

Stormwater Runoff: Nuisance or Asset?

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Roanoke River Watershed Open House

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Emerging Challenges in the Arena of Water Management

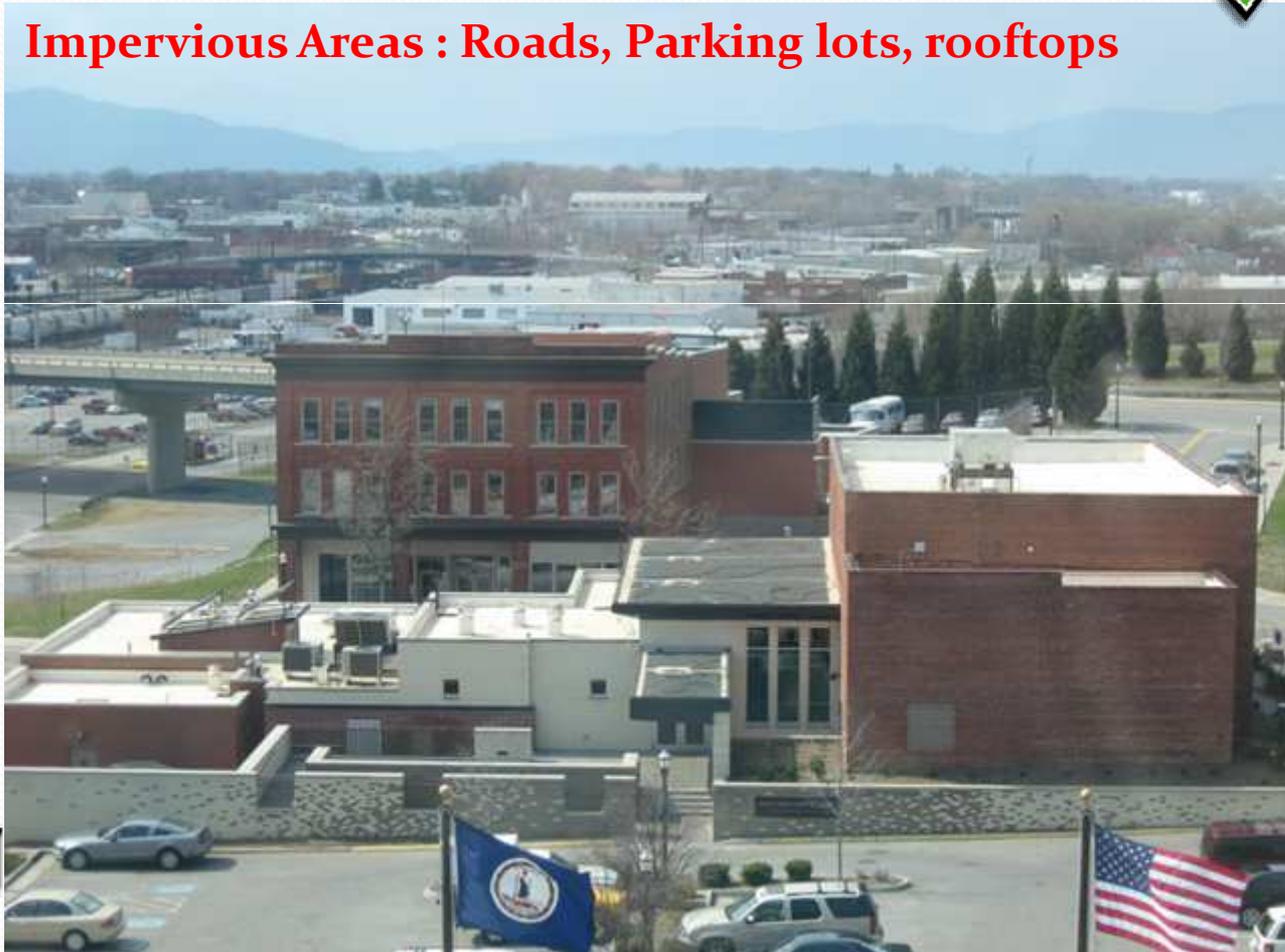
- Emerging contaminants in natural waters and drinking water systems
- Deteriorating and/or inadequate water infrastructure
 - Drinking water treatment/distribution systems
 - Wastewater treatment/discharge systems
 - **Stormwater runoff**
- Water and energy nexus
- Climate change and its impact on water resources & water infrastructure

Stormwater Runoff

Rainfall



Impervious Areas : Roads, Parking lots, rooftops



Runoff



Building Rooftops

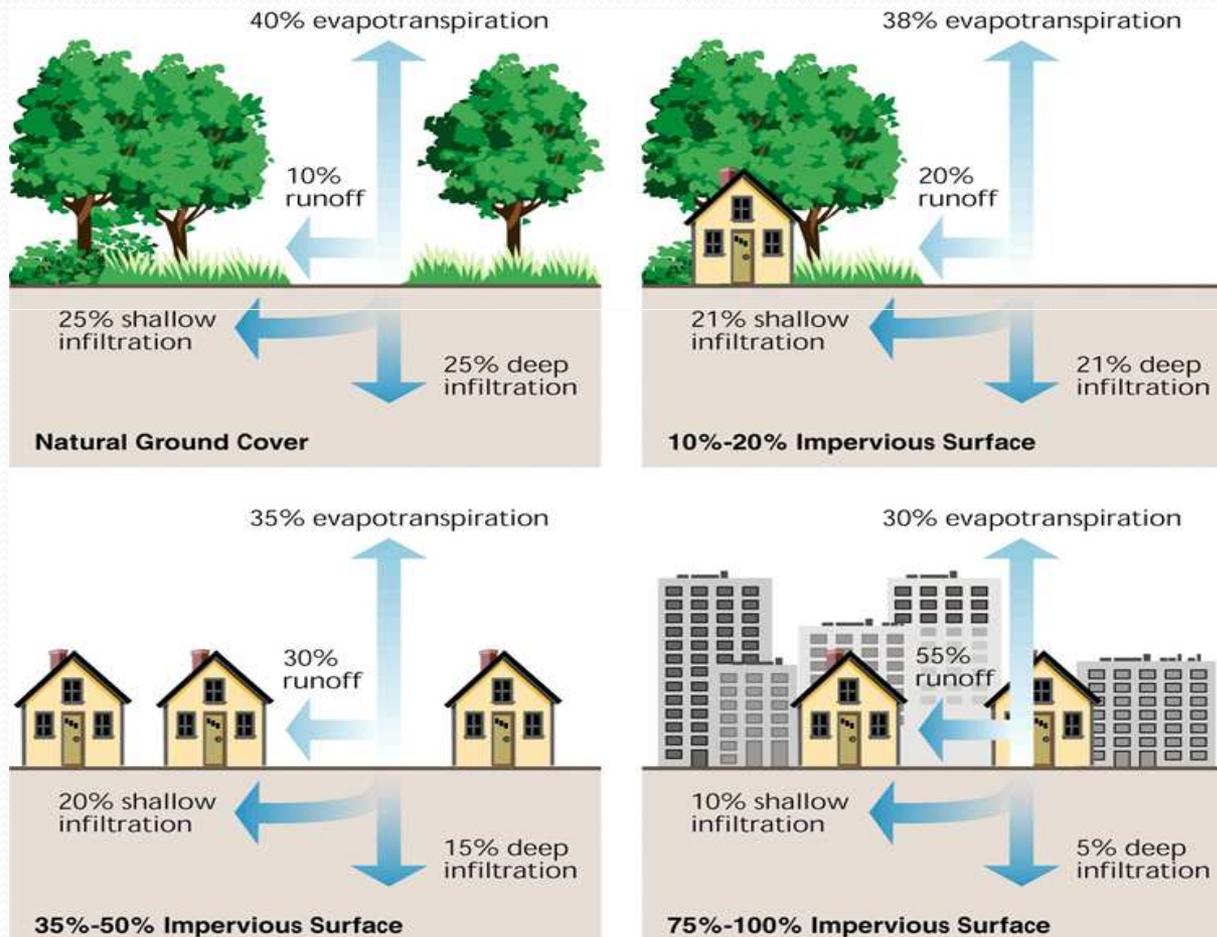
Rooftop areas constitute **30-40%** of impervious areas in urban settings.

The rooftop impact on stormwater runoff is significant!



www.science.tamu.edu

The Impact of Impervious Surfaces on Natural Water Flow



Source: Stream Corridor Restoration, 1998

Runoff from impervious surfaces moves via drainage network to stream, rivers and lakes



A Wasted Resource



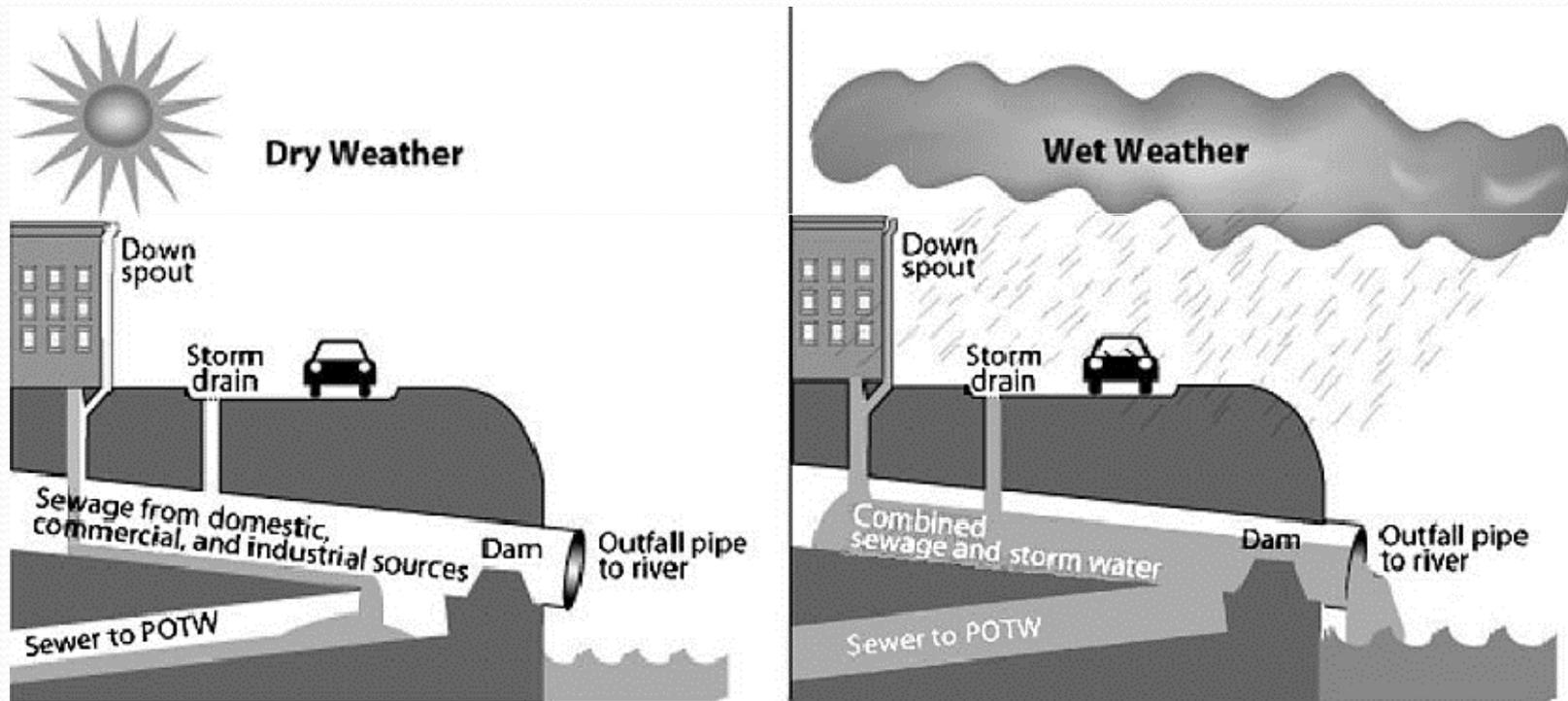
Stormwater Runoff: Ecosystem Consequences

The stormwater runoff contains many contaminants that enter streams/rivers/lakes:

- Metals - particularly zinc, copper and lead
- organic compounds including pesticides, fungicides, hydrocarbons in oil and grease, etc.
- Sediment
- Nutrients (N, P)
- Pathogens

Major Reason for the TMDL (total maximum daily load) Program for surface waters

Stormwater Runoff: Management Combined Sewer System (CSS)



CSS Overflow

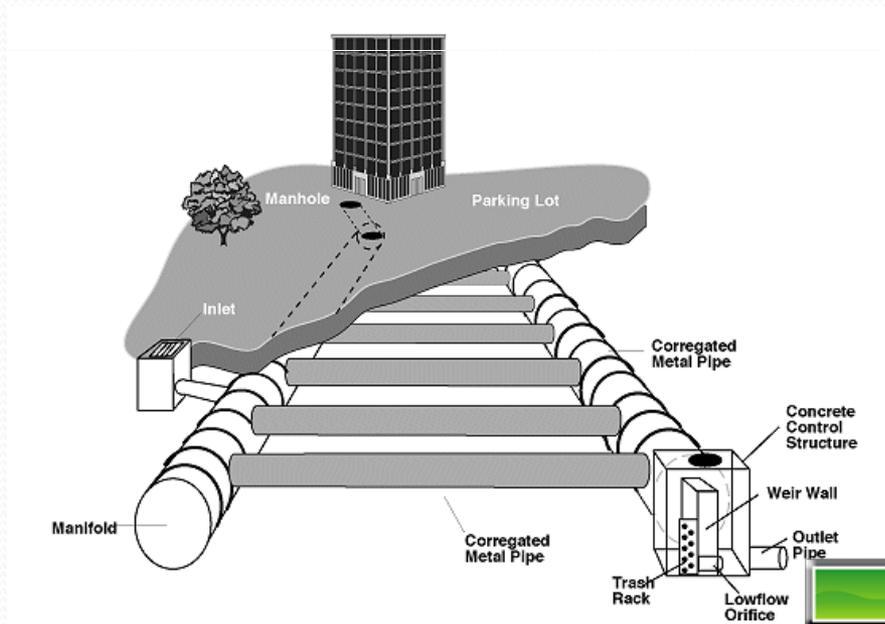
Municipal Separate Storm Sewer Systems (MS4)

- Designed to collect and transport stormwater (includes storm drains, pipes, ditches, etc.)
- Not a combined sewer system
- Not part of a Publicly Owned Treatment Works (sewage treatment plant).
- Owned by a state, city, town, village, or other public entity that discharges to waters of the U.S

Conventional Stormwater Runoff Management

The conventional stormwater BMPs are temporary water storage facilities: they do not sufficiently address water quality impacts of urban stormwater runoff

Underground Storage



Typical Underground Stormwater Storage System: Source: Montgomery County, MD

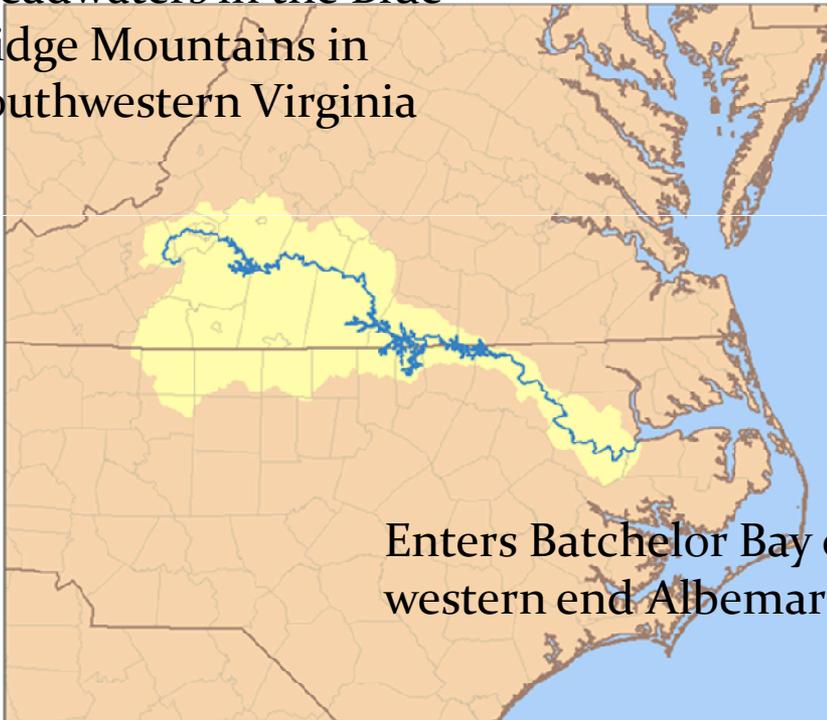
Wet Pond



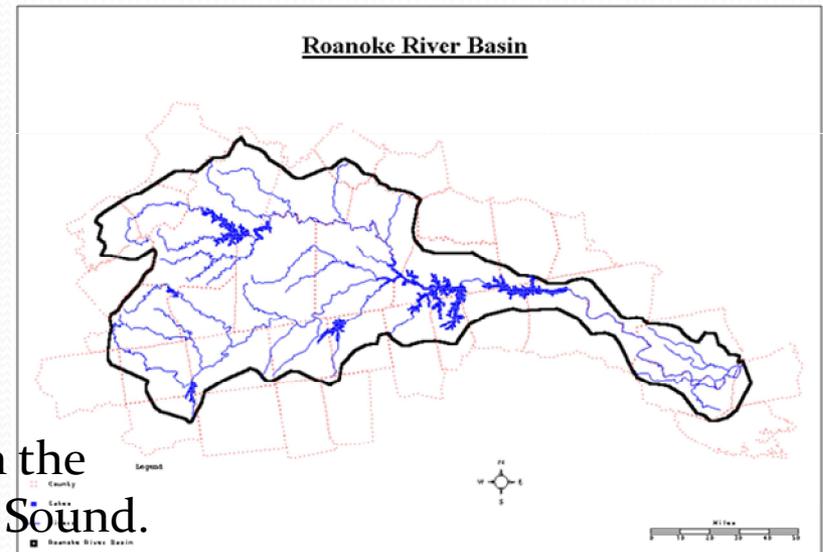
Source: <http://www.roanokecountyva.gov/gallery.aspx?AID=2>

The Roanoke River Watershed

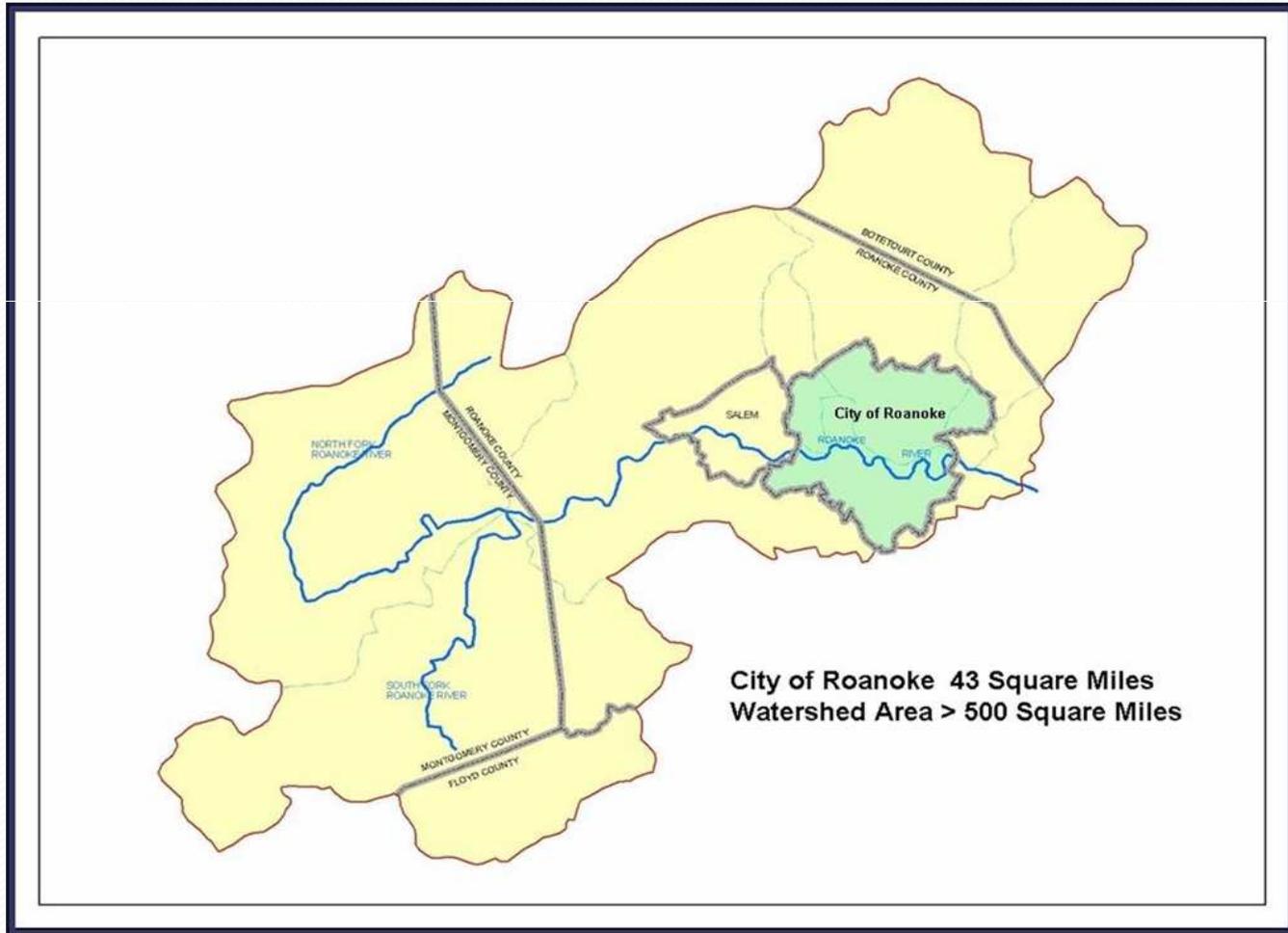
Headwaters in the Blue Ridge Mountains in southwestern Virginia



Enters Batchelor Bay on the western end Albemarle Sound.



Runoff Impact on Roanoke River



City of Roanoke

- **Total area** = 43 Square Miles or 27,520 acres (**11,137 ha**)
 - (source: Roanoke City)
- **Estimated impervious area** = 7,595 ac (**3,073 ha**) or **28%**
 - (source: Roanoke City)
- **Average annual rainfall** = 42.5 inch (3.54 ft.) (**108 cm**)
- Approximate runoff volume from impervious areas = 1156 million cubic-ft. – (**32.74 million cubic-meters**)
down to stormwater drainage and the river –
the wasted resource

Potential Water Quality Impact

Assuming that 80% of 1156×10^6 cubic-ft. enter the surface waters:

Runoff Volume = 925×10^6 cubic-ft.

According to scientific literature typical stormwater runoff contains 10^{-4} mg/L of copper

Copper Load to Surface Waters =

runoff volume x copper concentration

= 259 Kg/year or 571 pounds/year

Paradigm Shift

Think of stormwater runoff as an asset!

Possible uses of locally generated runoff

- Non-potable uses: flushing toilets, landscape irrigation, car wash
- Food production in urban settings – community gardens, fountains
- Groundwater recharge

Implement Low Impact Development Technologies

Low impact development (LID) technologies reduce runoff volume/rate, increase infiltration and ground water recharge

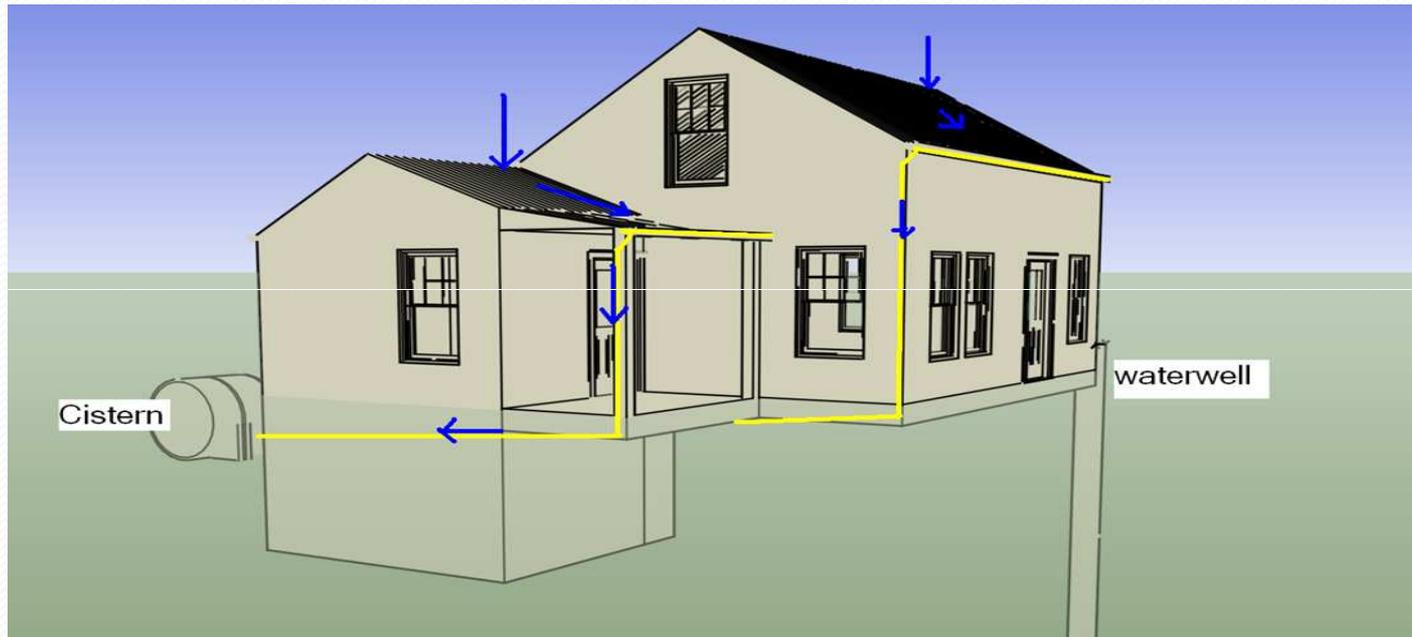
LIDs are decentralized water infrastructures, small to medium-scale technologies, that use locally generated rainwater (stormwater runoff).



Typical Low Impact Development (LID) Approaches for Stormwater Management

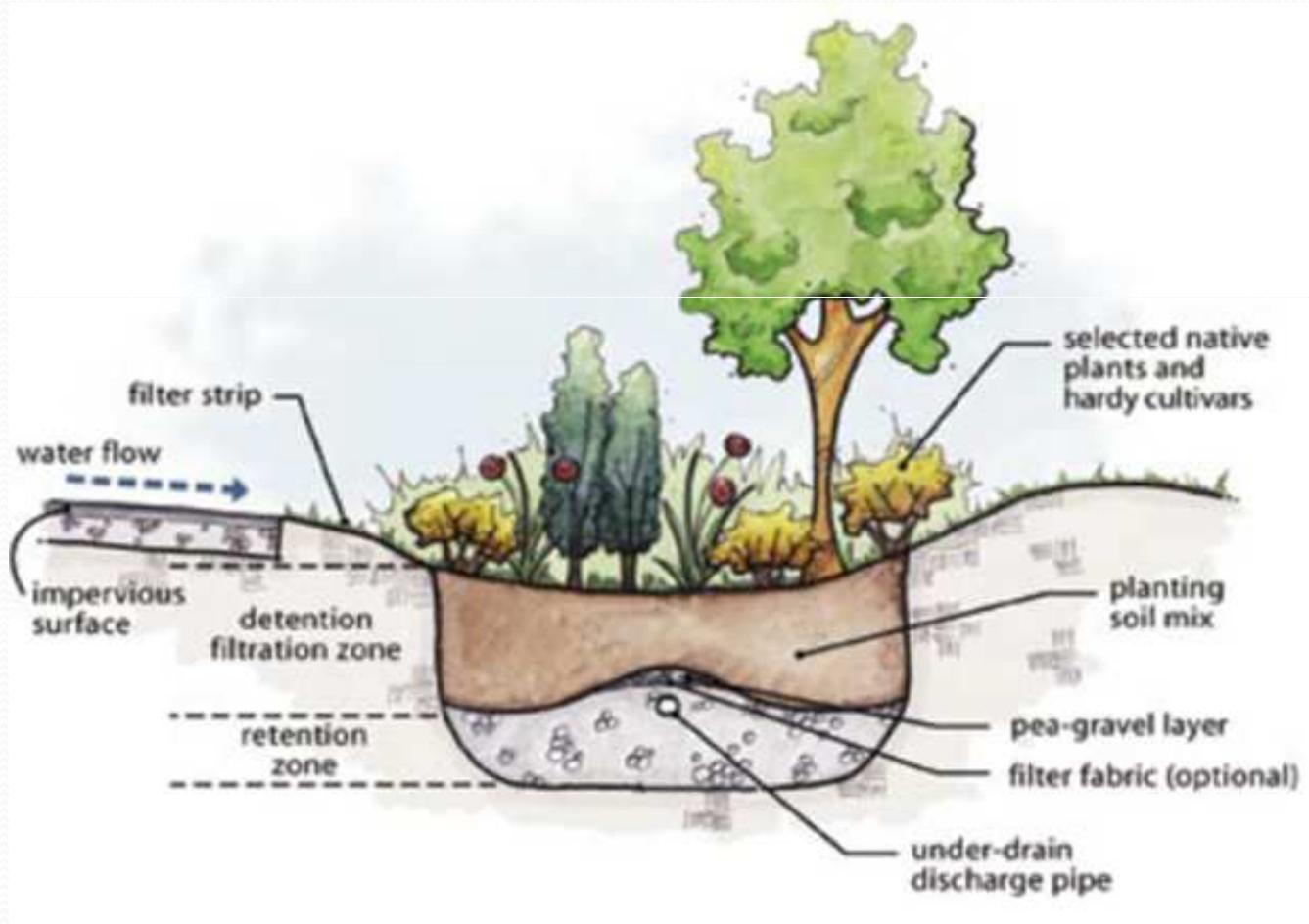
- Bio-Retention System (Rain gardens)
- Pervious Pavement
- Rooftop Rainwater Harvesting Systems
- Green Roofs

Rainwater Harvesting: Rainwater Capture and Use

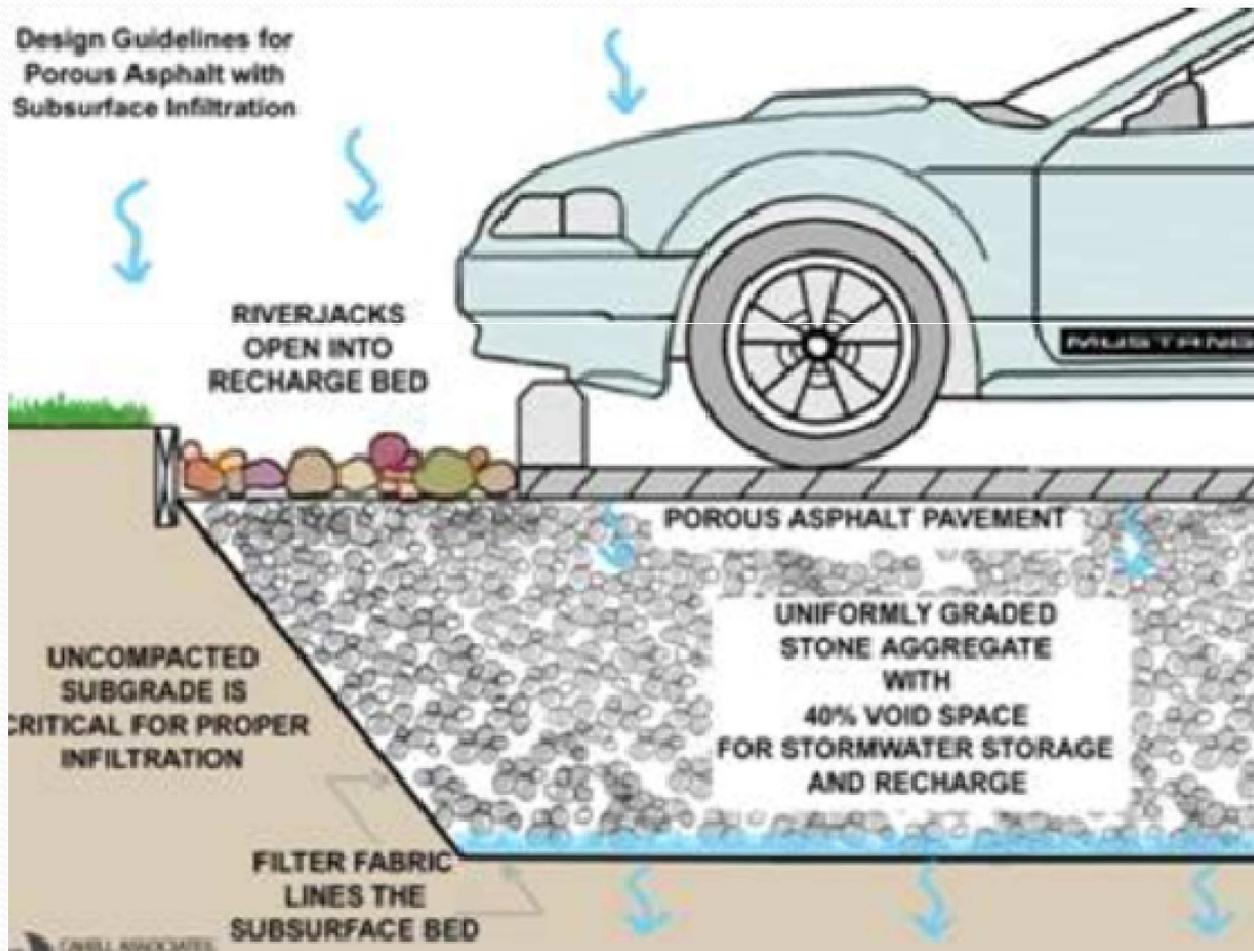


1,000 sq. ft. rooftop area can collect 620 gallons of water per 1 inch of rainfall

Bio-Retention Systems (Rain Gardens)



Porous Pavements



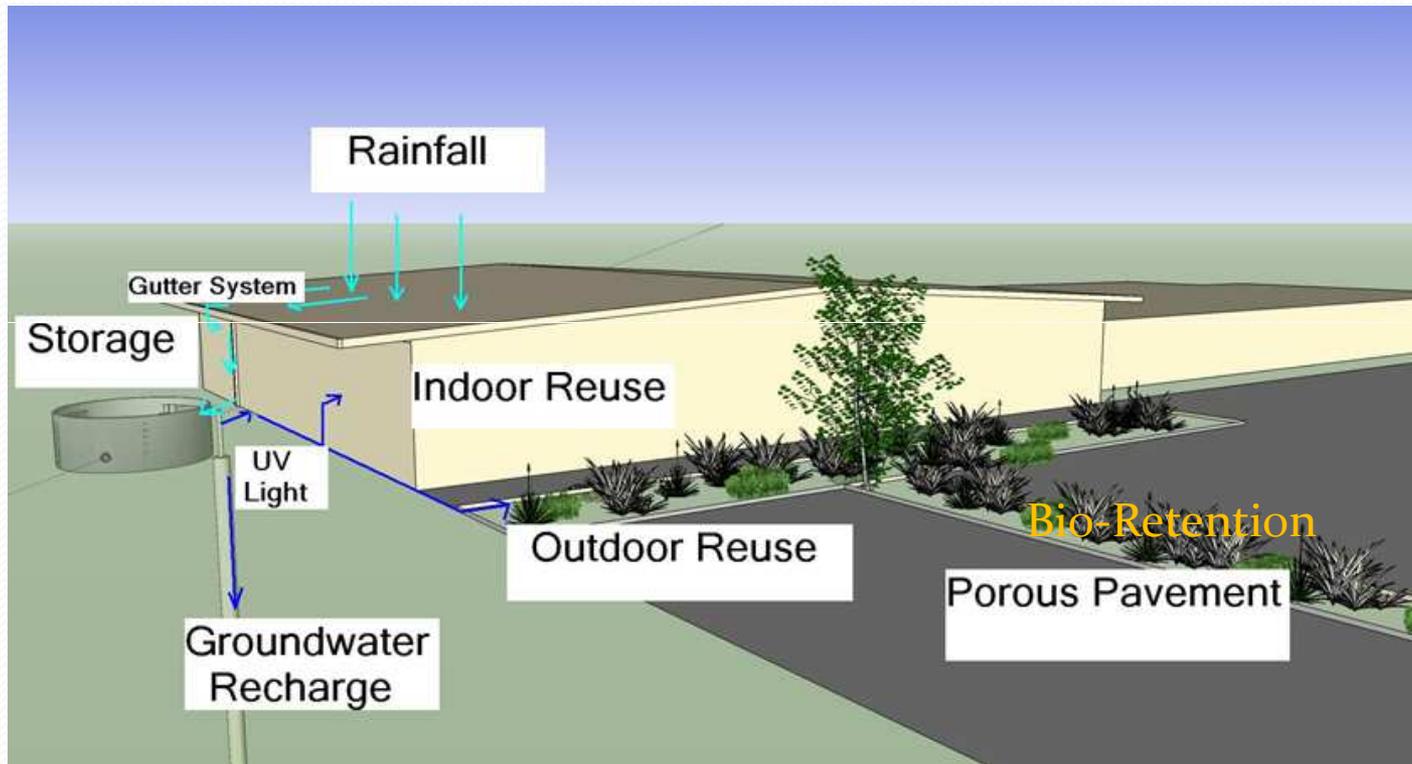
Green Roofs



<http://science.howstuffworks.com/environmental/green-science-pictures.htm>

Decentralized & LID Infrastructures

Use stormwater as an asset!



Replace and retrofit large infrastructure with smaller localized systems supported by local energy and water systems.

Thank You!

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