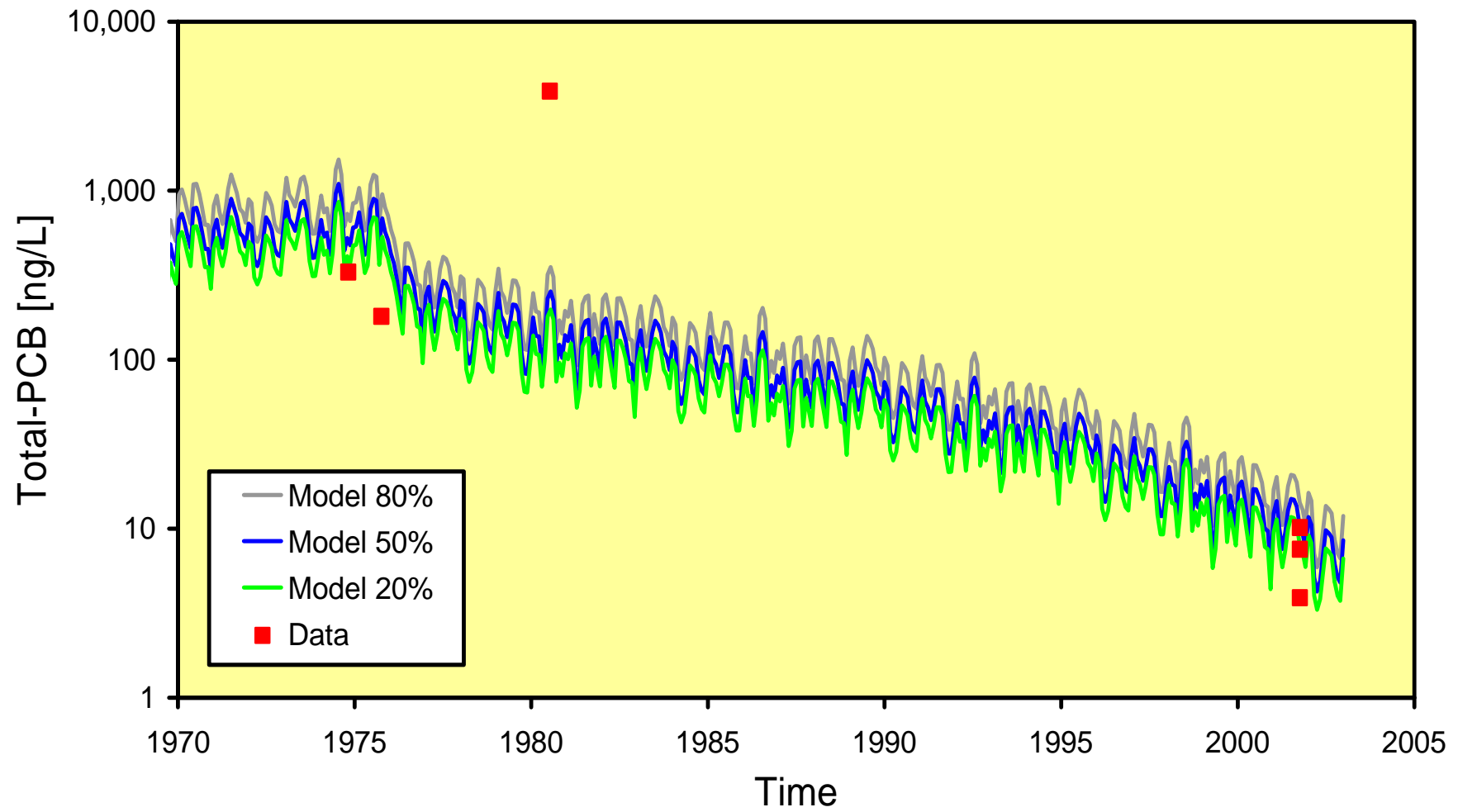


- ☐ Represents water column and sediments
- ☐ One-dimensional in longitude
 - ✓ 87 spatial segments
- ☐ Time-variable
- ☐ Hydrodynamics
 - ✓ Tidal heights
 - ✓ Chloride mass balance
- ☐ Organic carbon sorbent dynamics
 - ✓ Particulate carbon (biotic and detrital)
 - ✓ Dissolved organic carbon
- ☐ Penta PCB homolog

Short-term Calibration for penta-CB



Decadal Scale Calibration for penta-PCB



Key Findings

- ❑ The principal sources of PCB loadings are non-point source runoff, point sources and the mainstem Delaware River.
- ❑ The flux of PCBs between the gas phase in the atmosphere and dissolved PCBs in the water is a significant process affecting the achievement of the TMDLs.
- ❑ PCB loadings at head of tide (Trenton) have a significant influence in the tidal Delaware River.
- ❑ Water column PCBs are strongly influenced by loadings and sediments.

Summary points



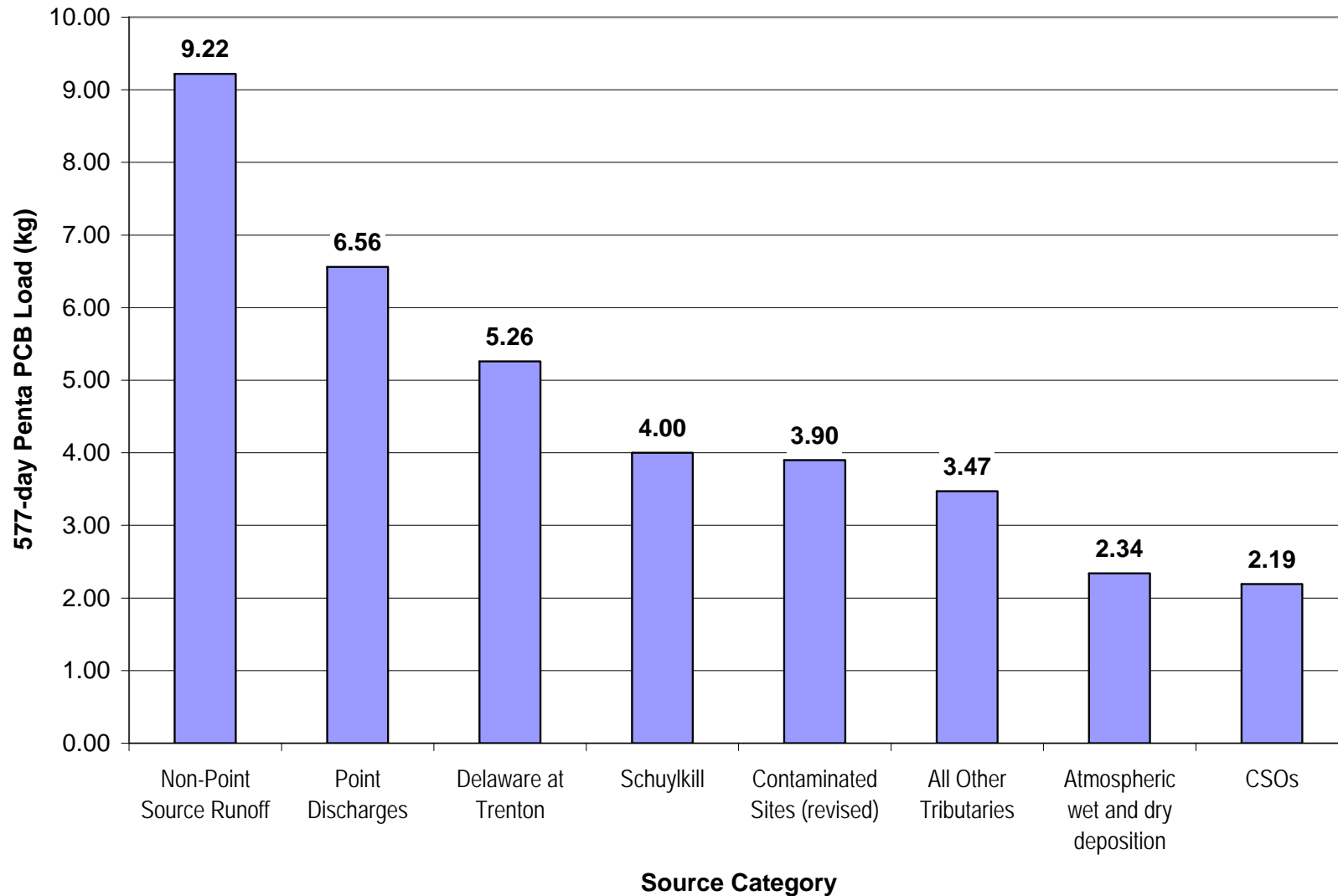
- ❑ Model for PCBs is developed and calibrated.
- ❑ Model is scientifically credible.
- ❑ Collaboration with Delaware Estuary TMDL Coalition
 - ❑ Avoided adversarial process and a competing model
- ❑ Model was used to develop Stage 1 PCB TMDL, but Stage 2 is necessary to address uncertainties.
- ❑ Model can be extended to other contaminants and to other watersheds.

Source Identification & Quantitation

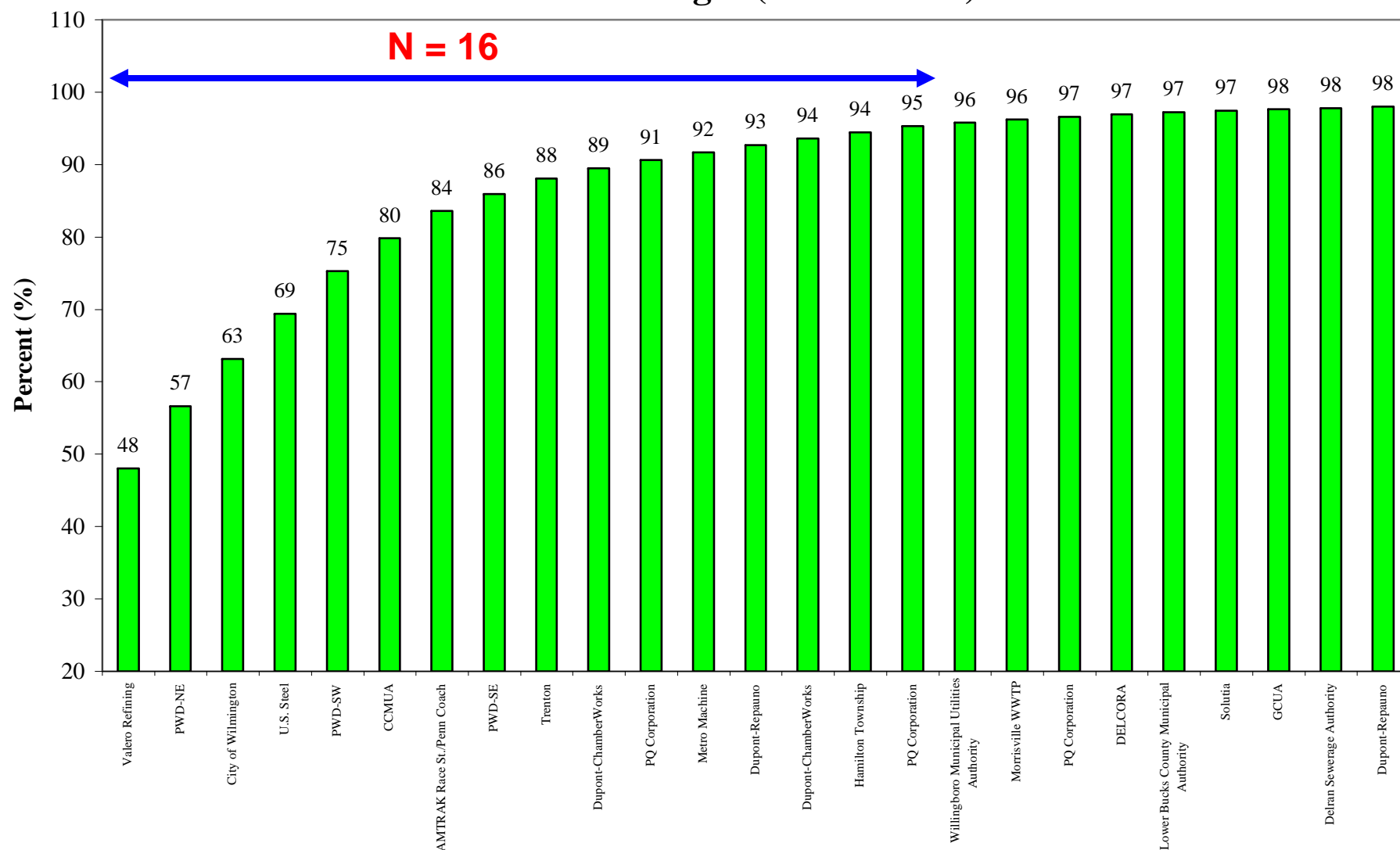
- ❑ Identifying and quantifying PCB sources using congener-specific analytical methods has several benefits:
 - ✓ Allows prioritization of sources for load reductions.
 - ✓ Reduces the uncertainty in model inputs.
 - ✓ Permits fingerprinting of sources.
 - ✓ Allows permittees/site owners to track the effectiveness of pollutant minimization activities.

Penta-PCB Load by Source Category

Sept 2001 through March 2003



Cumulative 2005-06 Penta-PCB Loadings NPDES Discharges (Total n=128)



Establishing TMDLs

- ❑ TMDLs are estimates of the loadings of each of the PCB homologs that can enter the estuary and still meet the current water quality criteria. They are *projected loadings* from all sources based upon assumptions called design conditions.
- ❑ Since current concentrations of PCB homologs are 500 times higher than the water quality criteria, the TMDLs and associated individual WLAs and LAs will be proportionately less.

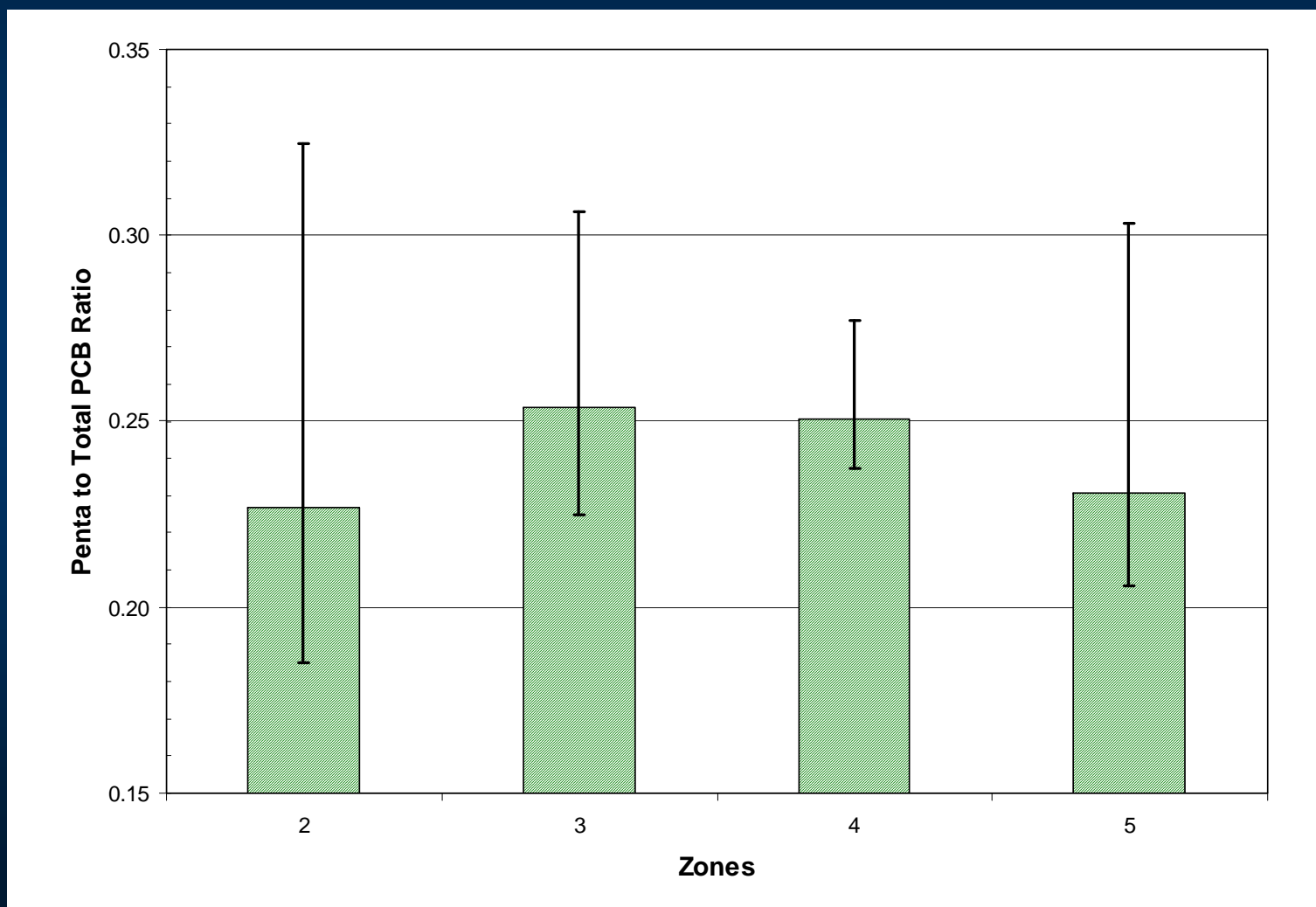
Summary of Approach for Stage 1

- ❑ Allocate 5% of each of the zone TMDLs to a margin of safety (MOS).
- ❑ Allocate to the contaminated sites category.
- ❑ Allocate the remainder of the zone TMDLs to a WLA portion and a LA portion based upon the current percentage contribution for each of the source categories to each zone during the period February 1, 2002 to January 31, 2003.

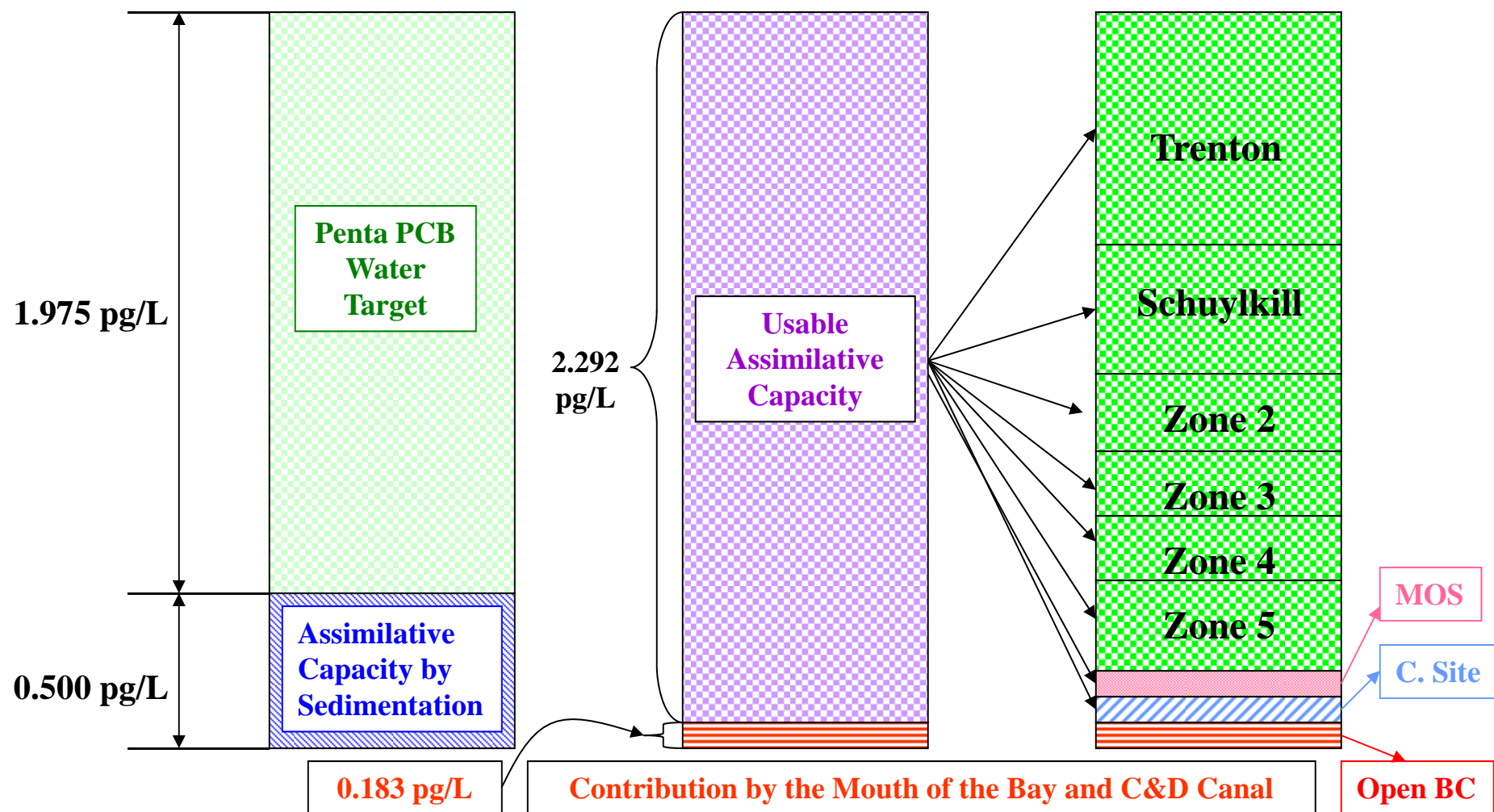
Summary of Approach for Stage 1

- Using the estuary-wide ratio of penta-PCBs to Total PCBs from ambient data collected in the Delaware Estuary, the zone-specific, penta-PCB TMDLs were scaled up using a fixed ratio of 1:4 to calculate the TMDL.

Ratio of Penta-PCBs to Total PCBs in Ambient Samples



Allocation of the Assimilative Capacity at the Critical Location



Stage 1 TMDLs for Total PCBs

Estuary Zone	TMDL	WLA	LA	MOS
	mg/day	mg/day	mg/day	mg/day
Zone 2	257.4	5.0	239.5	12.9
Zone 3	17.8	4.9	12.0	0.9
Zone 4	56.7	5.2	48.7	2.8
Zone 5	48.1	13.3	32.4	2.4
Sum	380.0	28.3	332.6	19.0

Approach for Establishing Stage 2 TMDLs

- ❑ The approach for establishing Stage 2 TMDLs is expected to be different than that used in Stage 1.
- ❑ Some of the reasons for this are:
 - ❶ A revised human health criteria for total PCBs has been developed that does not produce a sharp transition between zones.
 - ❷ An alternative allocation procedure for both the aggregate WLAs and LAs, and the individual WLAs and LAs that is more equitable will be needed.

Approach for Establishing Stage 2 TMDLs

- ③ TMDLs for total PCBs for each zone will be the sum of the TMDLs for four homologs without extrapolation from Penta-PCBs.
- ④ Alternative source reduction strategies that result from either the PCB Minimization Plans required in Stage 1 or the efforts of the PCB Implementation Committee will need to be considered , where appropriate, in allocating the zone TMDLs.

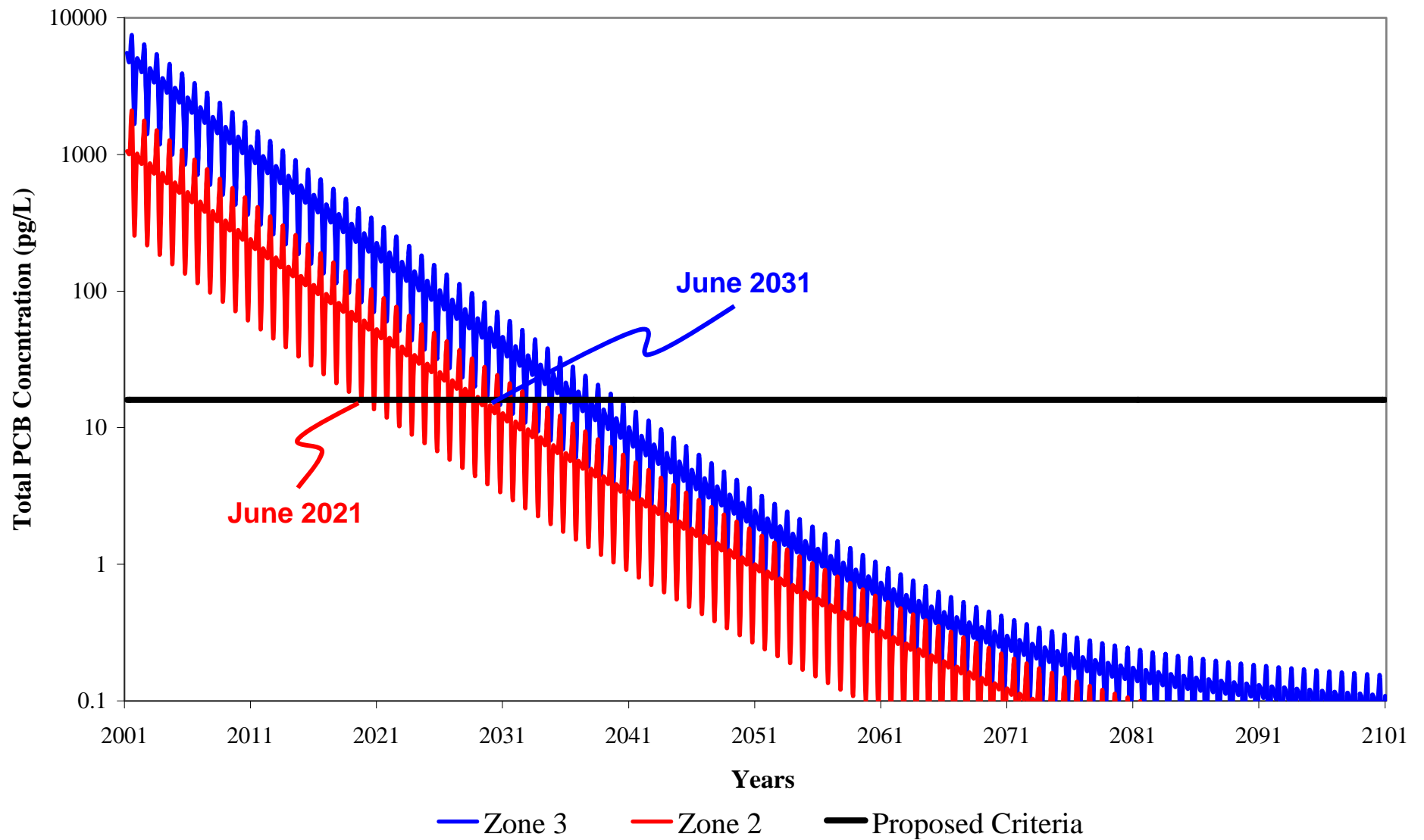
Progress to Date

- ❑ DRBC implemented the Stage 1 TMDLs by requiring point sources to conduct additional monitoring using low level techniques (Method 1668A). The results of this monitoring have been submitted and assessed.
- ❑ DRBC passed regulations in May 2005 requiring point source dischargers to submit and implement PMPs. 42 dischargers are initially required to submit the plans.
- ❑ Regulations can be applied to any point and *non-point source* that the Commission determines has an “adverse impact” on the water resources of the Basin.

Achieving Water Quality Criteria

- ❑ Reductions in PCB loadings will not immediately result in lower ambient water concentrations or in reduced tissue levels of PCBs in resident fish species.
- ❑ This is due to the continuing flux of PCBs from the sediments to the water column. As solids uncontaminated by PCBs settle to the bottom, this flux will ultimately reach equilibrium with the water column.

100 year projection with all sources set to zero



Achieving Water Quality Criteria

- ❑ Reductions in PCB loadings will not immediately result in lower ambient water concentrations or in reduced tissue levels of PCBs in resident fish species.
- ❑ This is due to the continuing flux of PCBs from the sediments to the water column. As solids uncontaminated by PCBs settle to the bottom, this flux will ultimately reach equilibrium with the water column.
- ❑ A long-term strategy for permitting point source discharges and addressing non-point sources such as contaminated sites and air sources is needed to ensure continued progress in reducing PCBs.

Contact Information:

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(609) 883-9500, ext.253

Information on the TMDLs, model development, sampling and analytical information, and PMP requirements and resources are available on the DRBC website at:

www.drbc.net

Stage 2 Implementation Requirements

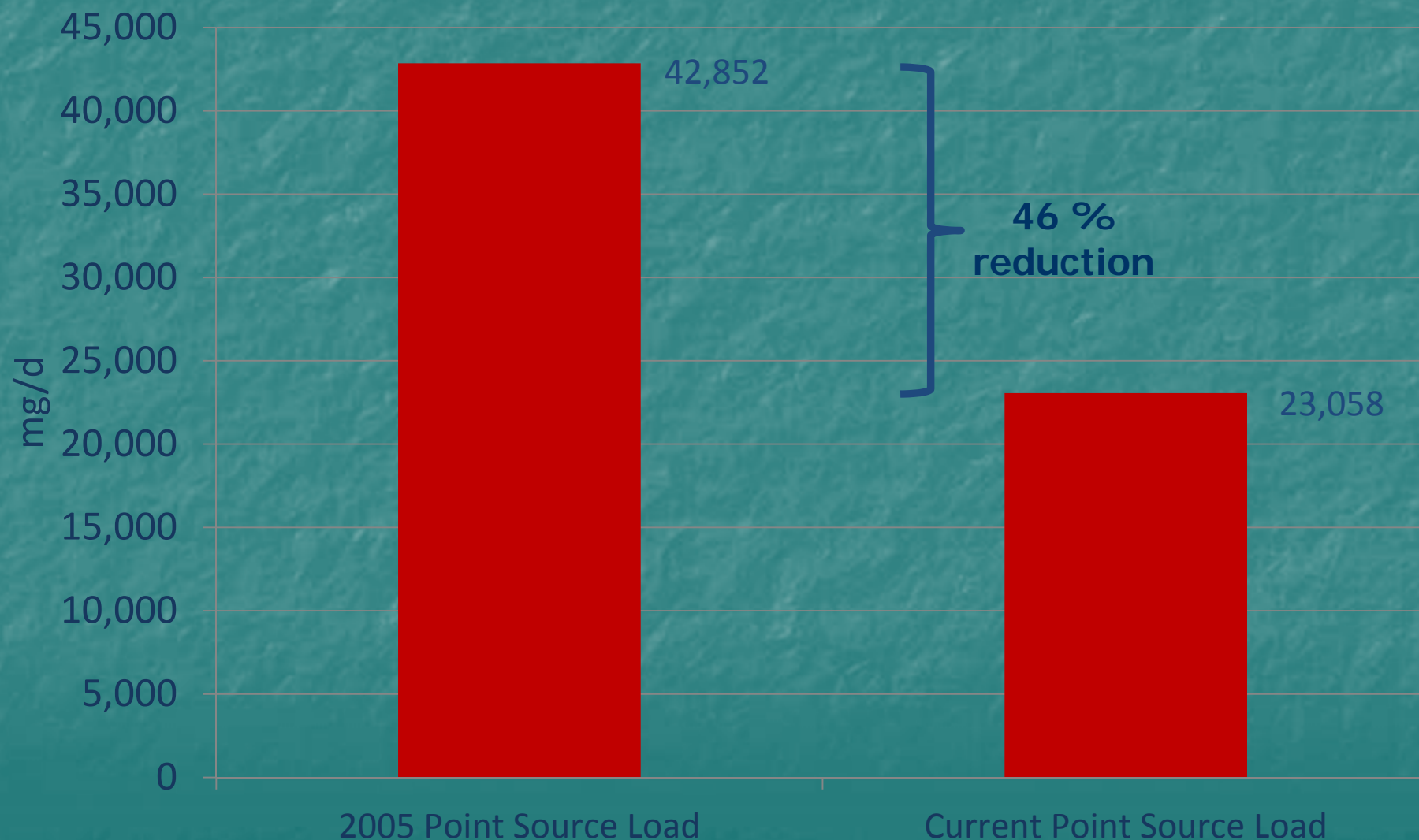
- Build upon the monitoring and PMP requirements of Stage 1 TMDLs.
- Incorporate the concept of an **Action Level**.
 - Purpose - to elicit a prompt response to elevated PCB concentrations above those achieved.
 - Establish duration and magnitude of elevated concentrations.
 - Document actions taken and return to PCB concentrations previously observed, or proposed actions to be included in a revised PMP.

NPDES Permitting Strategy

■ Two Response Levels Approach

- Based upon the last 10 data points collected under normal operating conditions.
- **Monitoring Trigger Level** (MTL) - based upon 95th confidence interval of the *median*.
 - Objective is to obtain additional monitoring data given the low frequency of permit monitoring required.
 - Permittee has primary responsibility – Reporting to DRBC required.
- **Action Level** - based upon maximum projected effluent concentration.
 - Objective is to require monitoring and submittal of a report.
 - Permittee and DRBC/State permitting agency share responsibility.

10 Dischargers Representing 90% of Point Source PCB Loadings in the Estuary



Incremental Progress

- Reductions in Loadings from Non-Point Sources
 - ✓ Removal of ~40,000 lbs. of PCBs from tidally-influenced wetland adjacent to tributary creek.
 - ✓ Removal of ~8,000 lbs. from NPL industrial site.
 - ✓ Inventory of Superfund sites - DelTriP
<http://www.state.nj.us/drbc/about/public/publications/deltrip.html>
- In 2013, DE and NJ relaxed fish consumption advisories to 1 meal per year in Zone 5.
- Ambient water concentrations did not change significantly as expected.