Part 1:
Urban Toxicant Contaminant Removal by Stormwater BMPs in the Chesapeake Bay

TOXIC CONTAMINANT WORK GROUP
NOVEMBER 10TH MEETING
TOM SCHUELER, CSN

Presentation Outline

- Defining Urban Toxic Contaminants (UTCs)
- UTC and the TSS Removal Benchmark
- Overall Findings on UTC
- UTC Accumulation In BMP Sediments
- Key Findings for Individual UTCs
- Comment Process and Next Steps

CHESAPEAKE STORMWATER NETWORK

Urban Toxic Contaminant Criteria

- The toxin is primarily associated with urban land use, compared to other sectors in the watershed.
- The toxin is either generated within the urban sector or is deposited from the atmosphere onto impervious surfaces and subsequently washed off.
- Urban stormwater runoff is the predominant pathway for transporting the toxin in the watershed.
- The toxin has "sediment-like characteristics" and can be removed by settling or filtering practices.
- The toxin is generated or produced in an upland landscape position in the watershed where it can be effectively treated by an urban BMP that captures surface runoff.
- Physical evidence exists that the toxin is captured and/or retained within an urban stormwater BMP.

How do the UTCs meet the criteria ?

Toxin Category	1. urban land use?	2. urban sources ?	3. stormwater pathway ?	4. Sediment like behavior?	5. Upland Position ?	6. Urban BMP Capture or Retention?
PCBs	**Y**	Y	**Y**	**Y**	Y	Y
PAH	**Y**	**Y**	Y	**Y**	**Y**	**Y**
TPH	**Y**	Y	**Y**	**Y**	Y	**Y**
Hg	**Y**	Y	Y	**Y**	**Y**	Y
UTM	**Y**	**Y**	**Y**	M	**Y**	**Y**
OTM	**Y**	**Y**	**Y**	M	Y	Y
Dioxins	Y	Y	Y	Y	nd	nd

UTC and TSS Removal Benchmarks

- Linking UTCs to a benchmark TSS removal rate
- Allows users to project UTC removal rates based on known TSS removal rates
- Can calculate reductions based on much larger CBP database on sediment removal by urban BMPs

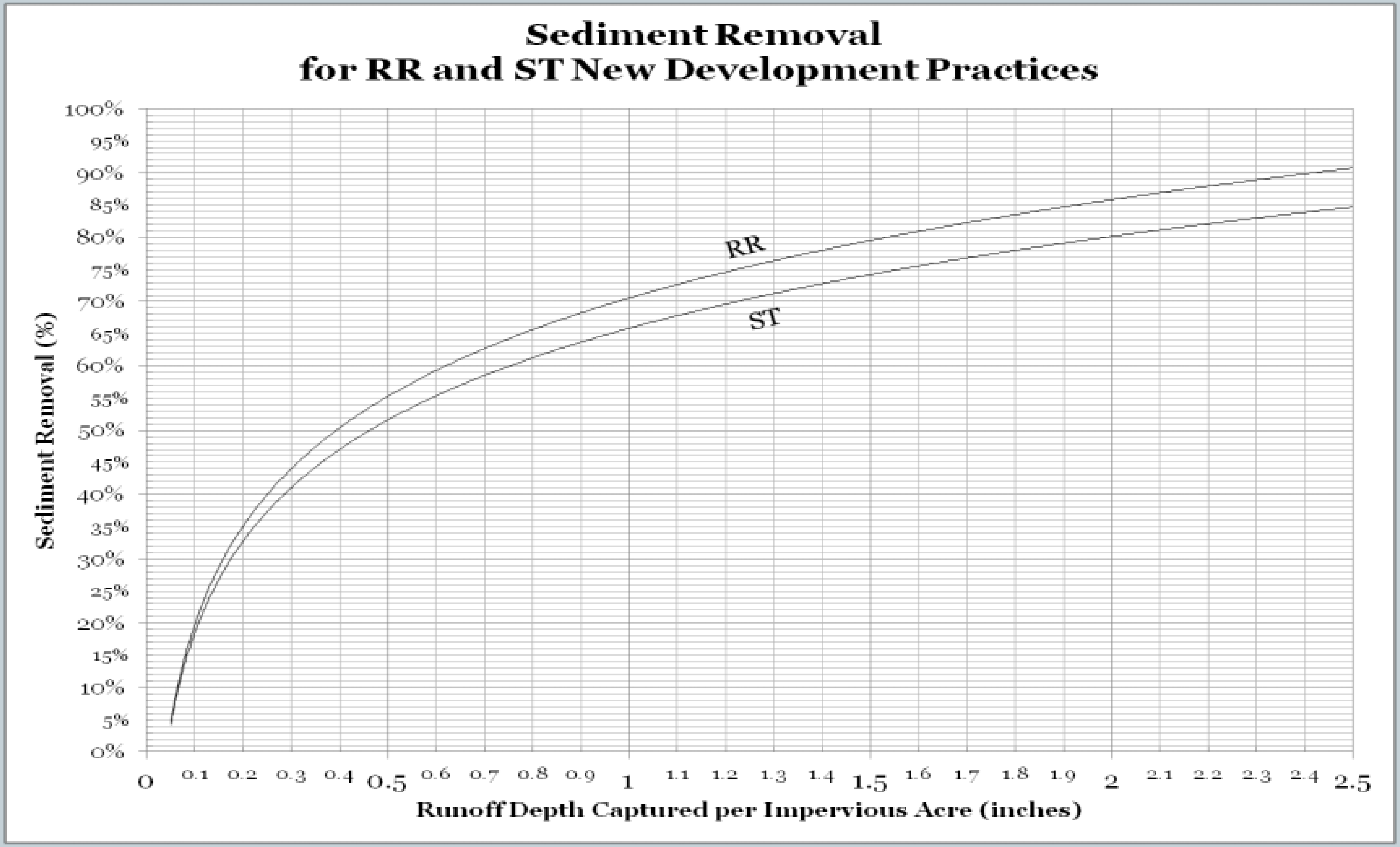
Suspended sediment and UTCs

- Share many characteristics
  - UTCs bind, adsorb or otherwise attach to sediment particles
  - UTCs are hydrophobic, have very limited solubility and often have a strong affinity for organic matter.
  - Both are also relatively inert, persistent, and not very bio-degradable.
  - Both are often associated with fine and medium-grained particles that are easily entrained in stormwater runoff.
  - Both are subject to high removal rates simply through gravitational settling in the water column and/or filtering through sand, soils, media or vegetation.

Approved CBP TSS Removal Rates for Urban BMPs

Urban Stormwater Practices		Removal
Stormwater Retrofits [2]		45 to 85%
New Runoff Reduction (RR) Practices [3]		45 to 80%
New Stormwater Treatment (ST) Practices [4]		40 to 75%
Wet Ponds		60
Constructed Wetlands		60
Dry Extended Detention Ponds		60
Infiltration		95
Filtering Practices (Sand Filters)		80
Bioretention	C & D w/UD	55
	A & B w/ UD	80
	A & B w/o UD	90
Permeable Pavement	C & D w/UD	55
	A & B w/ UD	70
	A & B w/o UD	85
Grass Channels	C & D w/o UD	50
	A & B w/o UD	70
Bioswale	aka dry swale	80
Urban Stream Restoration [5]		NA
Street Cleaning [6]		0 to 30
Enhanced Erosion and Sediment Control [7]		NA

More precise removal estimates using expert panel adjustor curves



Urban BMP Treatability for the 7 UTCs

Toxin Category	BMP Removal Rate?	Measured or Estimated?	Behaves like Sediment?	BMP Retention ?	Sediment Toxicity Concern?
PCBs	TSS	E	**Y**	Y	MOD
PAH	>TSS	E	**Y**	**Y**	HI
TPH	>TSS	M	**Y**	**Y**	MOD
Hg	>TSS	E	**Y**	**Y**	MOD
UTM	< TSS	M	Y	Y	MOD
OTM	< TSS	M	Y	Y	MOD
Dioxins	< TSS	E	Y	?	?

Comparative Ability of Urban BMPs to Remove Selected Trace Metals

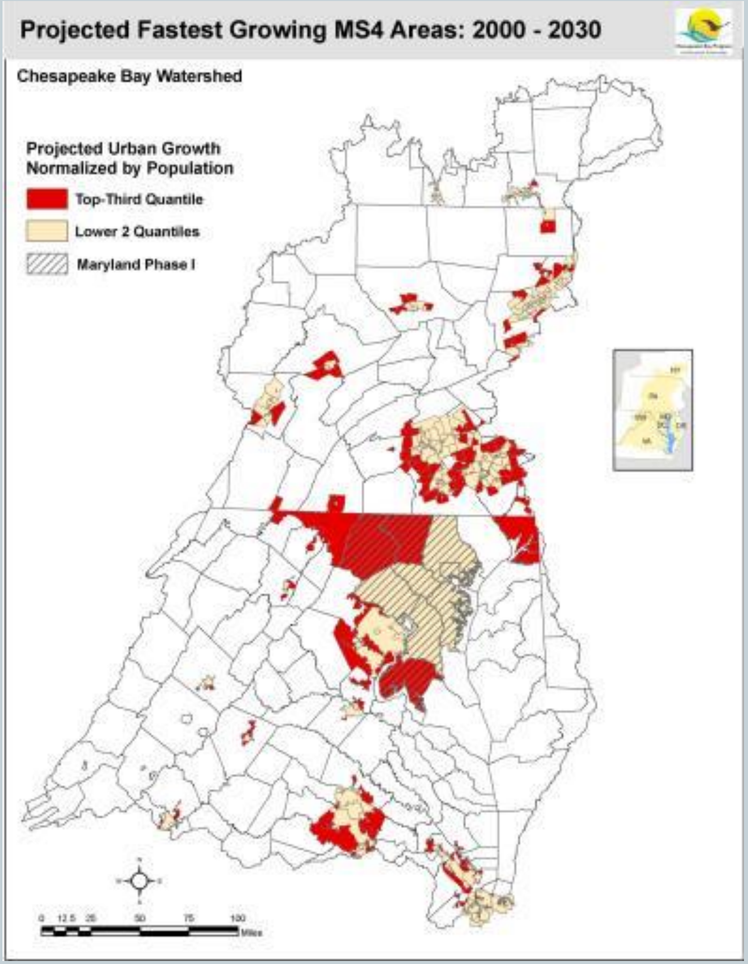
Stormwater BMP	Urban Trace Metals			
	Cadmium	Copper	Lead	Zinc
Bioretention	H	VH	VH	VH
Wet Pond	M	H	H	H
Wetland	M	H	M	M
Sand Filter	H	M	VH	H
Permeable Pavement	L	M	VH	VH
Dry Swale	L	H	--	VH
Grass Channel	M	L	L	M
Grass Filter	L	M	L	M
Dry Pond	L	L	M	M

VH: Very High Removal (76% to 100%)
H: High Removal (50% to 75%)
M: Moderate Removal (26% to 50%)
L: Low Removal (0% to 25%)

Overall Findings for All 7 UTCs

- Highest UTC levels are generated in older urban watersheds, especially those with extensive industrial, commercial or high ADT transport land uses.
- Target TMDL stormwater retrofits in subwatersheds with clusters of UTC hotspots to maximize toxin reductions.

Urban BMP Coverage in Bay Watershed



- Based on CBWM inputs, urban BMPs now cover 30% of urban land
- BMP coverage could increase to 40 or 50% by 2025 due to TMDL compliance in the urban sector
- UTC removal by nearly all urban BMPs is moderate to very high

Key Conclusion

- Existing BMPs are preventing a significant fraction of toxic contaminants from reaching the rivers and estuaries of the Chesapeake Bay and has been doing so for several decades now.
- A precise estimate of annual UTC removal is not possible, but a rough estimate is that BMPs are reducing UTCs by about 25% now and perhaps as much as 40% by 2025
- Bay TMDL is a key strategy in UTC reduction across the Bay watershed

Further Reduction Due to Pollution Prevention Practices ?

- No data to evaluate the impact of pollution prevention practices in reducing UTCs required under industrial and municipal stormwater permits.
- The potential effect of these practices could be considerable, as more than:
  - 2,700 industrial sites have stormwater permits in Bay watershed (25,000+ acres of impervious cover)
  - 1,000 MS4 facilities and public works yards are subject to the same regulations.
- Attach modest numerical TSS reduction requirements in the next generation of industrial and municipal stormwater NPDES permits to trigger greater UTC reduction?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UTCs and Watershed Lag Times

- Environmental benefits of the UTC reductions may not be fully realized for several decades
- Long lag time between when UTCs are first deposited on watershed surfaces or soils and cycle through the stream network to ultimately reach the Chesapeake Bay.
- Researchers suggest long lag times for the following UTCs
  - PCBs
  - PAH
  - Hg
  - UTMs
  - OTMs
  - Dioxin?
  - Also DDT and Chlordane

UTC Accumulation In BMP Sediments

- Persistent UTCs accumulate in BMP sediments over many decades at levels that trigger sediment toxicity guidelines.
- As many as 8 UTCs have pose a risk for sediment toxicity: PCB, PAH, Hg, Ni, Cr, Cu, Cd, and Zn
- Most research on older stormwater pond sediments

Managing the BMP Sediment Toxicity Risk

- Are BMP sediments an acceptable place to trap toxics in the urban landscape ?
- Where is the **next** place that sediments should go when they are cleaned out from BMPs ?
- Is UTC sediment accumulation only a concern for older stormwater ponds in highly urban/industrial watersheds ?
- Should we also be concerned about UTC accumulation in newer BMPs (e.g., bioretention) in all urban watersheds
- What is the **real** risk to aquatic life and human health in the stormwater pond environment versus the LID environment ?

Not a Bad Place, After All ?

Toxicity risk to aquatic life in the stormwater pond environment may be limited:

- Simplified food webs and low species diversity reduce bio-accumulation in urban fish and wildlife tissues.
- Not much of a benthic community in pond sediments
- Ponds appear to be effective at retaining UTCs over time
- Not clear whether UTCs are also high in other non-BMP sediments (e.g., urban creeks, rivers and estuaries).
- Extremely limited fish consumption from ponds and recreational contact with sediments is non-existent

New LID practices (e.g., bioretention) do not create aquatic habitat and removal of surface sediments is frequent

Managing Sediments in the Post-Stormwater Pond Phase

How we manage pond sediments during the sediment cleanout and disposal phase appears to the biggest risk

More research is needed to define:

Which types of ponds are the greatest risk ? (e.g., age, contributing land use, surface area or other factors).

Where in the landscape can the sediments be safely disposed ? (e.g., fill, mix w/ bio-solids, landfill, etc.) ?

Other UTC Management Strategies

- Past bans and/or product substitution efforts (lead, PCB, DDT)
- New bans and product substitution (coal tar sealant for PAH, brake pads and rotors for UTMs, more sustainable roofing materials for UTMs)
- Recycling and disposal (batteries, thermostats fluorescent light bulbs).
- Targeted street cleaning at older watersheds and industrial sites

Review Process for Part 1 Memo

- Request technical review by November 30
- Especially looking for comments on:
  - Implications for management of BMP sediments
  - Missing research, especially from Bay watershed
  - Research that does not corroborate or refutes the key findings
  - Other UTC management strategies that should be considered
- Send to Tom @ CSN @ watershedguy@hotmail.com

Questions and Answers

Part 2 Memo

- Emerging Toxics of Concern
  - Pharmaceuticals
  - Household and personal care products
  - Flame Retardants
  - Biogenic hormones
- Current and Legacy Pesticides
- Draft scheduled for completion by mid-December