

# Consideration of Leaf Litter as part of a Nutrient Management Strategy

Urban Tree Canopy Stakeholder Forum

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# Outline

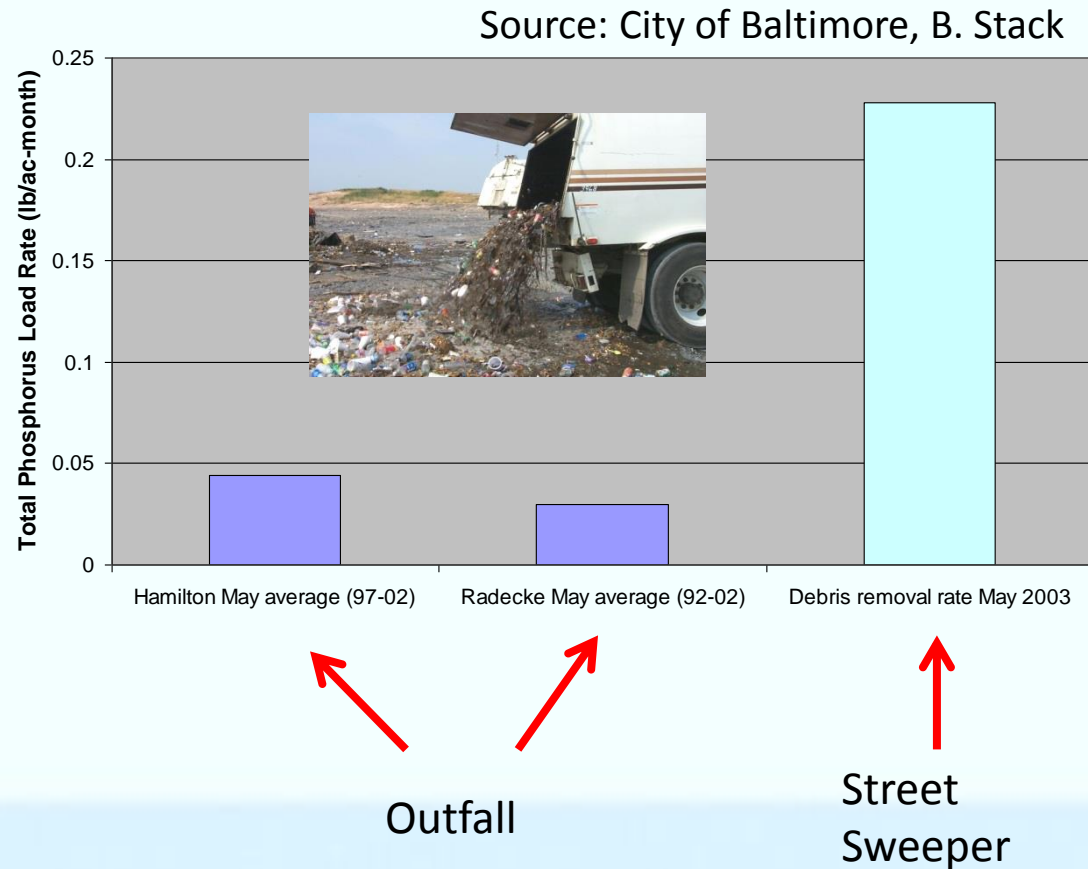
- Emerging topic of stormwater management research  
*(why do we care?)*
- Leaf litter in urban watersheds & streams
- Nutrient management
- Conclusions

**Trees are good.  
We need more.**



# Upland vs Outfall Nutrient Loads

- City of Baltimore street sweeping study, 2003
  - The material removed by street sweeping is not fully accounted for through outfall monitoring efforts
- Nutrient accounting for urban watersheds suggest a “missing load”



# Gross Solids aka the “Missing Load”



Litter



Organic Debris



Coarse Sediment

- Surface water monitoring equipment (automated samplers) limited ability to collect this material

*What is the nutrient contribution from gross solids, specifically organic debris?*

Much if it ends up in the stream



Photo: MWCOG 2009

# Fate of Leaf Litter in Urban Catchments: Upland



# Fate of Leaf Litter in Urban Catchments: In-stream

## Urban Stream Syndrome

- Consistently observed degradation of urban streams
- Altered hydrology flush material downstream
- Biologic condition may impair a stream's capacity to process and remove excess N
- Denitrification in urban streams may be carbon limited, not nitrogen limited (Newcomer et al 2014)

# Gross Solids Research Findings

*In urban catchments, there is a steady supply of leaf litter from upland areas aka “gutter subsidy”*

- 75 – 97% material collected by nets is leaf litter (Stack et al. 2013, MWCOG 2009, Rushton 2006)



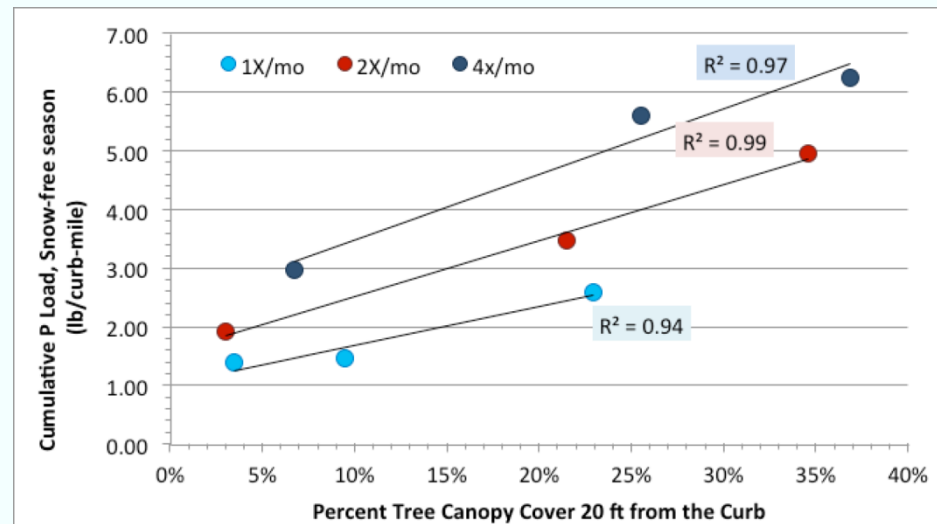
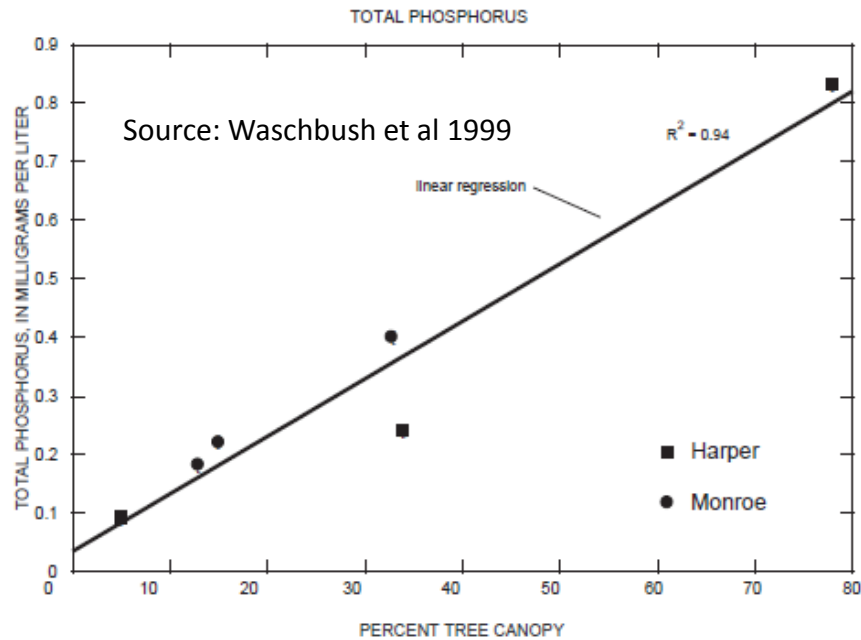
Photo: MWCOG 2009



Easton, MD. Photo. CWP 2013.

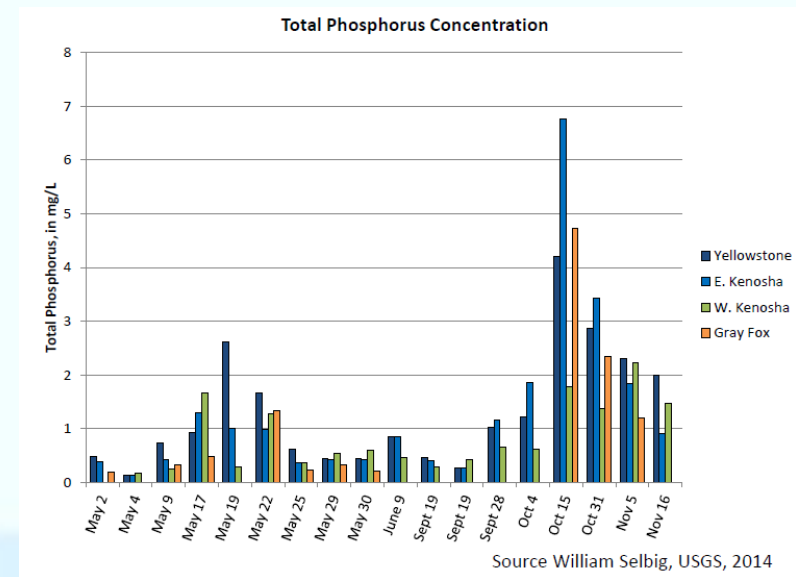






Source: Kalinosky 2013

- Increase in P loading in residential areas with higher tree canopy
- Coarse organic material accounts for up to 67% TP and 91% TN of nutrient load from street sweeper (e.g., Kalinosky et al. 2013)
- 30% TP load of residential street dirt from leaves (Waschbusch 1999)
- Seasonal pulse in Fall and Spring



- Rapid loss of P as leachate once immersed
- Hobbie et al 2013 found 27 to 88 percent of initial P in 24 hour lab studies via leaching
- Others found similar losses (Wallace et al 2008, Dorney, 1986, Ostrofsky 1997)
- Leaves become increasingly recalcitrant with loss of nutrients (slows microbial decomposition)



Photo Credit: Ken Belt



Photo Credit: Stu Schwartz

# Quantifying the Gutter Subsidy

~85% reduction or loss of nutrients

→ Upland  
→ Outfall  
Catch basins & storm drains

		TN (lb/ac/yr)	TP (lb/ac/yr)	Method
Upland	Nowak (2014)	28.8	2.95	City of Baltimore tree biomass based on USFS methods, amount of leaf material and literature values
Outfall	Stack et al (2013)	4.7	0.36	Whole leaf analysis of leaf litter collected at outfall, dry weight
Catch basins & storm drains	TBD	?	?	

# Nutrient Management

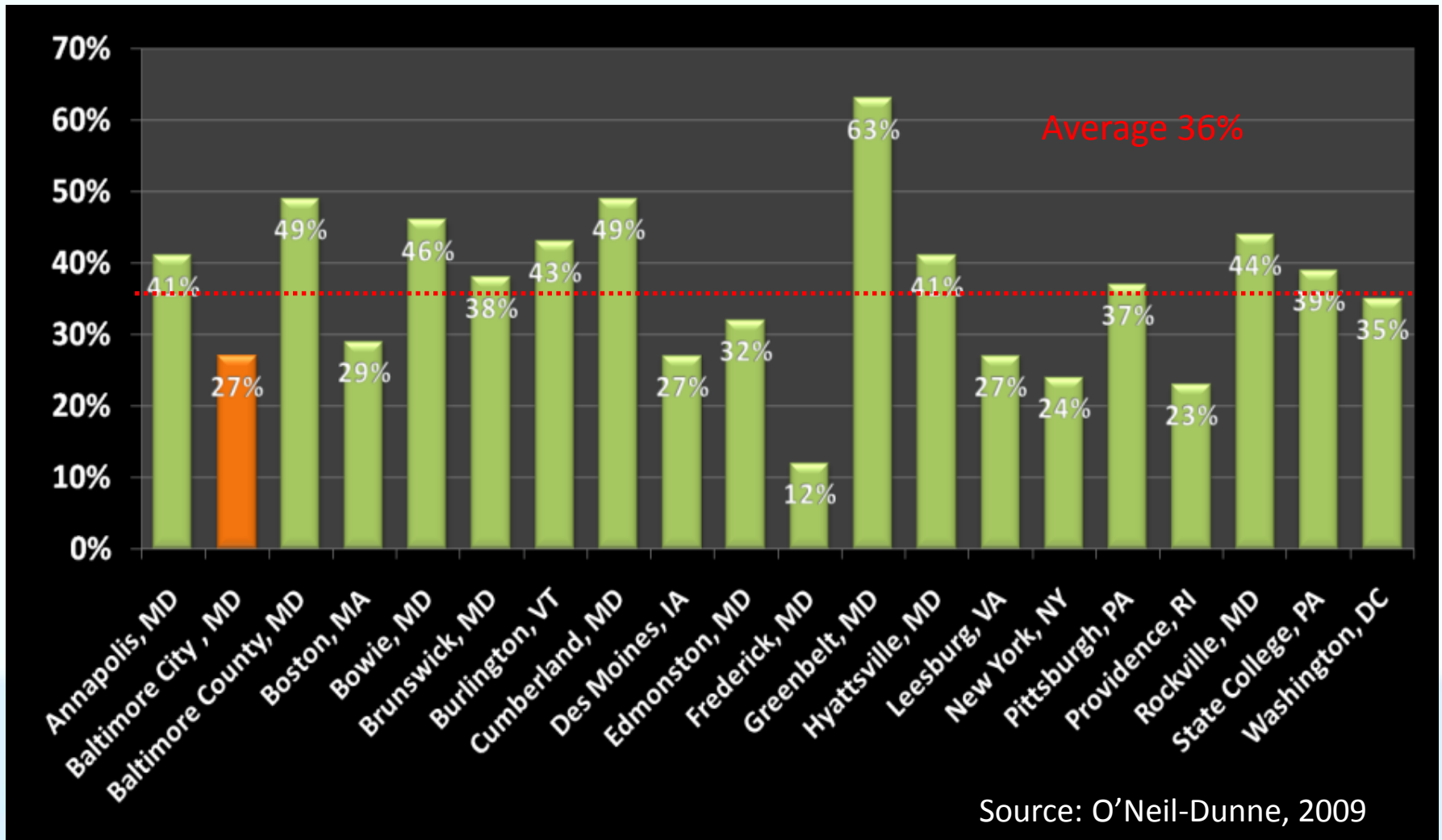
- The need to balance benefits of urban tree canopy cover with potential implications on water quality (amount, delivery)
- Street sweeping and net filters are cost-effective nutrient reduction practices compared to other structural practices
- Methods to estimate the benefit are based on 'best available' science
  - Whole leaf analysis , PSD, leachate
  - Nutrients and carbon affect in-stream processing
  - Bioavailability, microbial preferences...species specific

# Conclusions

- A lot of leaf litter collected in curb and gutter, then washed into storm drains and streams
- Leaf litter contributes to elevated nutrient concentrations in stormwater runoff; significant nutrient loading of street sweeper material
- Loss and transformations along & within urban drainage network
- Consideration of nutrient loadings from leaf litter on urban tree canopy credit

Thank you

# Estimated Urban Tree Canopy in the Chesapeake Bay Watershed



Source: O'Neil-Dunne, 2009