PCBs in the Potomac River

Results from recent field studies

Investigators

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Questions

1. How much do PCB concentrations and compositions vary spatially in the Potomac?
    1. Concentration gradients calibrate models
        1. Sediments
        2. Water column
    2. Compositional differences among sources?
        1. Congener fingerprints?
        2. Homolog models?
2. What are the current PCB loadings at the fall lines?
    1. How are they related to flow and solids loads?

Questions

3. Have PCB levels changed over time?

4. What is the spatial extent of ‘hot spots’?

    1. Under what conditions are PCBs transported from Anacostia?

5. What are the relative importance of known sources?

    1. What tools might be used to deconvolute multiple sources?

Potomac Water Column PCB Measurements

Project Title	Tributary	Samples	Dates	Investigator
Effects of Dredging on the Water Quality of the Anacostia River	Tidal Anacostia R at Bladensburg, MD	Dissolved and particle in water column	Sept - Oct 1992	Velinsky/ICPRB Foster/GMU
Dissolved and Particulate Transport of Chemical Contaminants in the Northeast and Northwest Branches of the Anacostia R (Appl Geochem 15, 901)	NE and NW Br Anacostia R	Dissolved and particle in water column	Sept 1995 - Sept 1996	Gruessner/ICPRB Foster/GMU
Effects of Stormwater Runoff on the Water Quality of the Tidal Anacostia River	Anacostia R	Dissolved and particle in water column	Feb -Nov 1999	Velinsky/ANS Foster/GMU Reidel/ERC
Bioaccumulation Dynamics of Hydrophobic Organic Contaminants in the Anacostia R Food Web	Anacostia R at Kenilworth Marsh and the Navy Shipyard	Dissolved, particle, bed sediments and biota	June 1998 - Aug 2000	Foster/GMU Velinsky/ANSP
Bioaccumulation of PCBs in Aquatic Biota from a Tidal Freshwater Marsh Ecosystem (Bernie's MS Thesis and Arch Environ Contam Toxicol 42, 396)	Dyke Marsh, Potomac River	Water, particles, bed sediments and biota	Oct 1998 and June 1999	Foster/GMU
PCBs in Urban Stormwater Runoff to The Tidal Anacostia River	Minor Tributaries and CSOs of Tidal Anacostia R	Dissolved and particle in water column	Apr - Aug 2002	Foster/GMU
2005 Potomac River Toxics Monitoring Program	Potomac mainstem	Dissolved and particle in water column	**June 2005 – February 2006**	Baker/UMD
Potomac Chemical Contaminant Survey	Potomac mainstem	Dissolved and particle in water column	**June 2005 – June 2006**	Baker/UMD
Longitudinal characterization of DC tidal Potomac waters	DC mainstem	Dissolved and particle in water column, bed sediments, sediment cores	**April 2005 July 2005 March 2006?**	Velinsky/Ashley/ Ridel-ANS-SI/DCDOH
Tidal portion of Oxon Run	Oxon Run	Dissoved and particle in water column	**5/9/2005**	Velinsky/Ashley/ Ridel-ANS-SI/DCDOH
Potomac SPMD monitoring	Mainstem Potomac	Dissolved + ?	**Summer, 2005**	VADEQ

Potomac River PCB Sediment Studies

Project Title	Tributary	Samples	Dates	Investigator
Potomac Chemical Contaminant Survey	Potomac mainstem	Bed sediments and toxicity	2005 (samples archived for PCBs)	Baker/UMD Fisher/UMD
2005 Potomac River Toxics Monitoring Program	Virginia tributaries and embayments	Bed sediments	**June, 2005**	Baker/UMD
Bioaccumulation Dynamics of Hydrophobic Organic Contaminants in the Anacostia R Food Web	Anacostia R at Kenilworth Marsh and the Navy Shipyard	Dissolved, particle, bed sediments and biota	June 1998 - Aug 2000	Foster/GMU Velinsky/ANS
Bioaccumulation of PCBs in Aquatic Biota from a Tidal Freshwater Marsh Ecosystem (Bernie's MS Thesis and Arch Environ Contam Toxicol 42, 396)	Dyke Marsh, Potomac River	Water, particles, bed sediments and biota	Oct 1998 and June 1999	Foster/GMU
Rural to Urban Gradient of PAH and PCB Concentrations in Sediments of the Coastal Potomac R Basin (Vickie's MS thesis)	Shenandoah R and Potomac R	Bed sediments	May 2000 and December 2000	Foster/GMU
PCBs Along a Sediment Transect in The Potomac R from The Allegheny Plateau to Chesapeake Bay (part of a Phil's PhD thesis)	Mainstem Potomac R	Bed sediments	June and Oct 2000	Foster/GMU
Longitudinal characterization of DC tidal Potomac waters	DC mainstem	Dissolved and particle in water column, bed sediments, sediment cores	**April 2005** **July 2005**	Velinsky/Ashley/Ridel-ANS-SI/DCDOH

Potomac River PCB Loadings Studies

Project Title	Tributary	Samples	Dates	Investigator
Chesapeake Bay Fall Line Toxics Monitoring Program	Potomac R at Chain Bridge	Dissolved and particle in water column	March 1992 - Feb 1993	Foster/GMU
2005 Potomac River Toxics Monitoring Program	Potomac R at Chain Bridge	Dissolved and particle in water column	**August 2005 – ongoing**	Baker/UMD
Effects of Stormwater Runoff on the Water Quality of the Tidal Anacostia River	Anacostia R	Dissolved and particle in water column	Feb -Nov 1999	Foster/GMU Velinsky/ANS
PCBs in Urban Stormwater Runoff to The Tidal Anacostia River	Minor Tributaries and CSOs of Tidal Anacostia R	Dissolved and particle in water column	Apr - Aug 2002	Foster/GMU
Determination of the Loadings of Organic Contaminants Above the Head of Tide of the Anacostia R Using Automated Sampling Techniques	NE and NW Br Anacostia R	Dissolved and particle in water column	**April 2004 - Oct 2005**	Foster/GMU

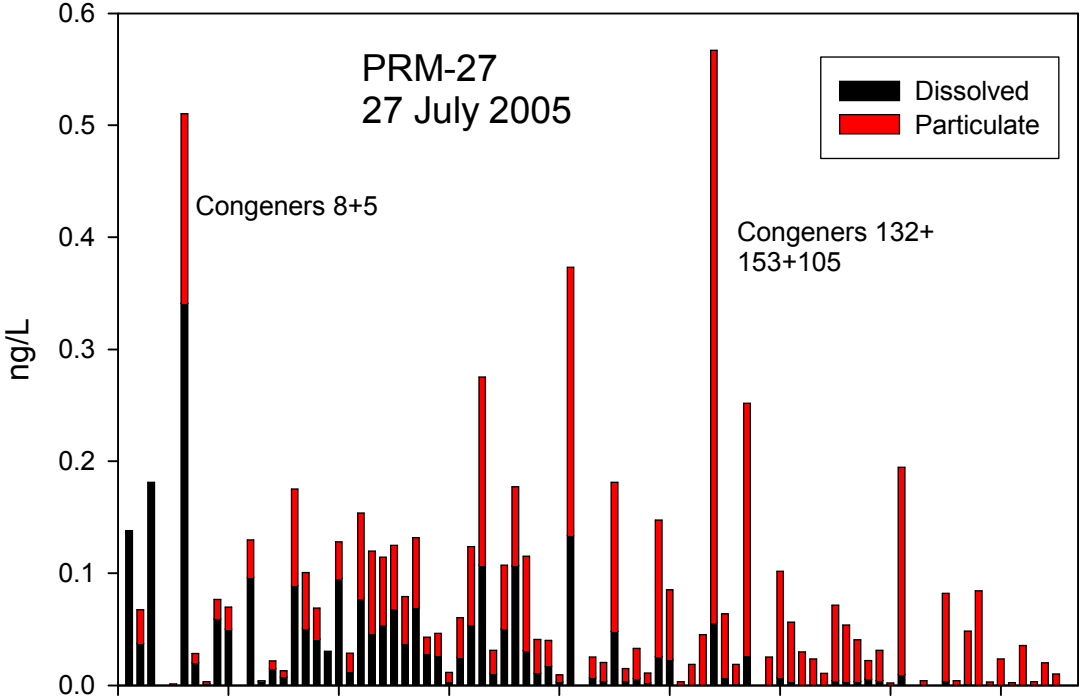
Some Issues About PCB Analysis

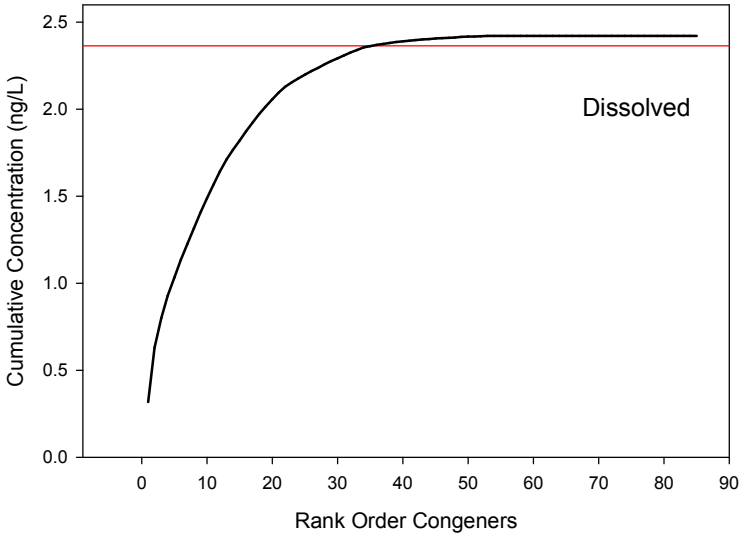
- Total PCB concentrations in Potomac River water column range from ca. 0.1 to >5 ng/L, with risk-based criteria <0.1 ng/L.

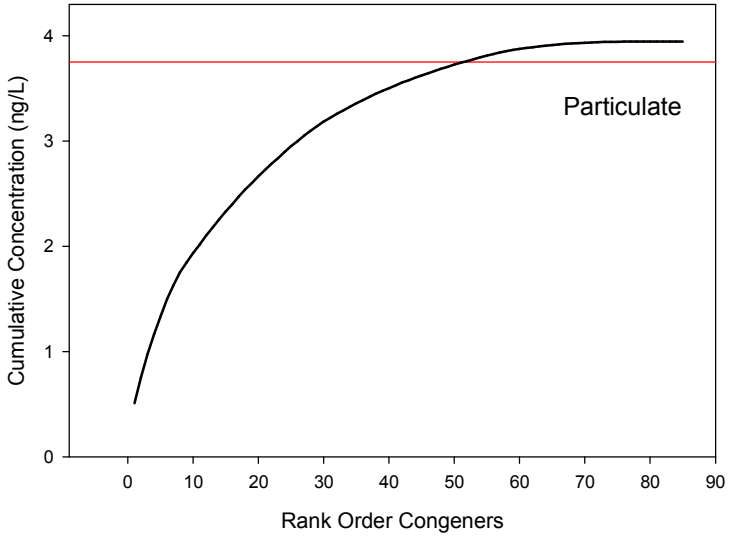
- Insufficient sample size and/or high method 'blanks' will frequently lead to "not detects" which complicate use in modeling

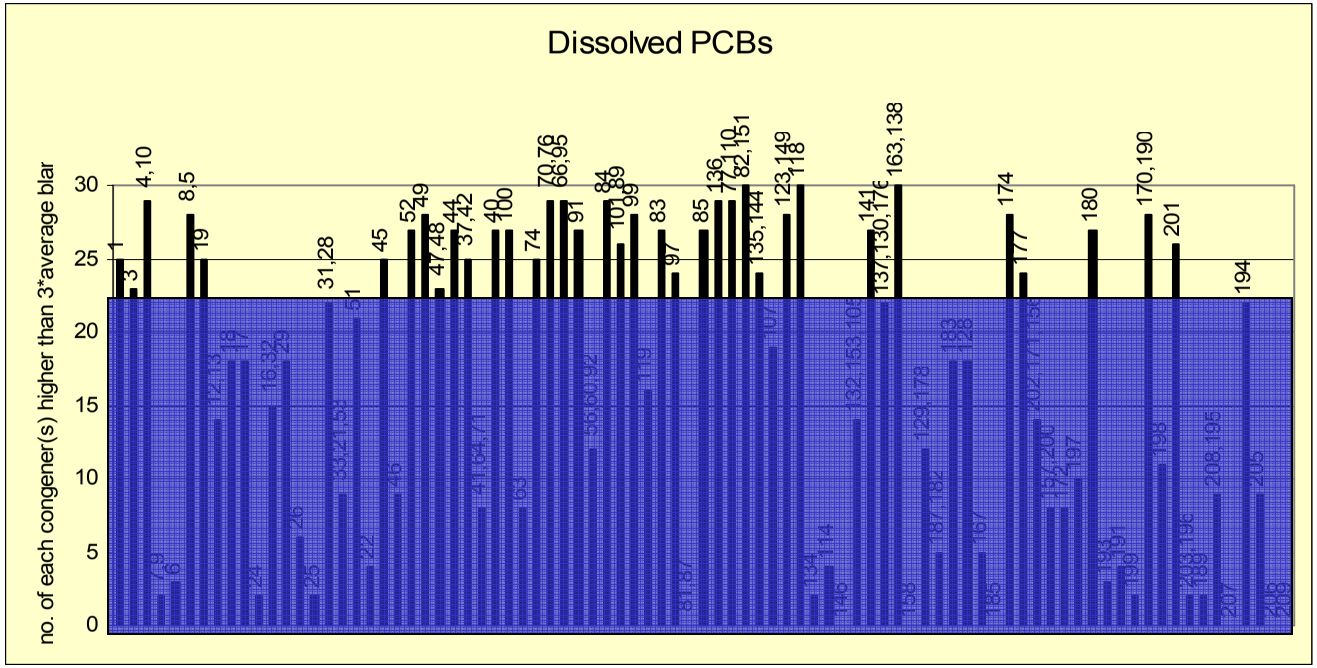
  – Improve sensitivity with high resolution mass spectrometry ($$$) or increased sample volume (time/temporal resolution)

- Which congeners to analyze?
  – 209 possible congeners, each with their own properties (transport/toxicity)
  – No analytical technique can measure each congener separately
  – In most environmental samples, 40-50 GC peaks make up >95% of *t*-PCB

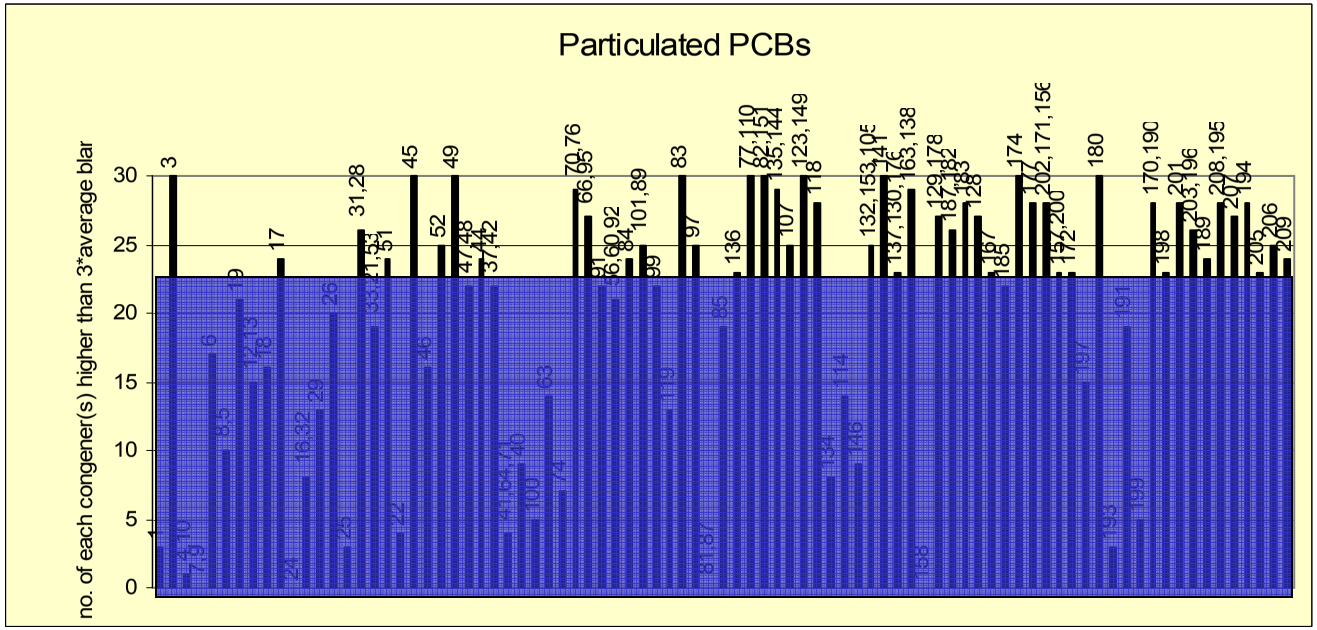

PRM-27
27 July 2005
Dissolved
Particulate
Congeners 8+5
Congeners 132+
153+105
ng/L
0.0
0.1
0.2
0.3
0.4
0.5
0.6


Dissolved
Cumulative Concentration (ng/L)
Rank Order Congeners
0.0
0.5
1.0
1.5
2.0
2.5
0
10
20
30
40
50
60
70
80
90

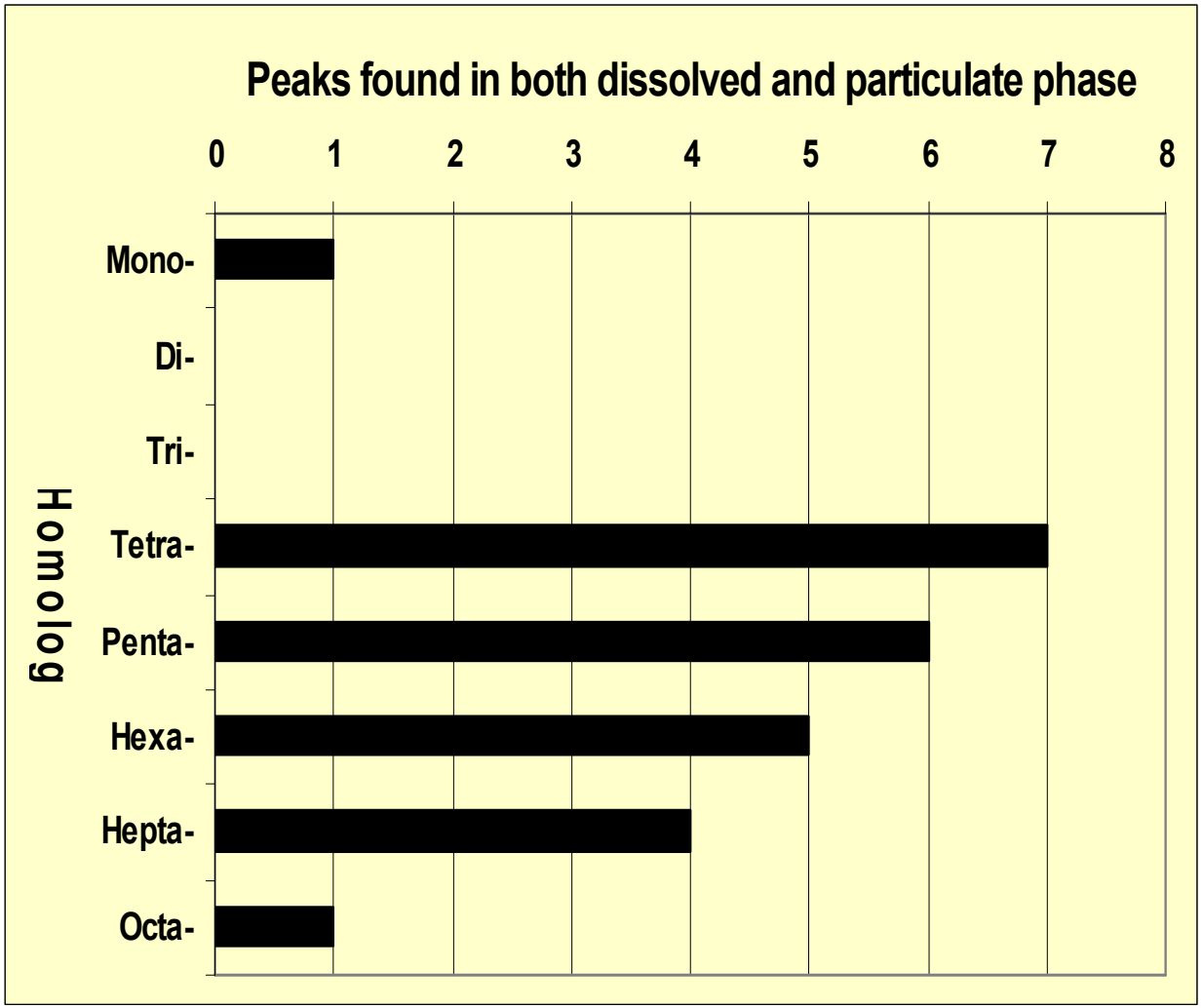

Particulate
Cumulative Concentration (ng/L)
Rank Order Congeners
0
1
2
3
4
0
10
20
30
40
50
60
70
80
90



•36 out of 85 Peaks were frequently (75% of 30 samples) detected in dissolved PCBs

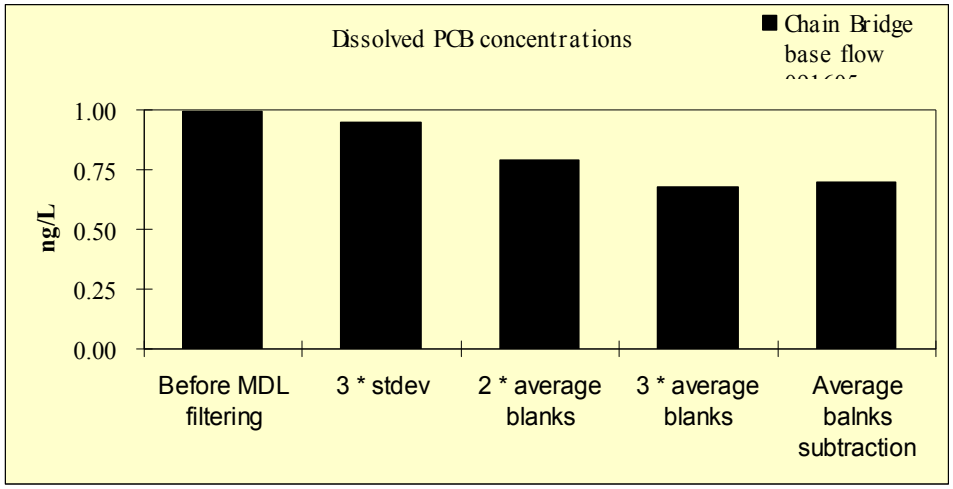


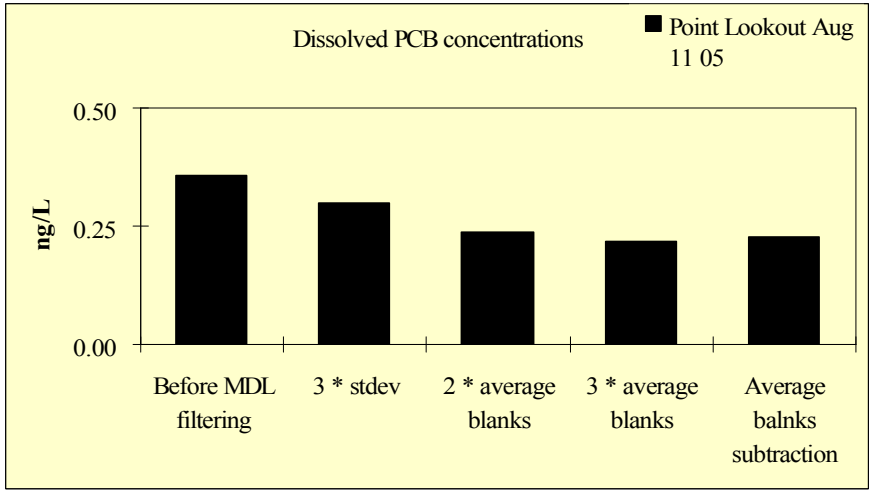
•47 peaks out of 85 in particulate PCBs

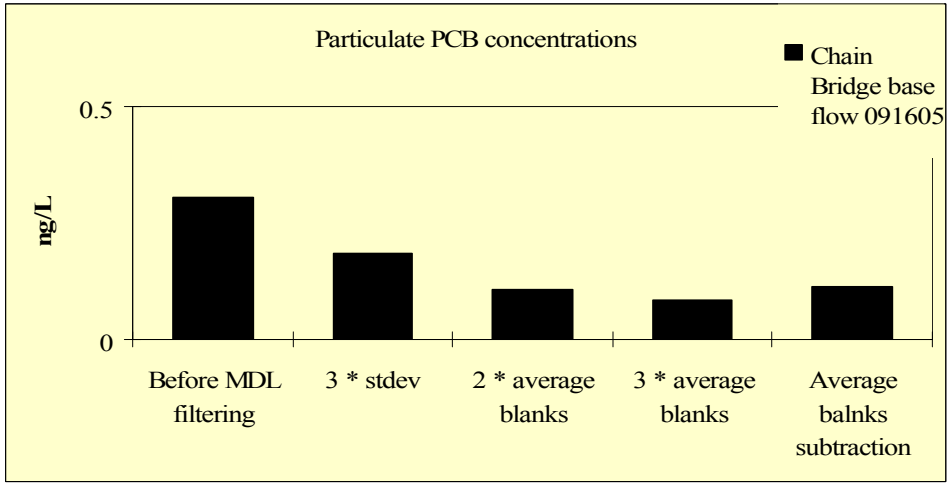

Peaks found in both dissolved and particulate phase
0
1
2
3
4
5
6
7
8
Homolog
Mono-
Di-
Tri-
Tetra-
Penta-
Hexa-
Hepta-
Octa-

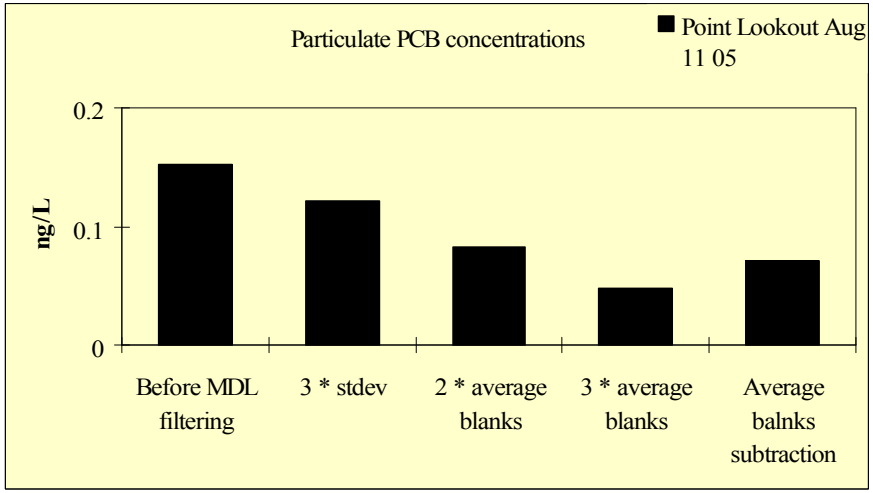
Correcting for Matrix Blanks

- Three times average blanks
- Two times average blanks
- Blank average subtraction
- Three times standard deviation


Dissolved PCB concentrations
Chain Bridge base flow
ng/L
1.00
0.75
0.50
0.25
0.00
Before MDL filtering
3 * stdev
2 * average blanks
3 * average blanks
Average balnks subtraction


Dissolved PCB concentrations
Point Lookout Aug 11 05
ng/L
0.50
0.25
0.00
Before MDL filtering
3 * stdev
2 * average blanks
3 * average blanks
Average balnks subtraction


Particulate PCB concentrations
Chain Bridge base flow 091605
ng/L
0.5
0
Before MDL filtering
3 * stdev
2 * average blanks
3 * average blanks
Average balnks subtraction


Particulate PCB concentrations
Point Lookout Aug 11 05
ng/L
0.2
0.1
0
Before MDL filtering
3 * stdev
2 * average blanks
3 * average blanks
Average balnks subtraction