# Tree Canopy Land Uses and Pollution Benefits

Water Quality Goal Implementation Team

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Chesapeake Bay Program

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# CBP Policy on Tree Canopy:

- Since 2003, it has been the policy of the Chesapeake Bay Program partners to increase urban tree canopy cover for water quality and other benefits
- This was reaffirmed and strengthened in the 2014 Chesapeake Bay Agreement Tree Canopy Outcome
- Forestry Workgroup urges including Tree Canopy land uses in Phase 6 of the watershed model

# WHY TREE CANOPY LAND USES IN PHASE 6?

- Urban tree canopy is the preferred land cover for water quality in developed areas, yet its benefits are not directly accounted for in the CB Model
  - Implication: Retaining tree canopy has no “value” in the TMDL framework, whereas Forest, Open Space, and other preferred land uses do
- Improves the ability of jurisdictions to track and manage tree canopy changes over time, towards meeting watershed goals
  - Important for TMDL as well as Bay Agreement Tree Canopy Outcome
- Tree Canopy meets the criteria for Land Uses:
  1) can be mapped
  2) has loading rates specific to that land use;
  3) has distinct best management practices associated with the land use

# Progress since August 10 WQGIT Discussion

- Sept 4 – Expert Panel provided Technical Memo and Literature Synthesis supporting recommended loading rates for Oct 1 calibration
- Sept 11 - Forestry Workgroup approved loading rates
- Sept 15 - Presented to Urban Stormwater Workgroup, comments received from jurisdiction representatives 9/22; posted FWG responses to comments
- Most responding jurisdictions supported TC land uses, provided there is time for modeling and Expert Panel questions to be addressed before final calibration decision (MD, DC, PA, WV)

**Key Questions Raised:**

1. Mapping
2. Effect on other loading rates
3. Science of loading rates

# TREE CANOPY: HAS BEEN MAPPED

- Tree Canopy has been mapped in three classes in preparation for the Oct. 1 Phase 6 Model calibration
  - Tree Canopy over Impervious (Developed)
  - Tree Canopy over Turf (Developed)
  - Tree Canopy over Open Space (Natural)
  - *Three classes necessary because loading rate differs based on underlying land use*
- Oct 1 Calibration Land Uses – combination of regional NLCD Tree Canopy data and local high resolution data in some areas
  - Tree Canopy covers 4% of Bay watershed (1.6 million acres)
  - ~51% of TC is over turf grass, 37% over open space, 11% over impervious
  - 90% of TC over impervious is over roads
- Final 2016 Calibration Land Uses will be refined considerably by high resolution data

Land Use Workgroup Chair Memo discusses methodologies for mapping and hindcasting Tree Canopy land uses; comparable accuracy to other land uses in model

# TREE CANOPY: EFFECT ON OTHER LOADING RATES

- Sector aggregate loads stay the same
- Within sector loads, loading ratios adjusted to include Tree Canopy
- Worked to address USWG concern of “double counting” the effect of tree canopy in the loading ratios

Olivia Devereux has provided Developed Land loading ratios that incorporate Tree Canopy land uses and adjust other loading rates to address double counting (see slides on WQGIT meeting page)

# TREE CANOPY – LOADING RATES

## Expert Panel - Review of the Science

- A total of 73 publications were reviewed by the Expert Panel
- Majority focused on hydrologic benefits
  - Interception
  - Evapotranspiration
  - Infiltration
  - Runoff Reduction
- Limited information on water quality and urban tree canopy

# INTERCEPTION value--
# Based on 24 Studies of Urban Forests

**Table 1. Rainfall Interception Studies of Urban Trees**

| Study | Location | Interception (% of annual rainfall)[1] | Species/Condition[2] | Type of Study |
|---|---|---|---|---|
| Wang et al. 2008 | Baltimore, MD | 18.4 | Tree canopy in Dead Run subwatershed | Modeling |
| Band et al. n.d. | MidAtlantic | Accotink 14.5%<br>Gwynns Falls: 15.7%<br>Rock Creek 19.6% | | Modeling |
| Xiao et al. 1998 | Sacramento County, CA | 11.1 | Tree canopy in the County | Modeling |
| Xiao et al. 2000 | Davis, CA | 15<br>27 | Pear (D)<br>Oak (E) | Measured |
| Xiao and McPherson | Oakland, CA | 14.3<br>25.2 | Sweetgum (D)<br>Gingko (D) | Measured |

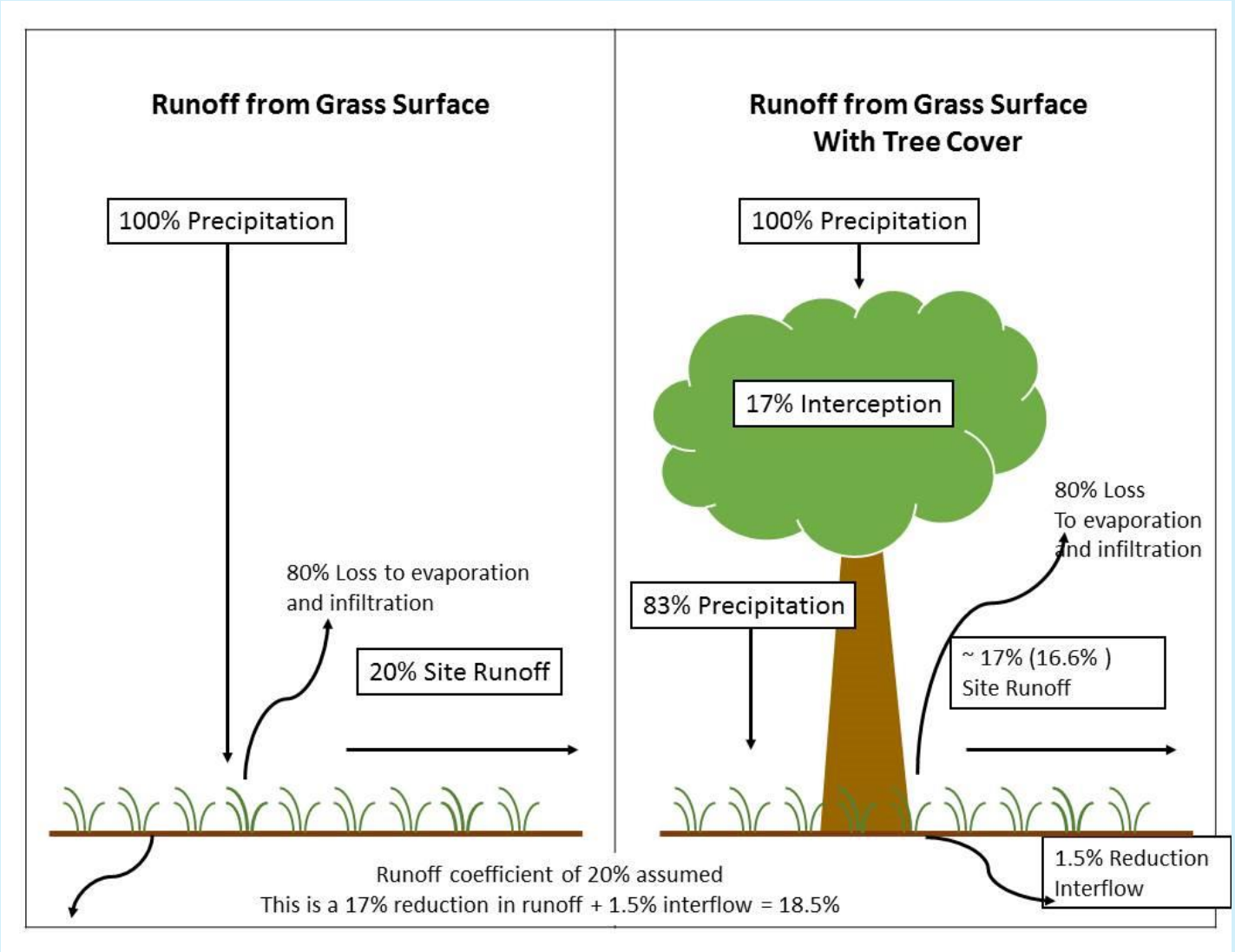
- *Emphasis on key studies in Mid Atlantic – 17% average*

# Runoff Reduction/Pollutant Load Reduction Connection

**Runoff reduction** is defined as the relative difference in runoff volume from an area with tree canopy compared to runoff volume from the same area without tree canopy

- Assumption: pollutant loads are reduced proportional to a reduction in runoff volume
- Examples of other models that use this assumption:
  - Simple Method
  - Runoff Reduction Method
  - i-tree suite of tools
- It is recognized that individual storm events (precipitation, seasonality) along with other site specific and tree characteristics, will have an effect on runoff production. Focus on studies with annual time step

METHOD: Compare the runoff reduction with and without using a simple mass balance approach for a site




Method and graphic modified from Herrera (2008)

# Recommendation for relative loading rate for tree canopy land use

Relative Loading Rate for Tree Canopy Land Use

- Accounting for interception & evapotranspiration for underlying landcover based on precipitation and surface runoff
- Transpiration loss from subsurface flow
- Results in the relative loading rates of

  - TP and TS = 17%
  - TN = 18.5%

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# Forestry Workgroup Recommends:

- Include Tree Canopy land uses and recommended loading rates in Oct 1 calibration
  - Allows for partnership to review model outputs with TC incorporated

- Final Expert Panel report should go through full CBP review and approval process
  - Allows for questions to be addressed by Panel and refinements to be made if needed before final 2016 calibration