Using OM: The Gutter Subsidy, Organic Matter Dynamics, and GSIs

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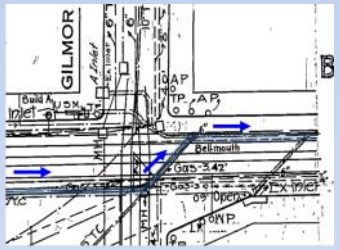
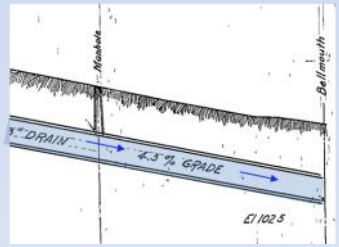
US Forest Service

STAC: Peculiarities of Perviousness
The Effect of Tree Canopy on Urban Land
Annapolis, MD
April 22-23, 2014

UMBC
UMCP





What is OM: DOC & POM?

(i.e., Organic Matter is dissolved or particulate)

Dissolved Organic Carbon (DOC)

Fine POM 0.0007 to 1 mm (FPOM)

Coarse POM (1 mm or more)

Coarse Woody Debris

Litter and Trash

K Belt Photos

Urban RO: POM & DOC…
Huge Fluxes & Processing

Baisman Run, storm, Ivy Hill Rd.

Dead Run, Colonial Dr.

K Belt Photos

Urban: Diverse, large Sources of OM

Biofilm, Hydropsychid Nets
Dead Run, Baltimore

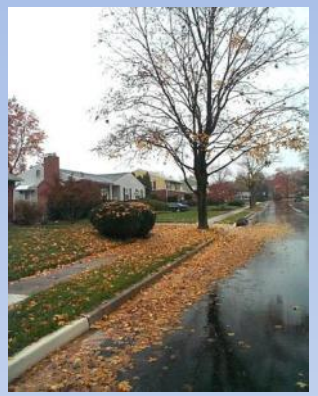
Catch basin Cleanout
NURP Baltimore Study

Full catch basin in WS263
West Baltimore City

Surcharging sanitary sewer
manhole, Gwynns Falls

- **Leaves (leachate, FPOM)**
- **grass clippings, etc.**
- **Animal waste**
- **Sewage**
- **Garbage**
- **Stream biofilms**
- **Etc.**

Why is OM Important ?

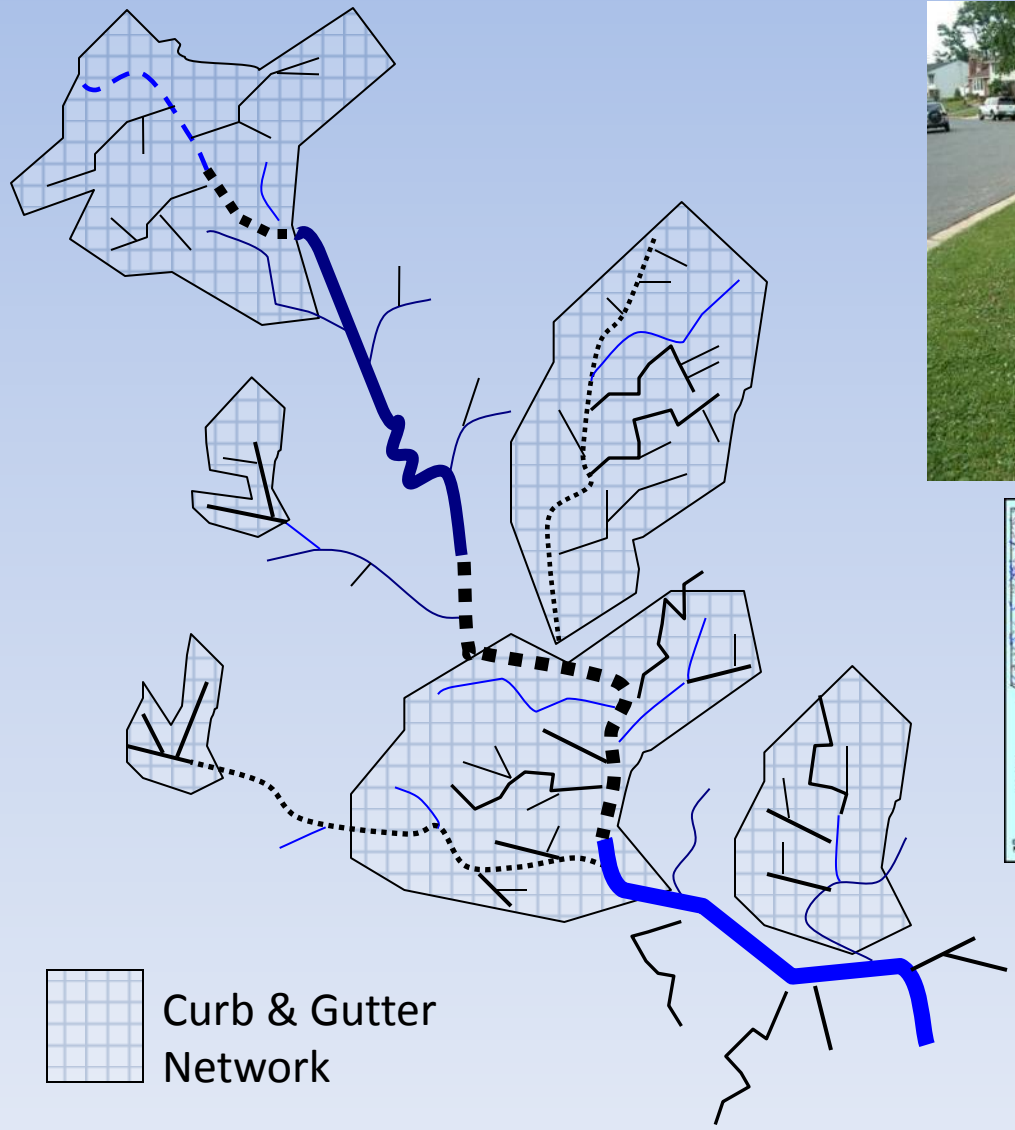


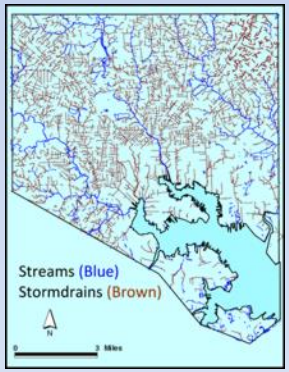
Diptera: Tipula sp.

- **Food source** (growth, microbial functions) and habitat (leaf packs)
- Urban landscapes are **important exporters of carbon** (i.e., OM and associated N & P)
- **Many Linkages** (Carbon/Nitrogen ratios. BGC processes, microbial ecosystem function, e.g., denitrification, metal binding, disinfection by-products, DO demand)

The “Gutter Subsidy”

Mega Drainage Density & Endless Zero order “streams”



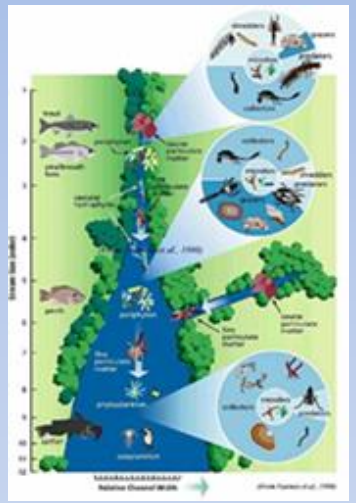


Map: Baltimore City DPW

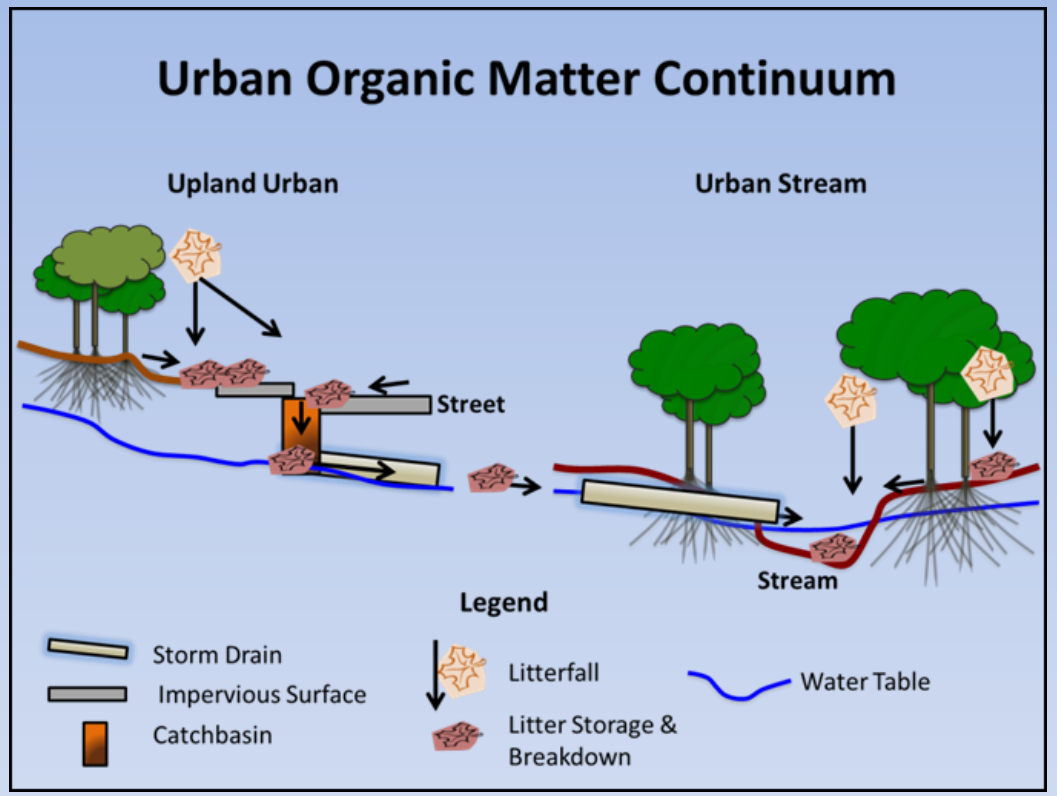
Large “Leaf Loads”

K. Belt Figure, Photos

A Tale of 2 Stream Continuums



The River Continuum

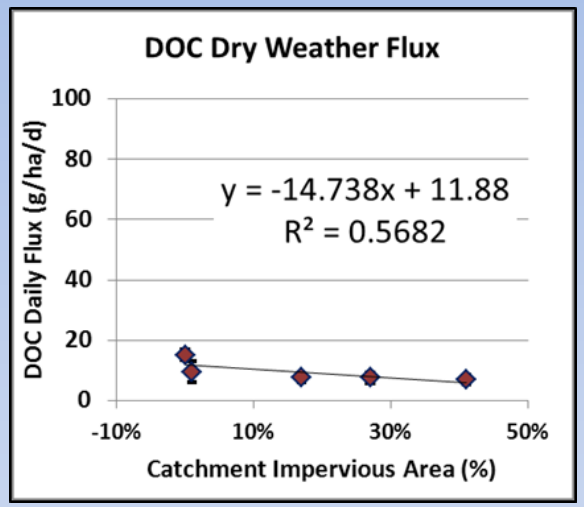


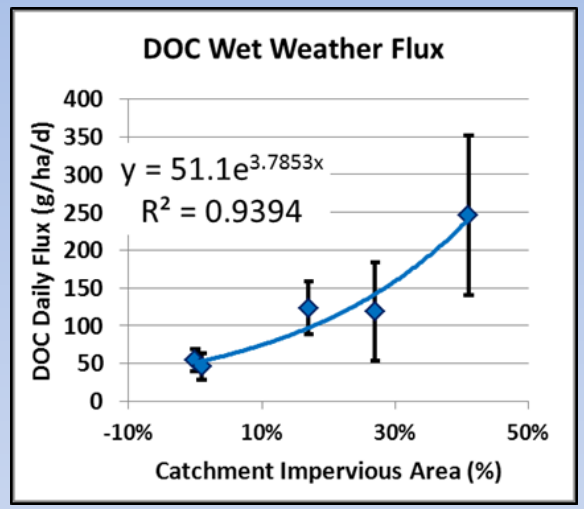
K Belt Figure

The Upland Urban Stream Continuum

Dissolved Organic Matter (DOC)

Storm Drains as Tile Drains?



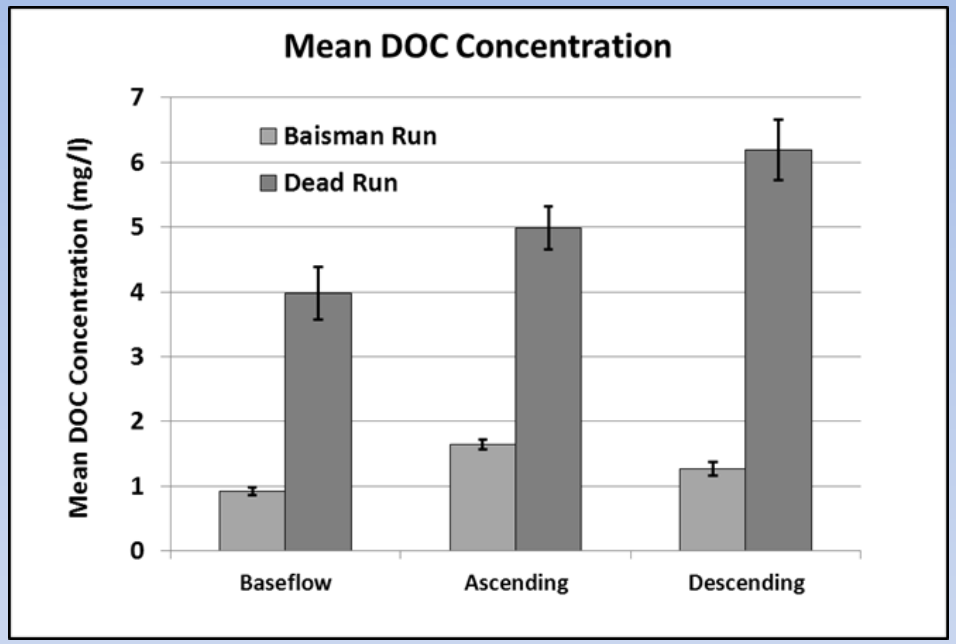


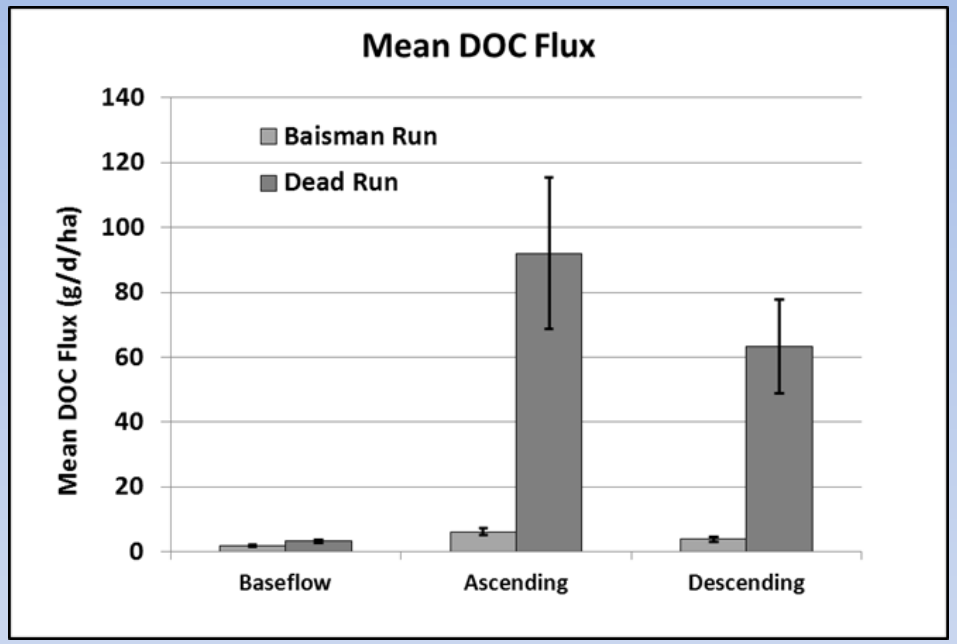
Urbanization Increases Flux with Elevated Flows

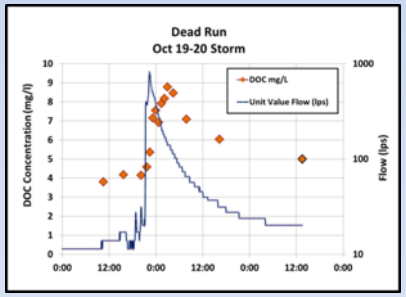
(DOC concentration increases with Flow)

Real Storms: DOC Concentration and Flux

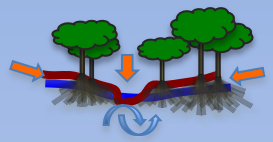
Urban vs. Forest





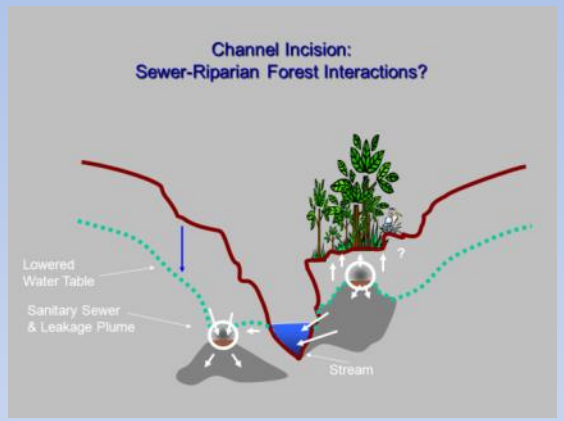


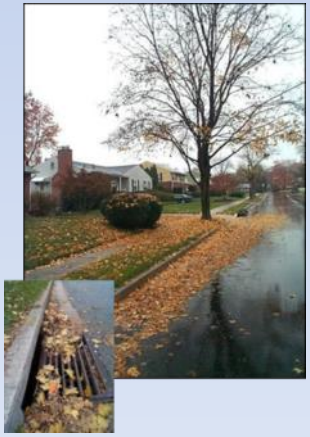
- Urban: Much higher concentrations & fluxes
- Even in descending flows

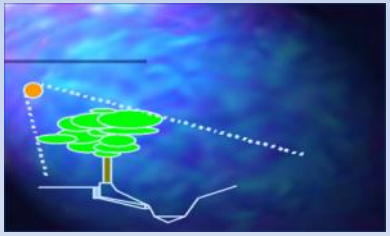


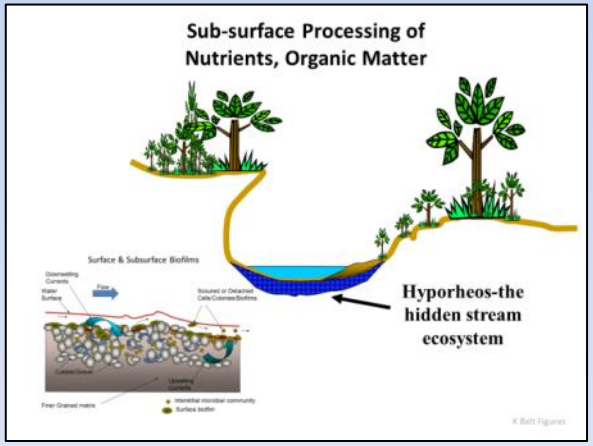
Many OM Questions

- Carbon
- Thermal
- Biogeochemistry
- Waste wood
- Transpiration
- Interception



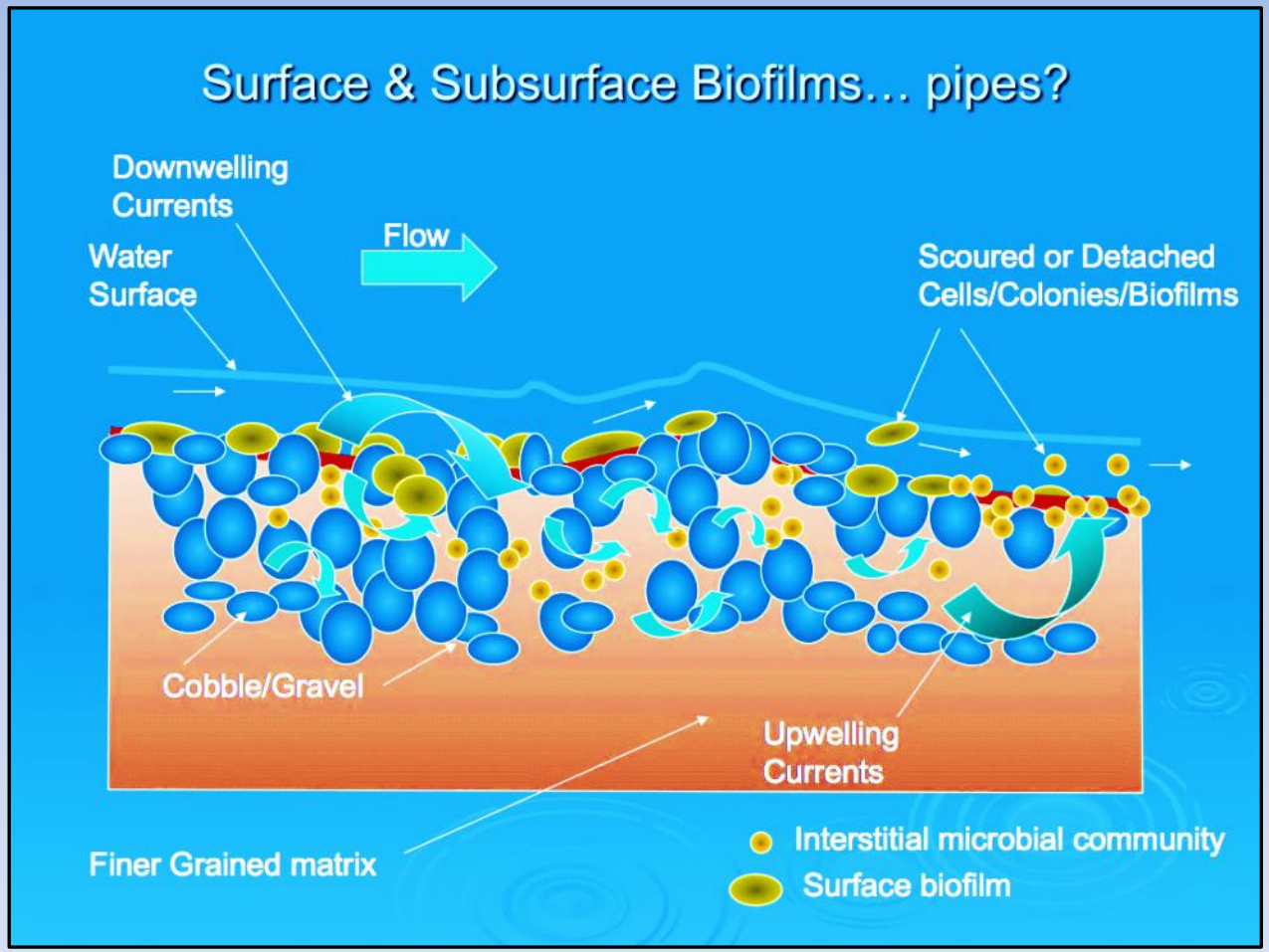






K Belt Photos, Figures;
Bio Ret Photo, PG Co DEP

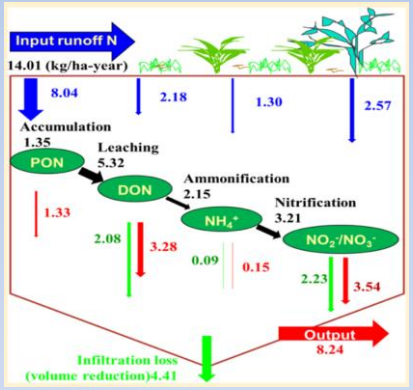
OM for Microbial Processes… GSIs(?)



K. Belt Figure

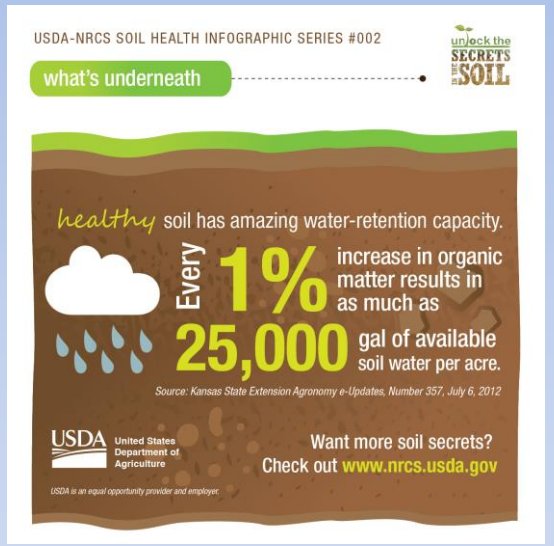
Urban Watershed Mgt: OM, N, P, TSS…
Lots of GSI design elements and choices…. E.g, …

Leaching… Microbiological Processing?



Li, L. and A. P. Davis (2014). "Urban Stormwater Runoff Nitrogen Composition and Fate in Bioretention Systems." Environmental Science & Technology 48(6): 3403-3410.

Water Retention Capacity



USDA NRCS

Urban Watershed Mgt: OM, N, P, TSS…
The basic ecohydrological decision..
Based on designing flow paths:

Maximal Hydrologic Retention (biological processing)

Vs.

Rapid infiltration (RO volume control)

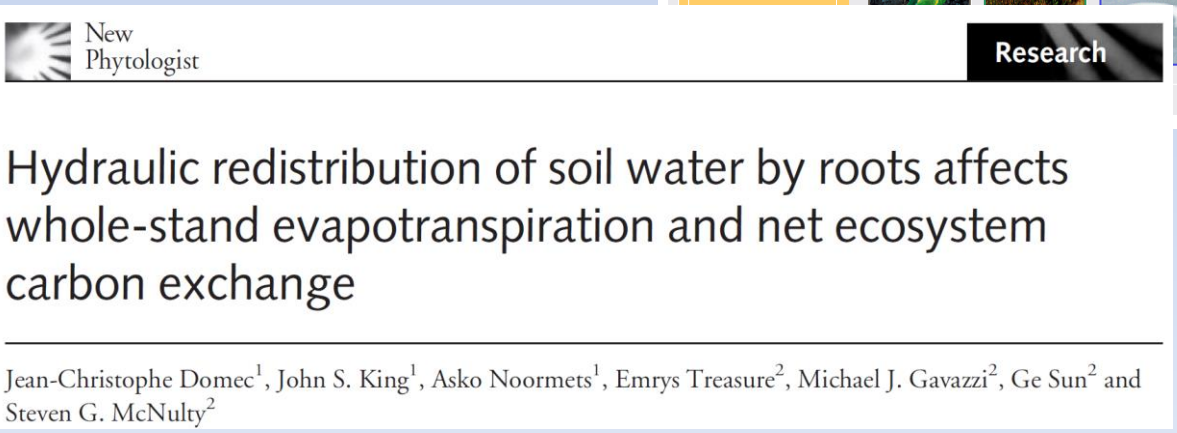
Modeling: OM, N, P, TSS…
The basic ecohydrological decision:

Maximal Ecohydrologic Complexity

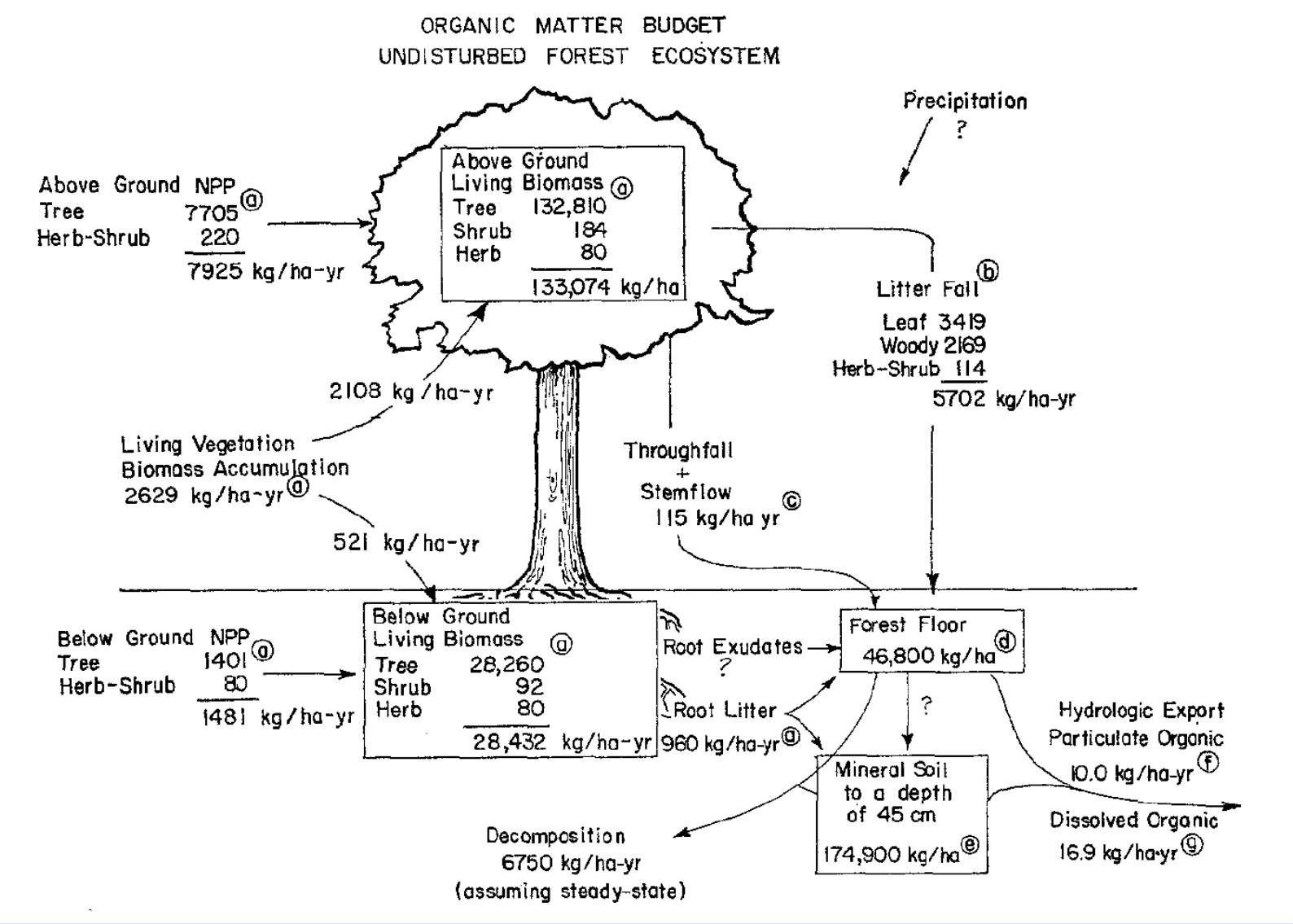
Vs.

GSI Design & Mgt. Guidance

Modeling… need an ecohydrological approach … looking for input, suggestions

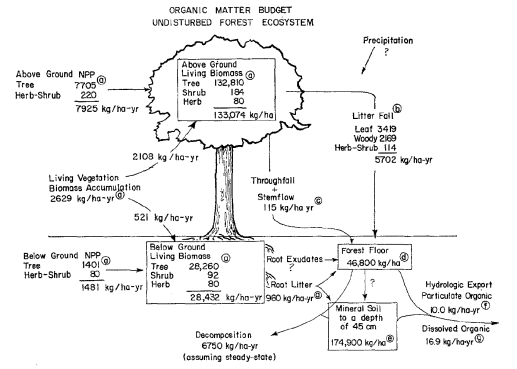


Lots to Consider… There is a lot to Forest-soil ecosystems



Gosz 1979

Opportunity… especially in GSI "ecosystems"



New: Put the "Green" into GSIs:

- GSIs: trending to smaller, upland "facilities"
- Small storm hydrology dominates
- Opportunity for longer residence times
- … more time for "biology" to play a role

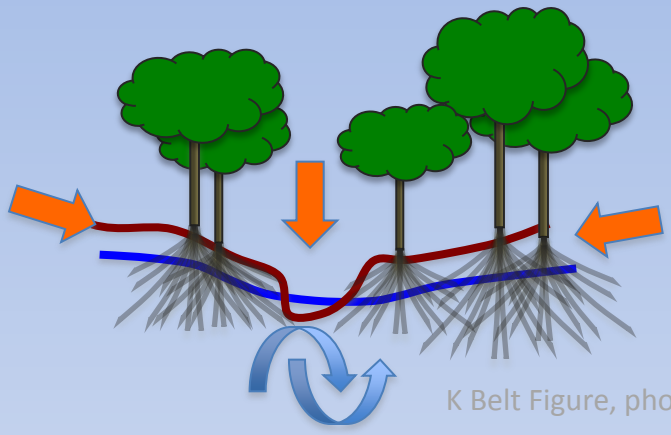
A new kind of "Designing with Nature"?

- Can we design forest ecosystems into GSI? … i.e., not just "recreating" one component of "natural" hydrology
- Hyperfunctional agro-forestry?
- Ecosystem Processes: e.g., denitrification, hydraulic redistribution, ET, etc.

Organizing frameworks:

- The Urban Watershed Continuum (flowpaths..)
- Ecohydrology (biology rules..)
- Systems Ecology (e.g., soil ecosystems)

How can ecohydrological science inform urban watershed mgt?



K Belt Figure, photo

K. Kallaugher, Baltimore Sun