Stormwater Management

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UGA Extension

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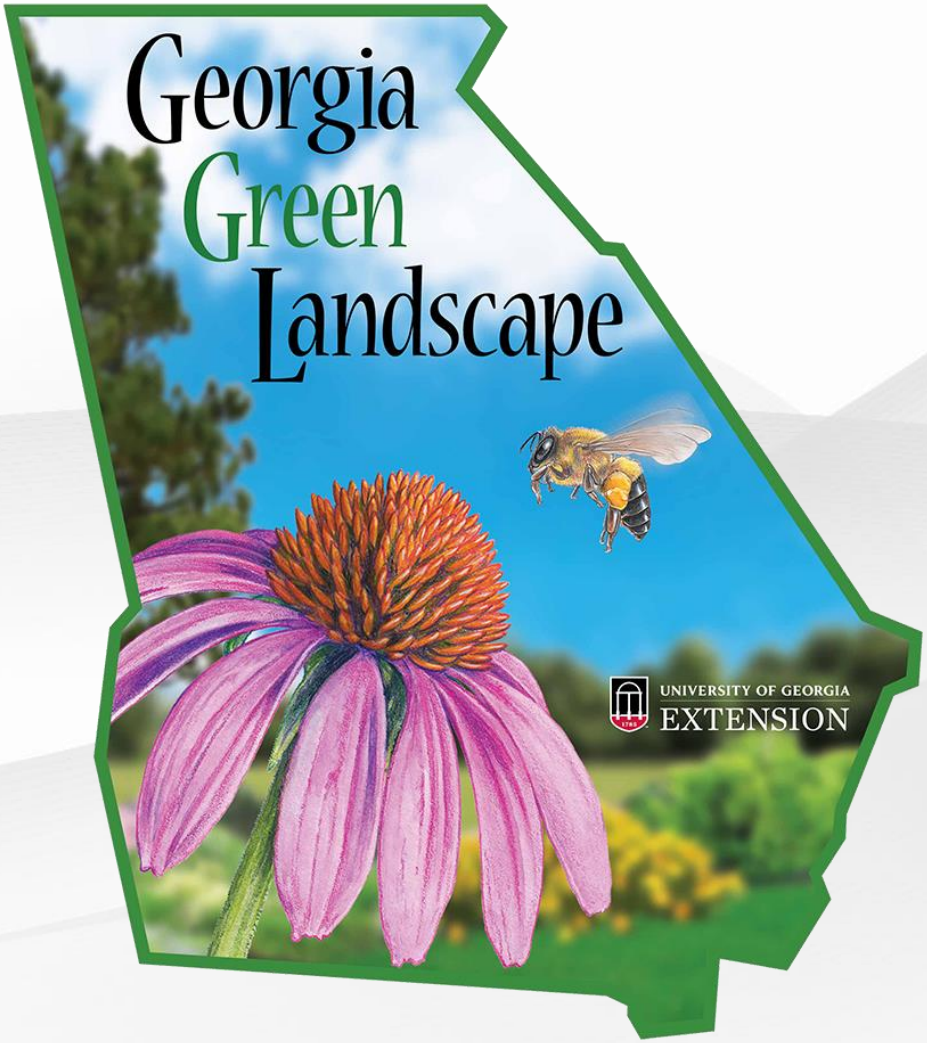

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https://extension.uga.edu/

The following presentation is part of the University of Georgia Extension service Georgia Green Landscapes program funded by the Center for Urban Agriculture. These guidance series will help Georgia residents create certified sustainable Georgia Landscapes, protecting our natural resources for future generations.

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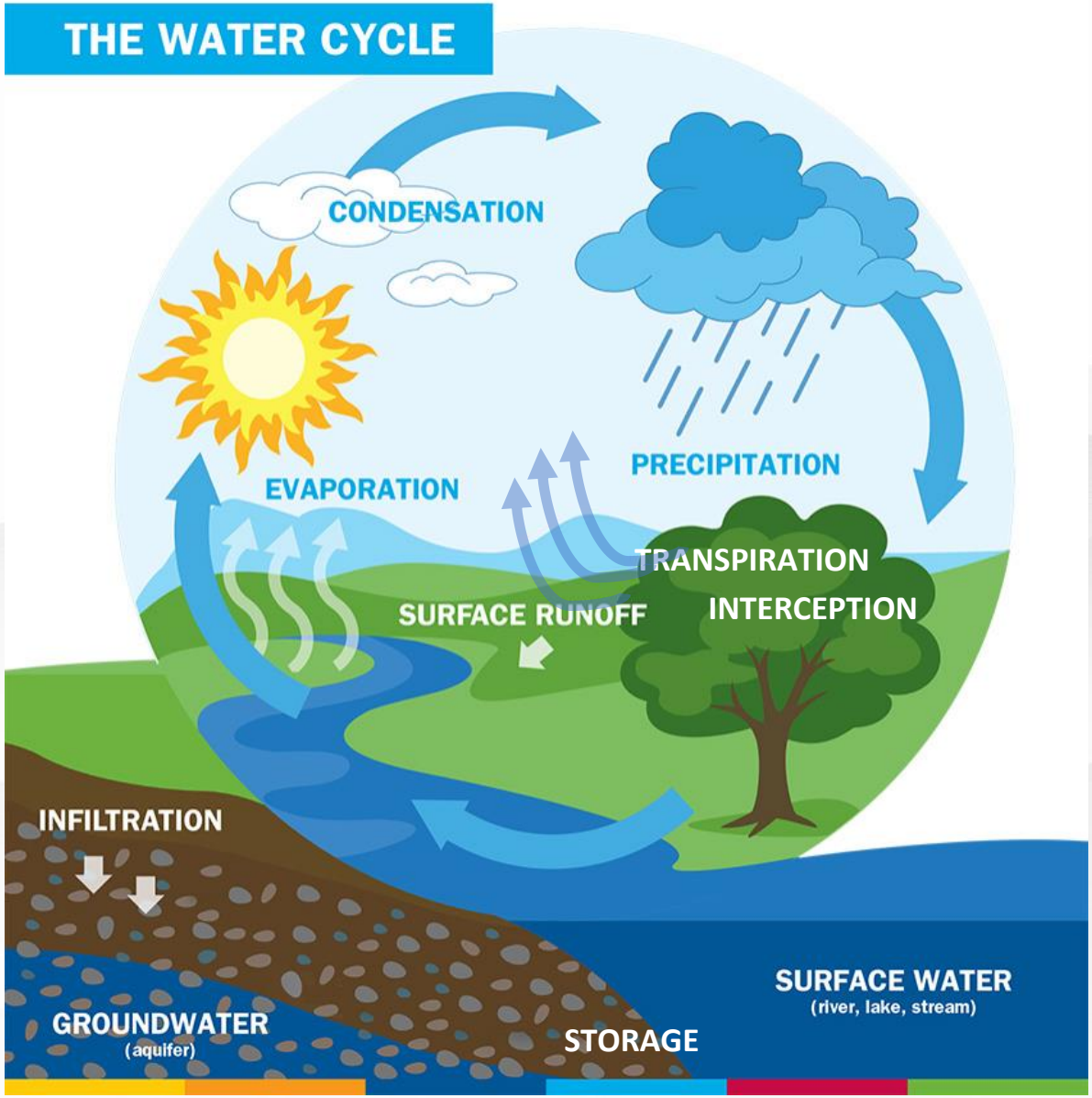
Stormwater - Rainfall or melting snow on the landscape due to a recent weather event. It can infiltrate into the ground, be stored in surface waters, evaporate, or run off the land. Typically, the term is used to refer to **runoff**.

https://www.americanrivers.org

Rainfall Pathways

- **Runoff** - Precipitation that hits saturated or impervious ground and flows overland downhill.
- **Interception** - Rainfall caught and held or slowed by vegetation.
- **Infiltration** - Precipitation soaking into soil and recharging aquifers.
- **Storage** - Rainwater held for a long time. (Short term in surface waters for days to months. Long term for 1000's of years in aquifers or glaciers.)
- **Evapotranspiration –** Sum of evaporation and plant transpiration.



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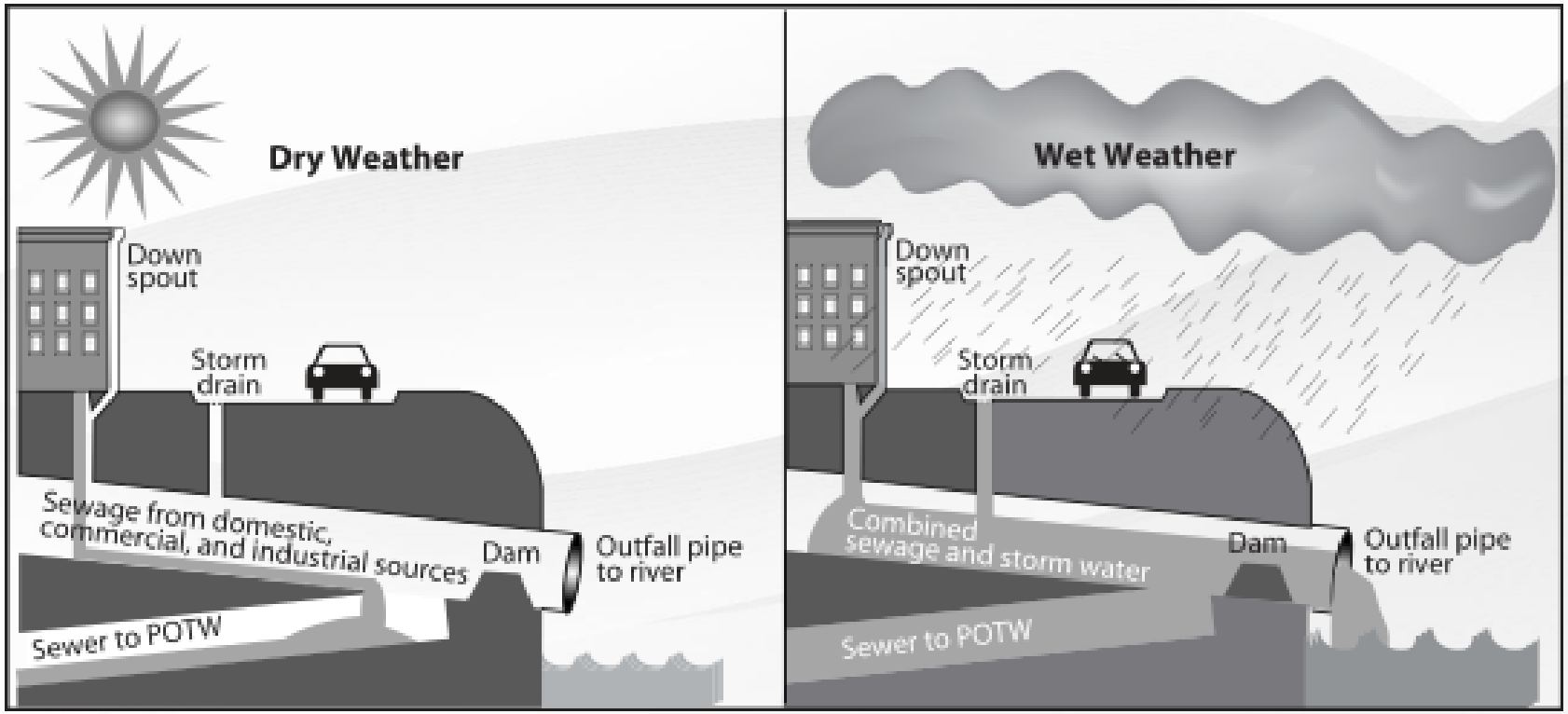
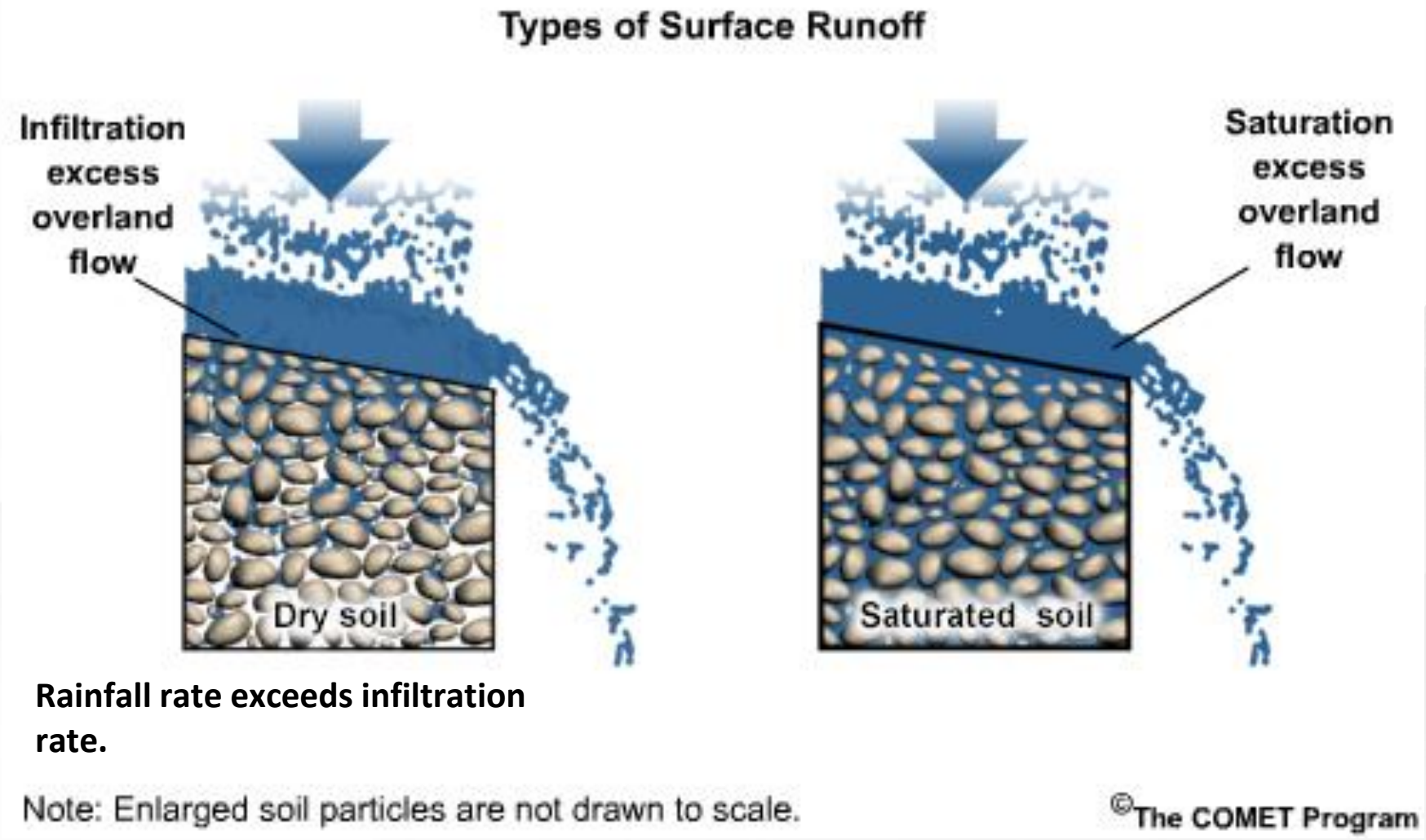
Stormwater Impacts Landscapes and Waterways

- Picks up pollutants (sediment, nutrients, metals, fertilizer, animal waste) as it runs to water bodies, contaminating recreational waters and aquatic wildlife habitat.
- Combined Sewer System Overflows - Wastewater lines that also accept rain runoff are overloaded during storms, spilling into local waterways.
- Flooding and damage to homes, business, and roads.
- Erosion of topsoil reduces soil health.

Combined sewer system overflow contains human and industrial waste, toxic materials, landscape debris, and stormwater. Some combined systems exist in larger cities in Georgia. Were early designs to treat stormwater, when working correctly.




Types of Surface Runoff
Infiltration excess overland flow
Dry soil
Saturation excess overland flow
Saturated soil
Rainfall rate exceeds infiltration rate.
Note: Enlarged soil particles are not drawn to scale.
©The COMET Program

Soil conditions leading to infiltration excess overland flow.

Photo credit:
https://www.texastreetrimmers.com

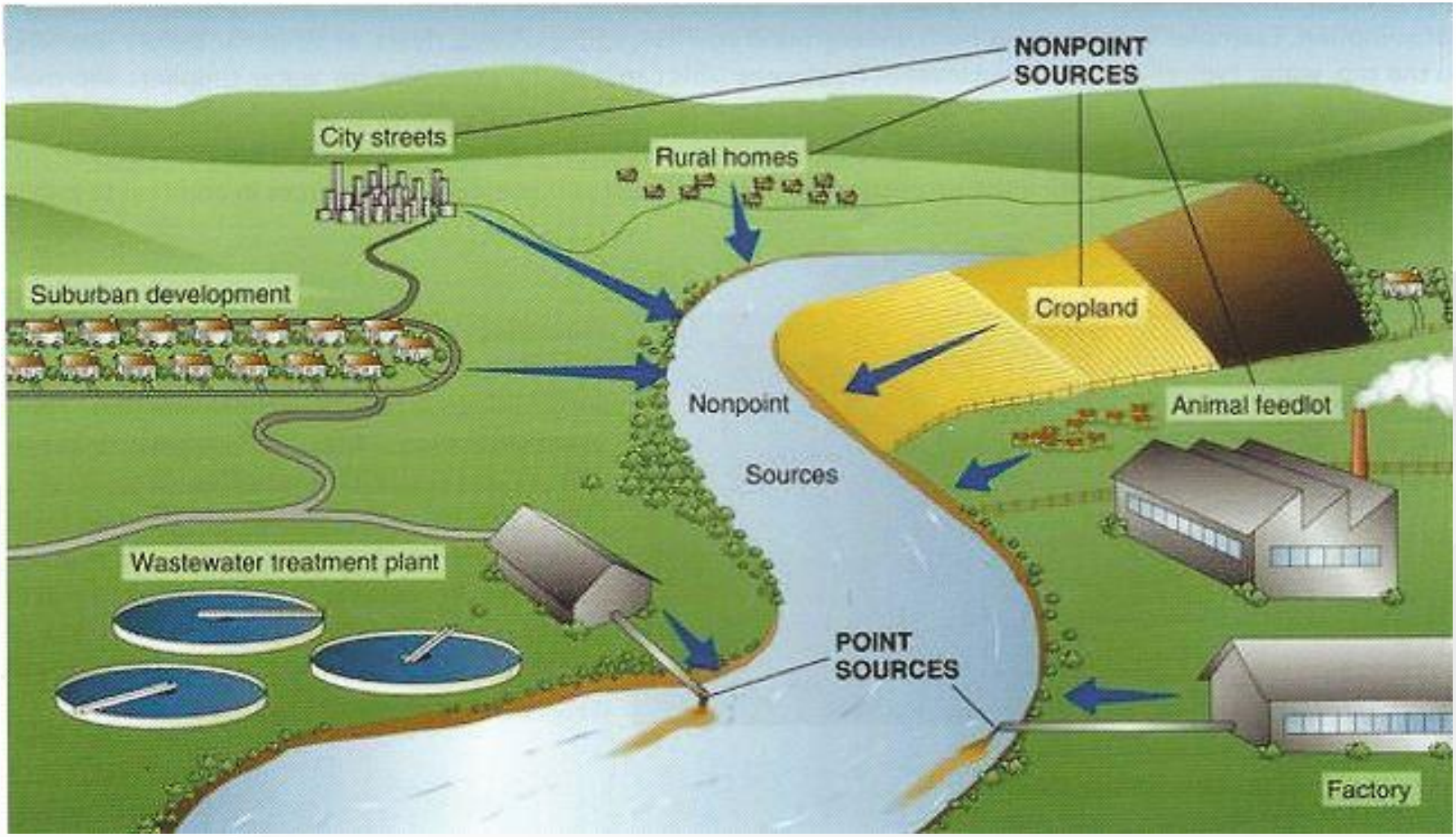
Saturated overland flow.

- Movement of stormwater across natural landscapes depends on field slope, type and density of vegetation, soil structure, subsurface drainage patterns, and the frequency and force of storm events.
- Georgia Piedmont soils have a moderate infiltration rate (average 0.2 inches/hour for sandy clay loam), and they hold water better than sandier soils.

Stormwater flow increases with high rainfall rates and presence of more impervious surfaces on the landscape.

- Stormwater contributes to non-point source water pollution. Contaminated runoff from landscapes enters local surface waters across broad sections of their boundaries, including:
  - City pavement and roofs
  - Suburban neighborhoods
  - Agricultural land
  - Rural roads and residences

- Point-source water pollution comes from an identifiable discharge location and can be regulated for pollutants.
  - Wastewater treatment
  - Factory and power plant effluent
  - Also “gray infrastructure” stormwater pipes. (Untreated stormwater sent directly to local waterways via infrastructure.)



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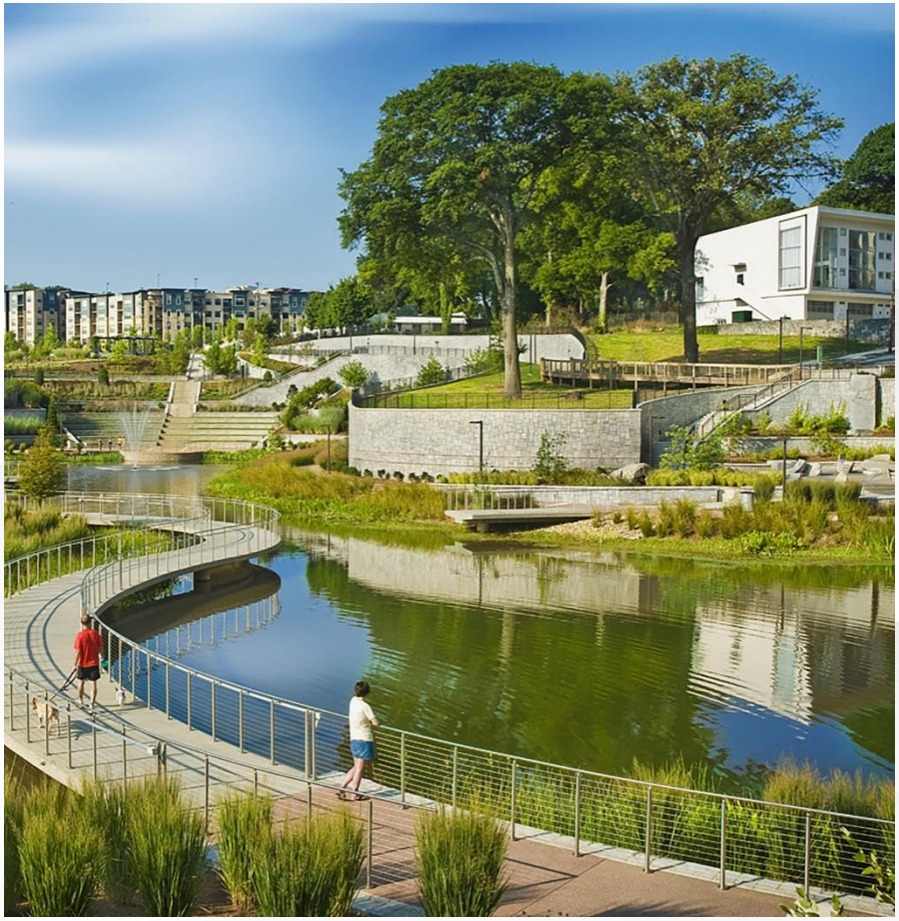
- Some cities and counties, based on population density, can be regulated under MS4 programs (Municipal Separate Storm Sewer System).
- They are required to have stormwater permits and must develop a Stormwater Management Program with the following components:
    - Public Education and Outreach
    - Construction Site Erosion Control
    - Public Participation and Involvement
    - Post Construction Stormwater Management
    - Illicit Discharge Detection and Elimination
    - Pollution Prevention and Good Housekeeping

- There are various “gray infrastructure” engineering methods that hold, infiltrate, or deliver stormwater to avoid flooding…..

- More advanced designs have been developed and classified as **Green Infrastructure** (GI) practices. A term that grew out of best management practices and low impact development ideology in urban settings during the 1980’s.

What is Green Infrastructure?



Atlanta, Historic Fourth Ward Park

- Landscaping and building techniques with plants, soils, and materials intended to mimic natural hydrologic processes.
- The main goal of GI is to treat, slow, and reduce stormwater flow from landscapes.

- **Green Infrastructure** reduces and treats stormwater at its source, while delivering environmental, social, and economic benefits.
- **Gray infrastructure** moves urban stormwater away from development through conventional piped drainage systems to nearby surface waters, sometimes without treatment.
- If your municipality has a stormwater tax, GI installation might allow you a tax reduction.

Native flowers in a front yard rain garden.
gogreendeerfield.org

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Green Infrastructure

- Promotes stormwater infiltration to soils and surface aquifers.
- Prevents stormwater flooding and damage.
- Protects surface waters and aquifers from contamination.
- Prevents soil erosion.
- Designed to drain or move water without stagnation.
- Creates wildlife habitat.
- Creates a cooling effect on urban surroundings.
- Conserves water for landscape irrigation.
- Can be installed where space is limited
- Is more aesthetically pleasing.

Green Infrastructure Includes:

- Green roofs
- **Drywells**
- **Rainwater harvesting**
- Permeable pavement
- Stormwater wetlands
- Bioretention cells and planters
- Tree trenches
- Vegetated curb extensions
- **Bioswales**
- **Rain gardens**

Photo credit: https://www.epa.gov

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Green Roofs

- Vegetative layer that grows in specially designed media on multiple drainage support layers.
- Usually installed on larger buildings for greater reductions in stormwater.
- Insulates buildings from cold and heat. (≈R-5)

Green roof on
Georgia Tech campus

https://sustainability.uga.edu/student-programs/greenroof/

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- Reduces urban heat island effect.
- Noise reduction.
- Pollinator habitat.
- Food production.
- Irrigation not needed for certain plant species.
- Landscape maintenance and roof inspection necessary.

UGA campus

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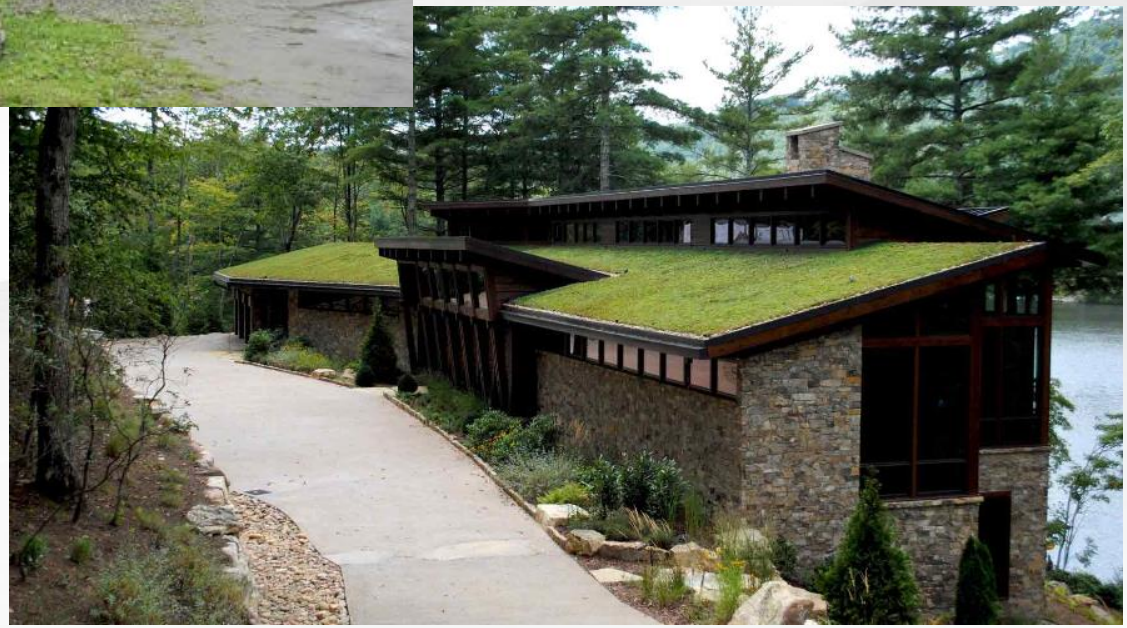
Residential Green Roofs



www.livingroofsinc.com

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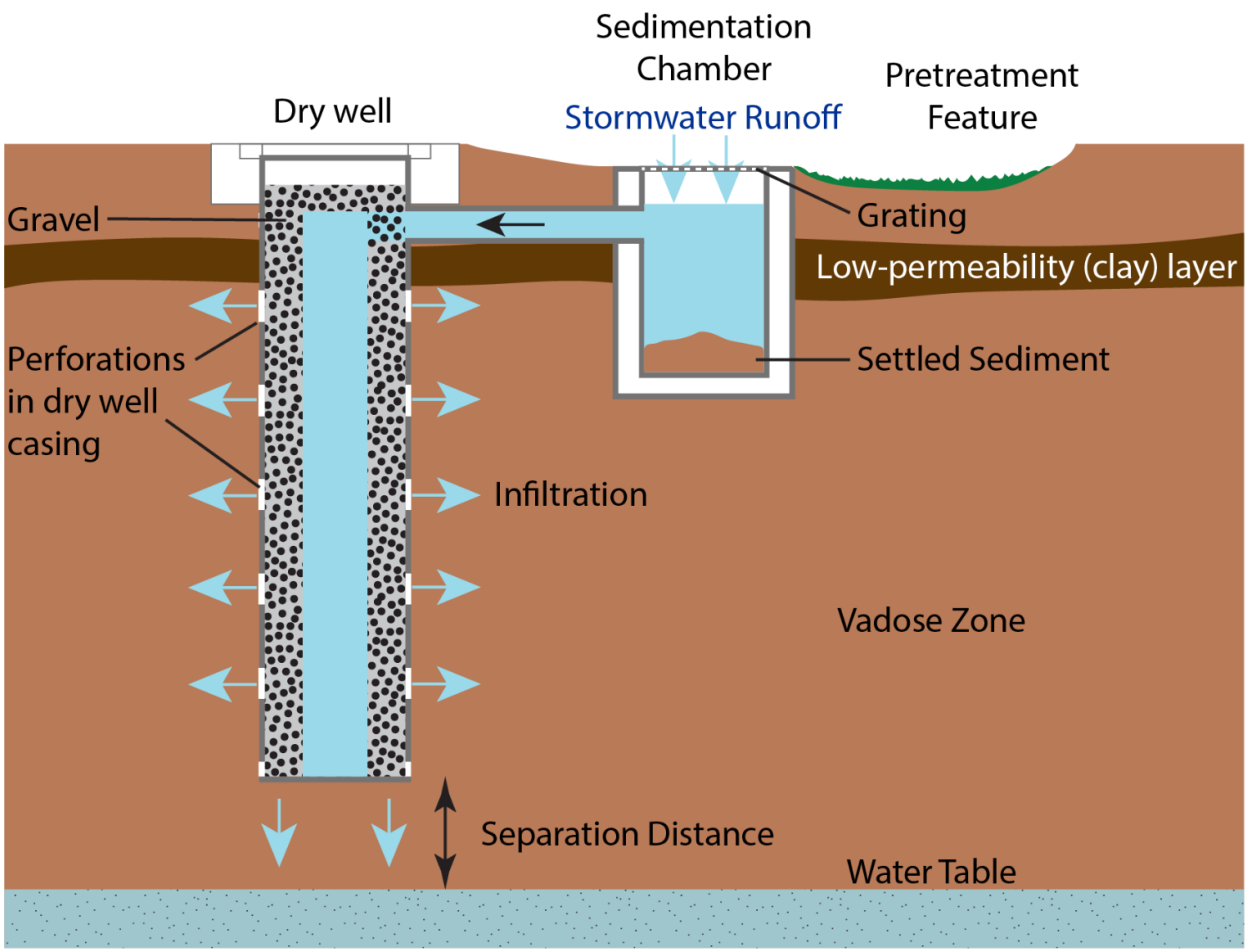
Drywells

- Excavated depression filled with uniform graded washed rock that temporarily stores stormwater until it infiltrates the underlying soil.
- Dry wells can be connected directly to downspouts or by way of a grated yard drain.



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- Infiltration trench uses a similar theory but are linear surface or subsurface features.
- Runoff from parking areas can also be directed to dry wells.
- Prevent soil compaction around dry well location to maintain infiltration capability.
- Inspect for ponding at surface. Water should not remain for 72 hours after rain event.
- Check settlement chambers for debris.
- Keep downspouts clear.

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Rainwater Harvesting

- Rain barrels or cisterns.
- For conserving water, retaining or treating stormwater, or re-use for other purposes.
- Reduce the volume and rate of stormwater flow from impervious surface. Usually roof tops.

Cisterns

- Cisterns are generally larger containers on or above ground, collecting rain from commercial or public facilities.
- Used for on-site irrigation or domestic non-potable supply.
- Automatic or passive drawdown to deliver to a vegetated infiltration area (may be required for stormwater tax credit).

Rain Barrels

- Generally on residential properties for smaller volume.
- Raise rain barrel off the ground for room to fill watering can and maintain some pressure for a drip hose.
- Can be multiples in succession.

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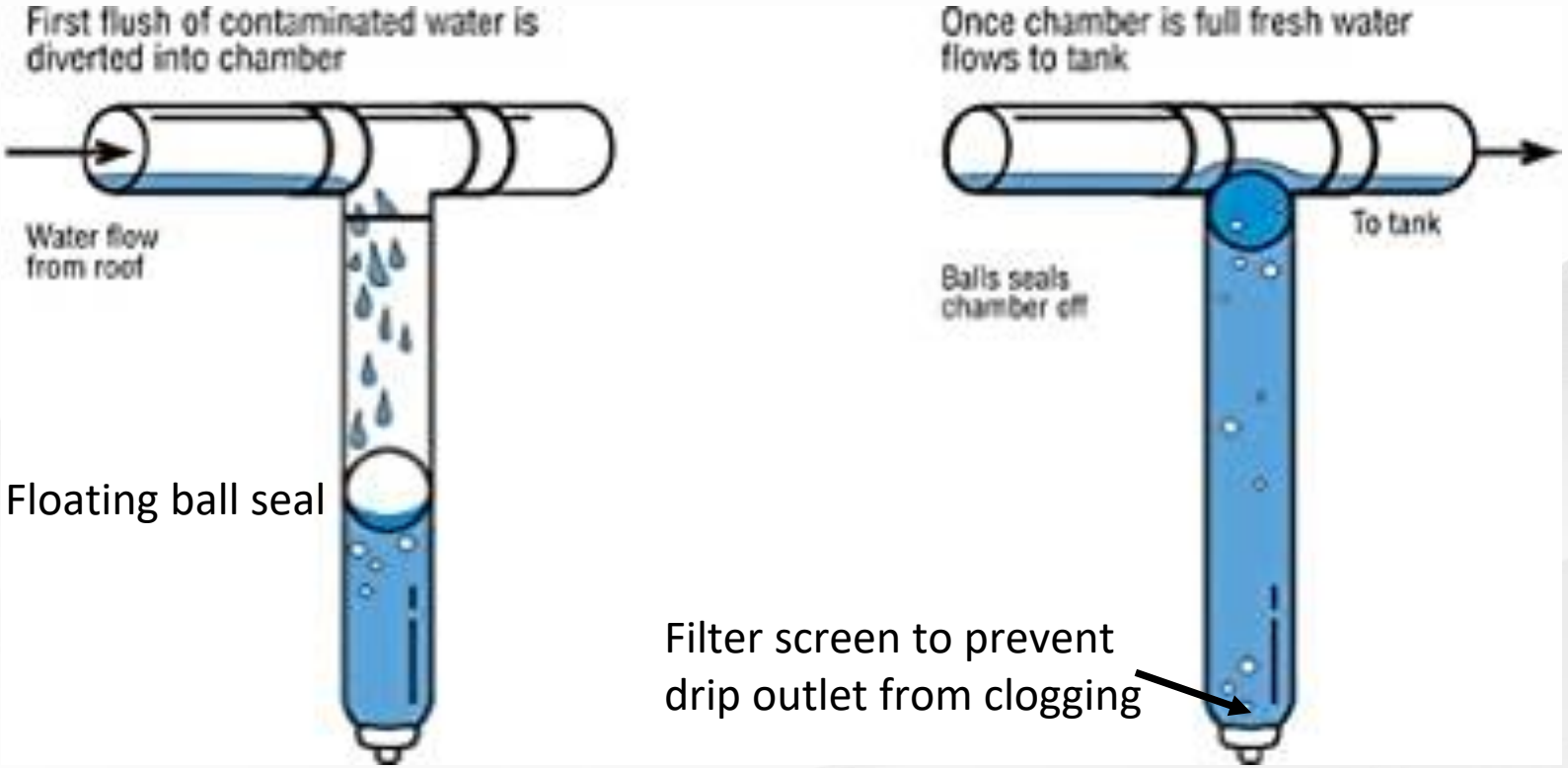
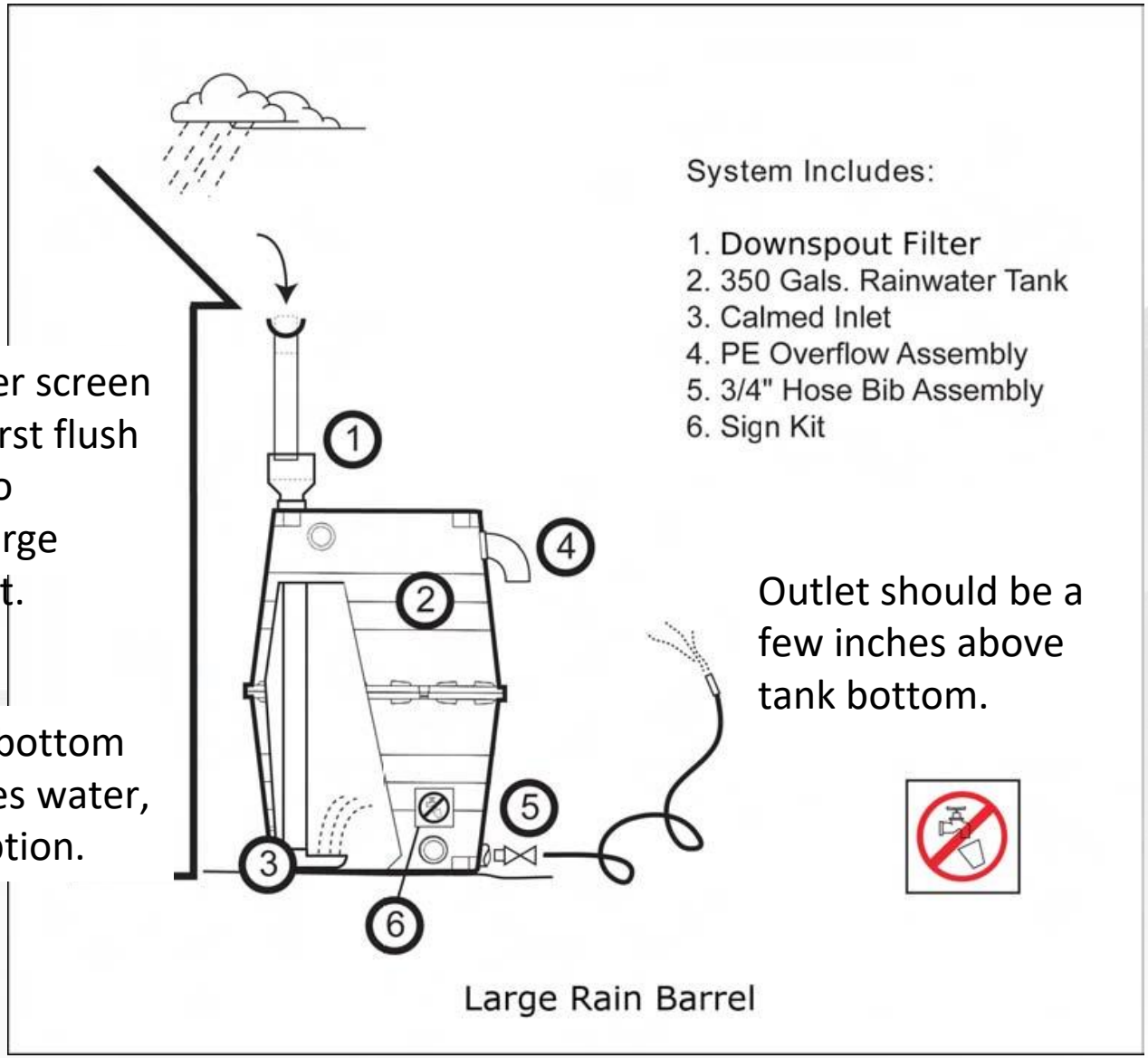
Pre-filters

With diverter to barrel

First Flush Diverter



Rain Barrel Components



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Rain Barrel Irrigation Water Quality

- Disinfect rain barrel water before irrigating a vegetable garden. Household, unscented bleach with a 5–6% chlorine solution added at the rate of 1/8 teaspoon (8 drops) of bleach per gallon of water.
- A 55 gallon rain barrel would need approximately one ounce of bleach added on a monthly basis. During periods of frequent rainfall, bimonthly treatment may be necessary. Wait approximately 24 hours after the addition of bleach to allow the chlorine to dissipate before using the water.
- When using harvested water to irrigate a vegetable garden, avoid getting water on the plant itself. Apply only to the soil, possibly through drip irrigation.
- Water should be applied in the morning only. Harvesting should not take place right after watering. Allow time for leaves to dry and some ultraviolet light disinfection.

Rain Barrel Maintenance

- Clean pre-filter screens.
- Maintain outlets a few inches above tank bottom
- Drain and clean sediment from tank bottom.
- Chlorinate as needed
- Maintain overflow to an infiltration area for maximum stormwater management

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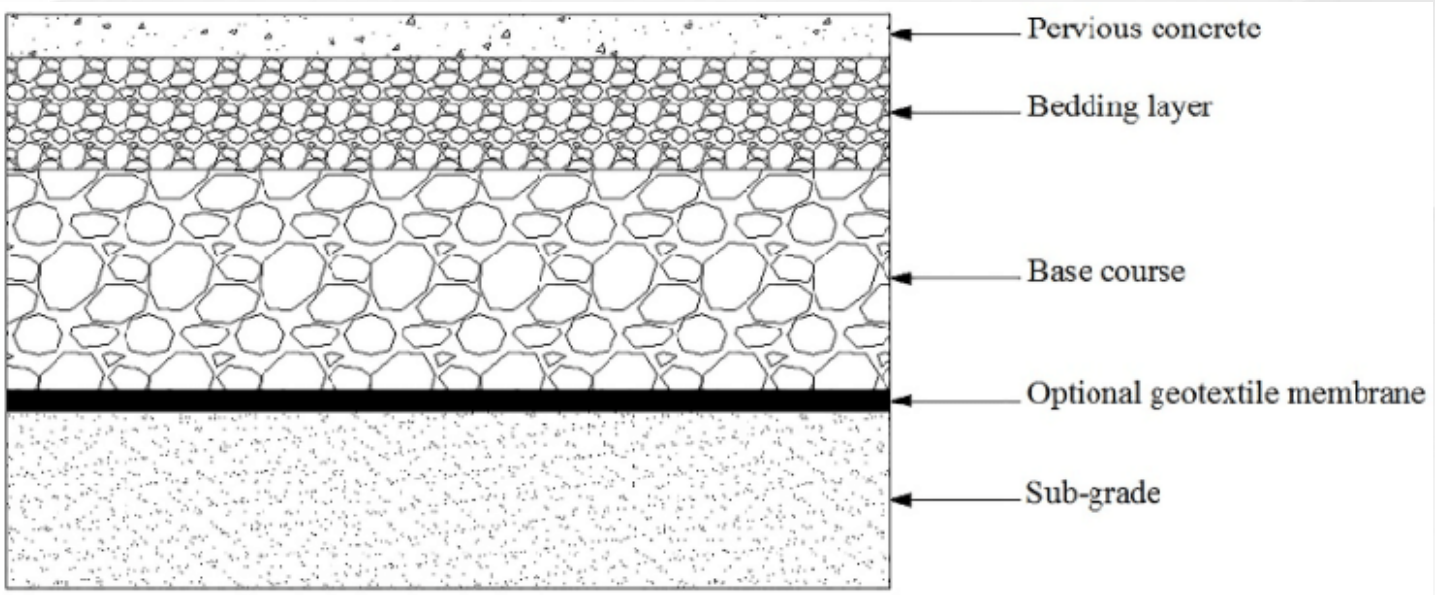
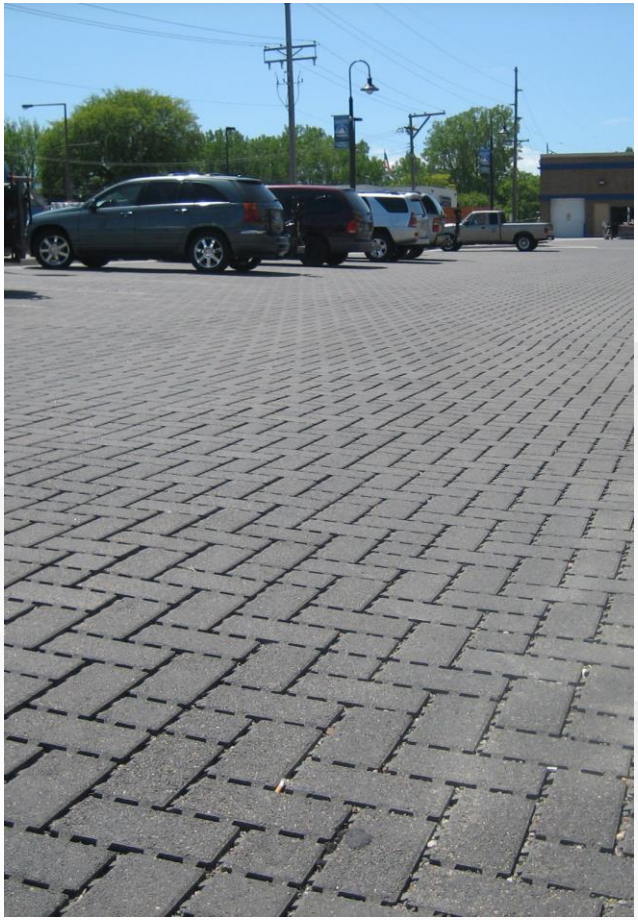
Permeable Pavement

- Porous Asphalt
- Pervious Concrete
- Permeable Pavers
- Plastic Grids



Plastic Grids



- Keep clean of sediment
- Vacuum sweepers or high-pressure wash for pavers and concrete/asphalt
- Check observation wells for proper drainage time (24-48 hrs)
- Maintain stone/gravel to height between grids and pavers

Stormwater Wetlands

- Built to mimic natural wetland processes that store and filter water, support wetland vegetation and animals, and replenish groundwater.
- They reduce stormwater volume and peak flows to protect nearby streams and natural wetlands from erosion.
- Utilize submerged, floating, and emergent wetland plants, as well as more upland species along the water's edge.

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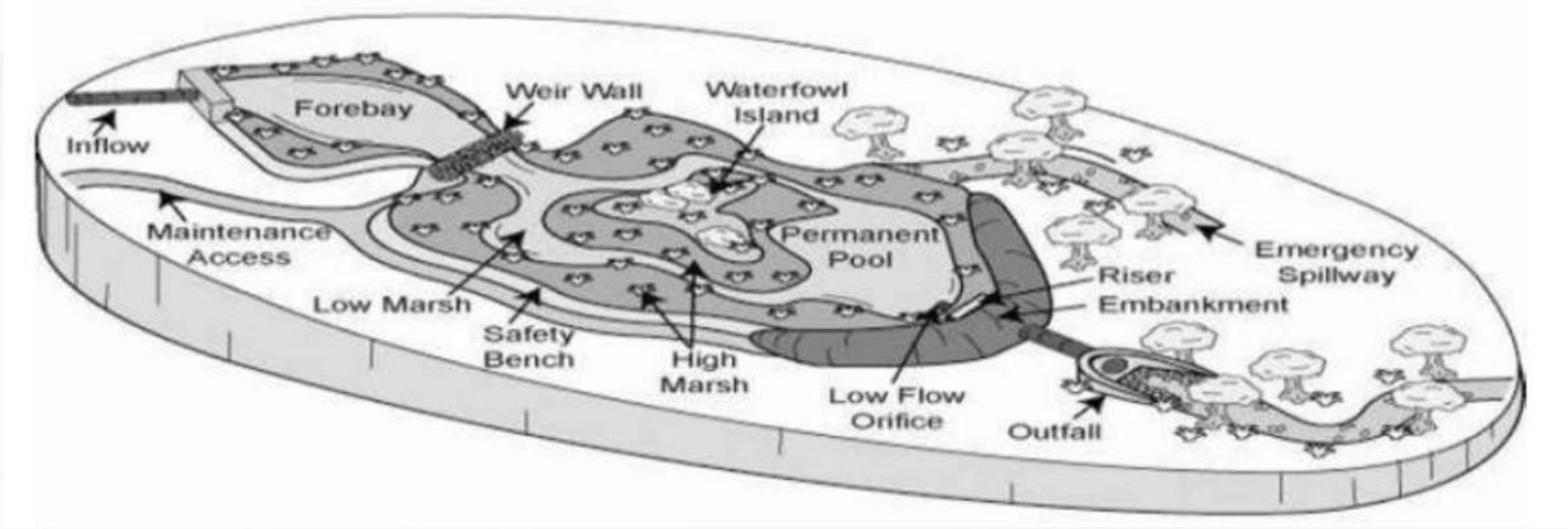
- Components include inlets, forebays to collect runoff sediment, pipes and weirs for moving water throughout, ponding areas, and outlets.
- Take at least 6 – 12 months to establish. Inspect vegetation after that point.
- Ongoing maintenance of forebay cleaning, vegetation health, control structures, dams, and wildlife damage.



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McDaniel Branch wetland, City of Atlanta

Bioretention Practices

- Vegetated depressions that receive stormwater for slowing, storing and treatment.
- Stormwater infiltrates soil and plant roots, where it is treated by physical, chemical, and biological processes.
- Avoid compaction during construction.
- Drainage media is specifically designed.

Kendeda Building for Innovative Sustainable Design. Georgia Tech campus

Bioretention Cells and Planters

- Reduce water pollution and runoff volumes. Engineered and constructed sub-grade ensures adequate percolation of runoff.
- Optional underdrain control structures.
- Can link to conveyance system.
- Water treatment by infiltrating water vertically through soil.

https://capecodgreenguide.wordpress.com/2015/02/27/bio-retention/

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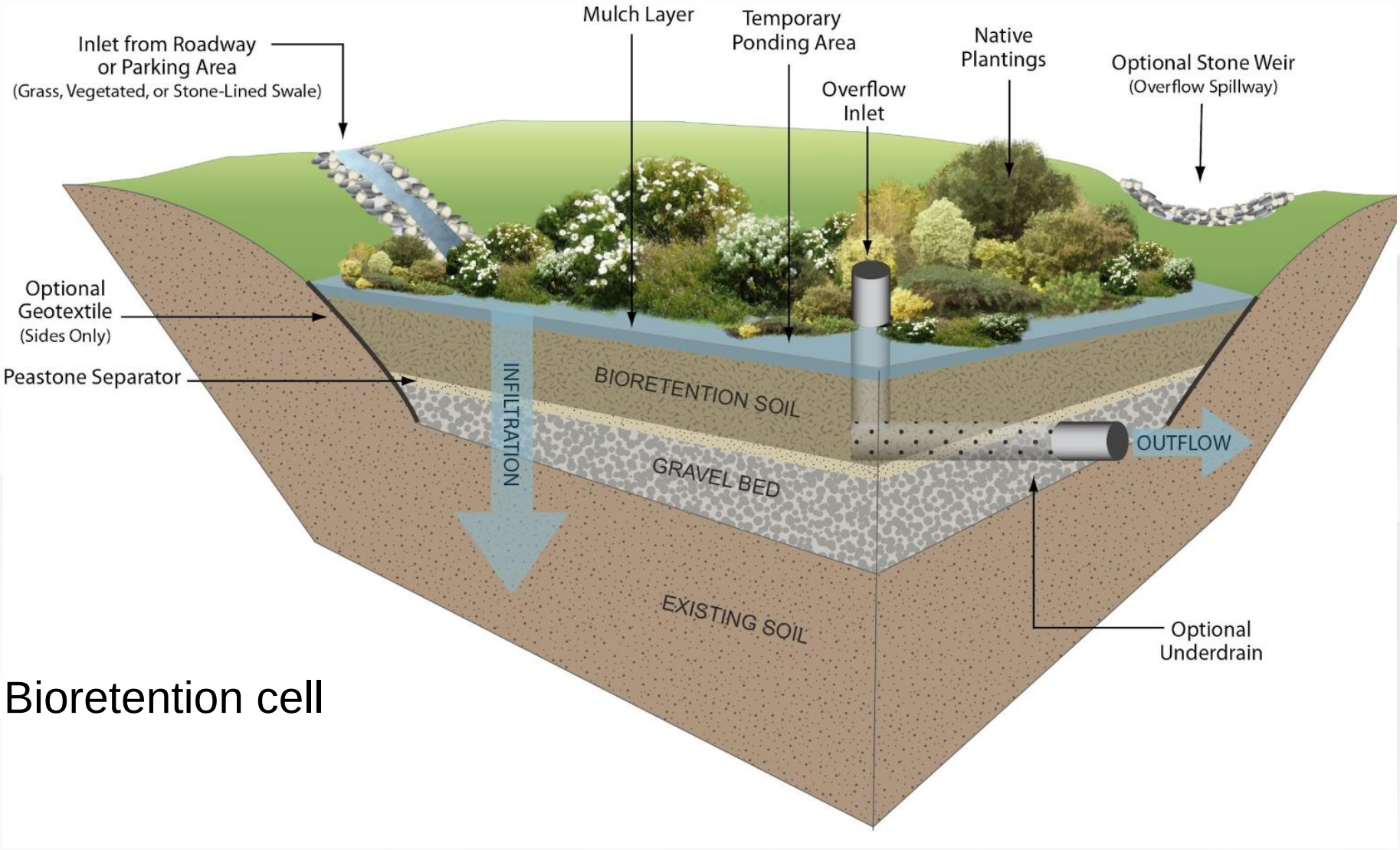

Bioretention cell

http://prj.geosyntec.com/npsmanual/bioretentionareasandraingardens.aspx

Bioretention Planter

- Reservoir in dense urban setting.
- May infiltrate to native soil below or be lined with an underdrain to link to other infrastructure and overflow systems.

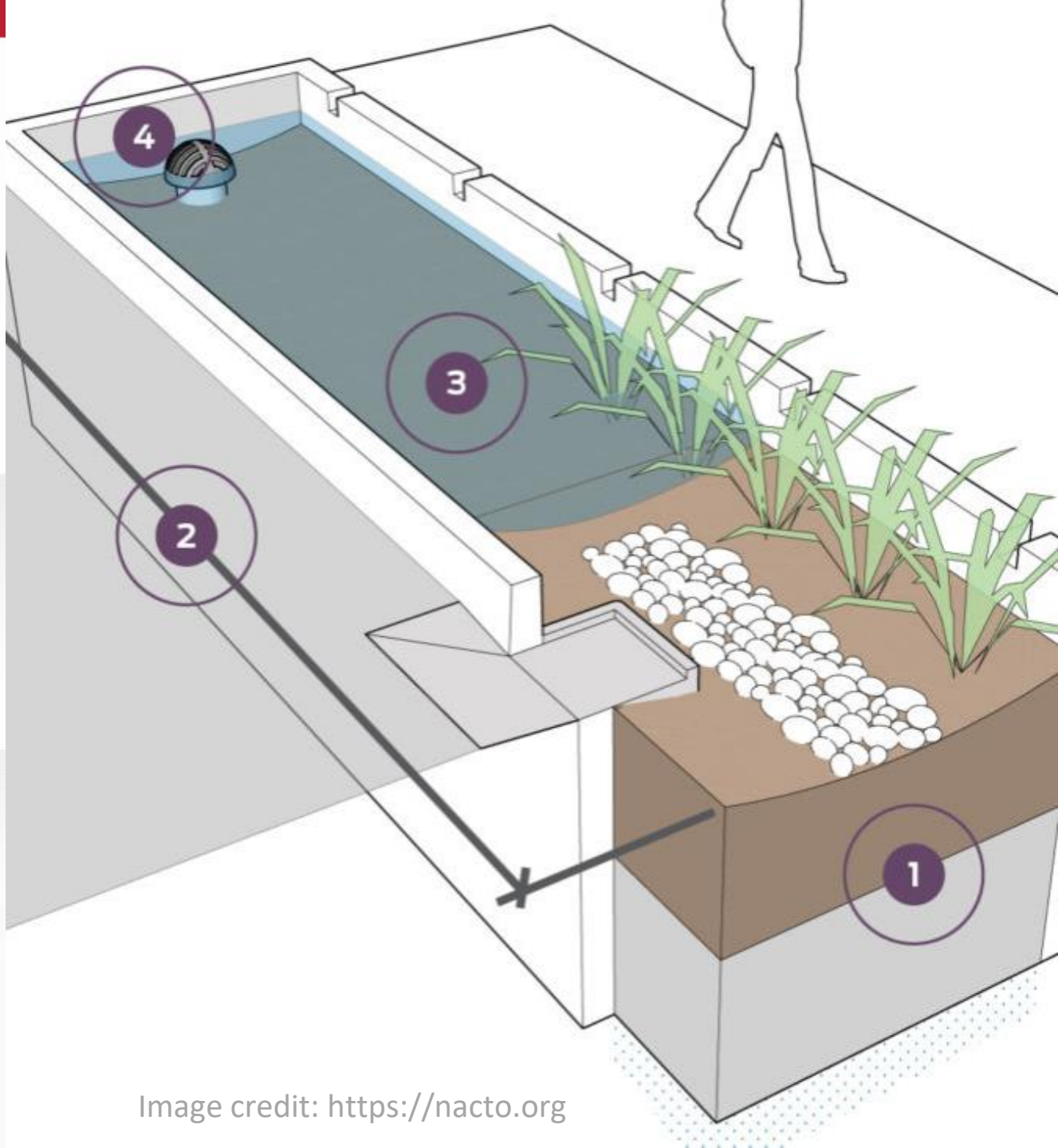

Image credit: https://nacto.org

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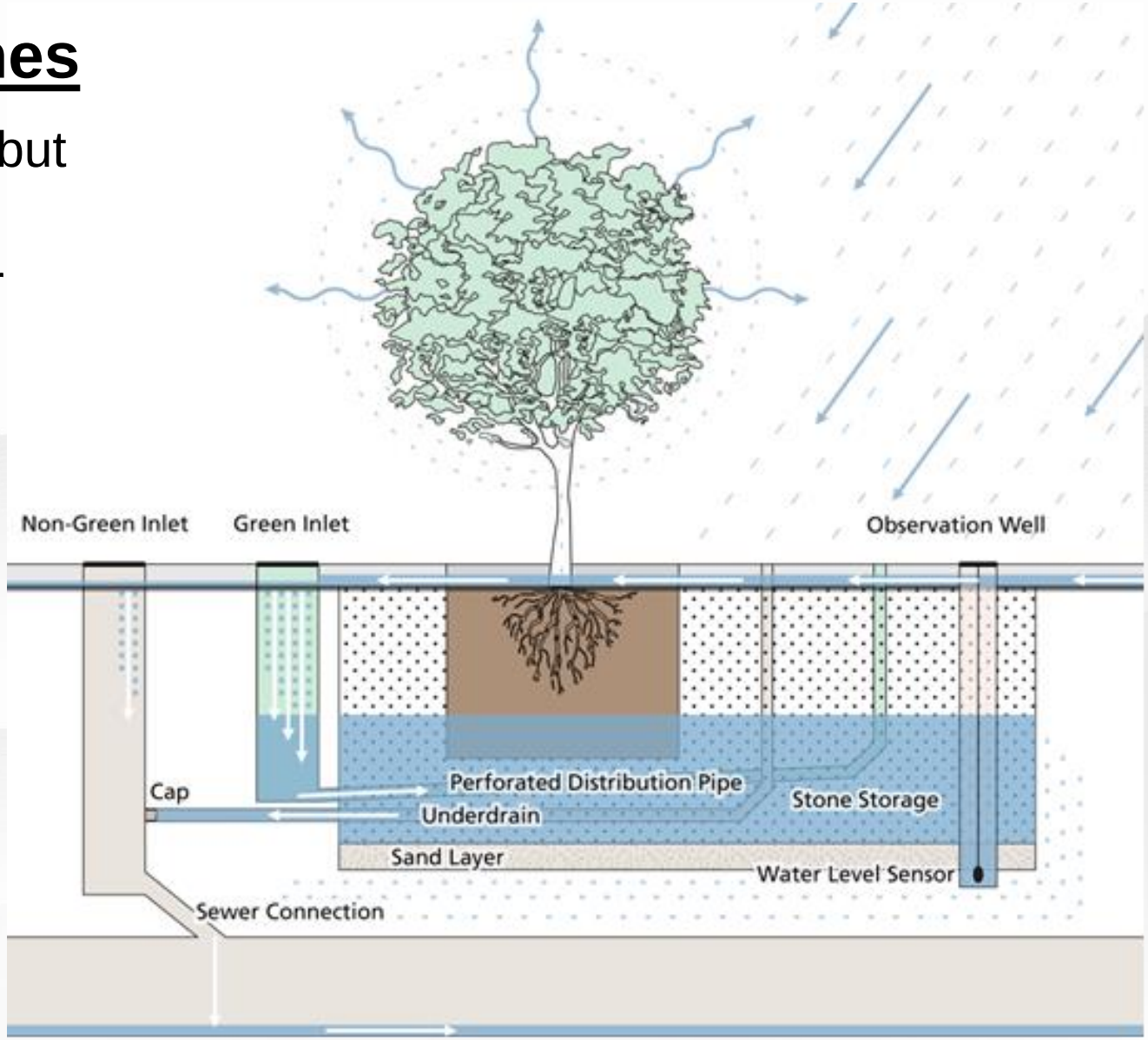
Tree Trenches

- Like planters, but with trees.
- Conceal water storage below sidewalks and street.



http://archive.phillywatersheds.org/what_were_doing/green_infrastructure/gsi_monitoring

Vegetated Curb Extensions

- Stormwater control that also improves pedestrian safety and calms traffic. (aka “bulb out” or “bump out”)
- Water enters through curb cuts.

Bioswales

- Usually along roads
- May be interconnected in series
- Treat stormwater by moving horizontally through vegetation
- Add check dams to slow the water flow and promote infiltration.

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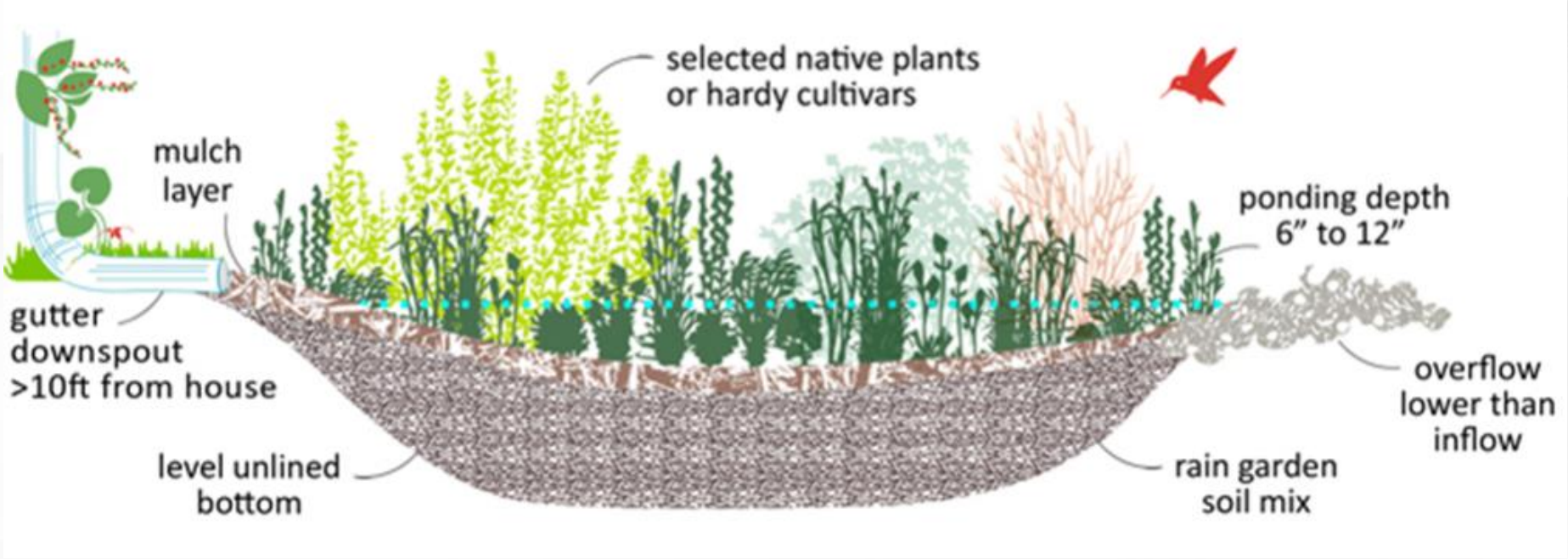
Photo credit: https://www.esf.edu/ere/endreny/GICalculator/index.html

Photo credit: http://news.cornell.edu

Bioswale planting designs are infinite.

Rain Gardens

- Low maintenance, low water use, beautiful landscape feature
- Increases infiltration of stormwater
- Reduces stormwater runoff and pollution
- Reduces flooding risks and flood damage downhill or downstream
- Can provide a different kind of habitat in the landscape



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- Similar to Bioretention Cells, except:
  - ❑ Soil may or may not be amended.
  - ❑ Usually no underdrains or control structures.
  - ❑ Subgrade soil properties less restrictive than bioretention.
- Rain garden soil mix - 50% sand, 25% topsoil, and 25% compost. No more than 10% clay.
- The soil mix should be 12 – 24 in. deep.
- Native soils below the rain garden soil mix should have infiltration rate > 0.5 inches per hour.
- Call 811 to find utility lines before you dig.

- A 100 sq.ft. rain garden can often receive water from an area 5 to 10 times larger than it's size.
- Sloped sides at 2H:1V maximum, 3H:1V preferred.
- Use temporary erosion and sediment control (hay, silt fence etc.) during construction.
- Prevent over-compaction of soil mix. No heavy machinery in practice area.
- Outlet drain/overflow should be below inlet at elevation that results in maximum desired water depth during storms.
- Cover inlet and outlet with river stone or turfgrass to prevent erosion.
- Can receive water from downspouts or funneled across a surface of lawn or pavement.

- Typical rain garden depth 6 to 8 in.
- Ponding should last no more than 48 hours after rain stops.
- Will not increase mosquito numbers
- Will attract water loving critters such as frogs, toads and snake

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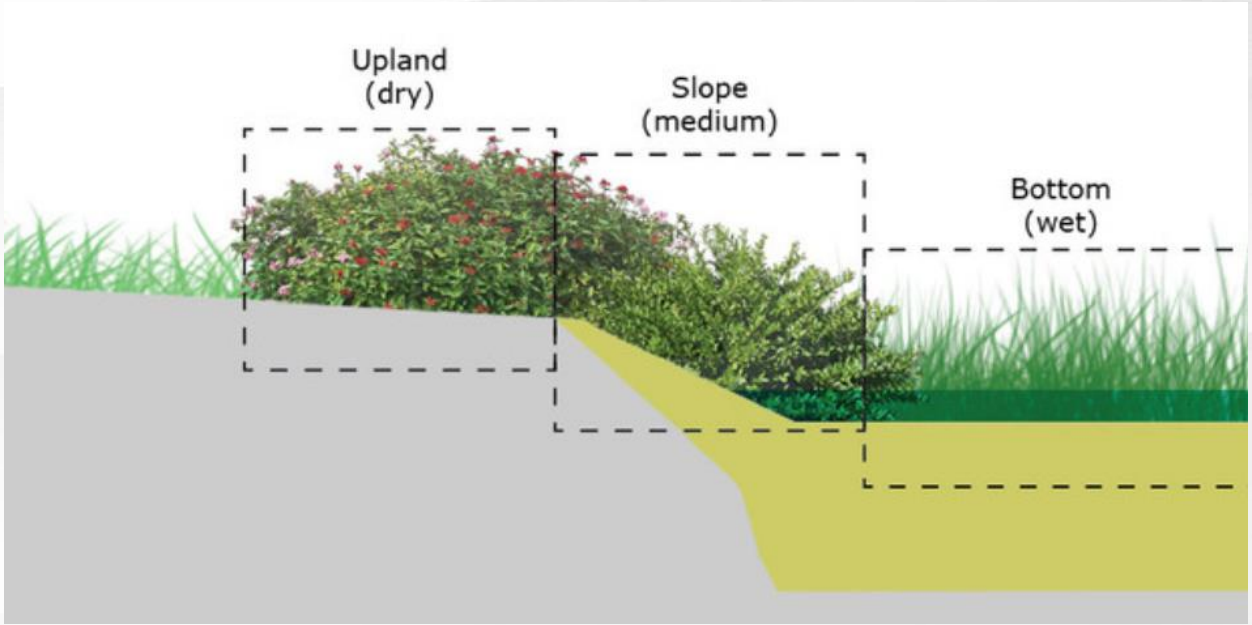
- Plant in zones of dry, medium, and wet tolerant, from the top of the slope to the basin. Plants should be wetland and drought tolerant.
- A good list of plants (and construction advice) can be found in the UGA Extension Bulletin: *Rain Gardens in Home Landscapes.*
  https://secure.caes.uga.edu/extension/publications/files/pdf/EB%20101_3.PDF



A rain garden with a dry creek bed design.

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Certification Checklist Items:

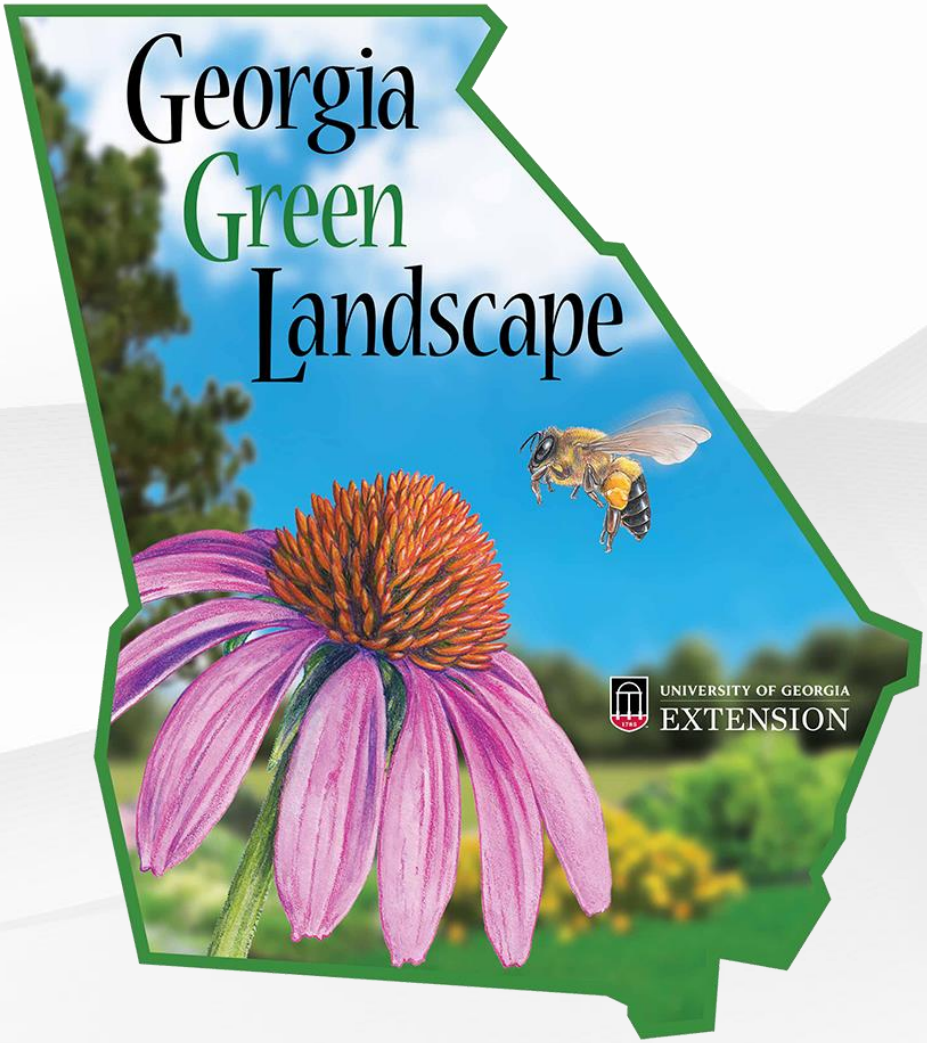
- Install a rain barrel to reduce stormwater flow from your property. Use it to water your plants!
- Install a rain garden to accept stormwater from your rooftop, sidewalks, patio, or driveway.
- Build a bio-swale or vegetated grass swale to move and infiltrate water on your landscape to prevent stormwater and erosion.
- Install pervious landscape pavers or porous concrete or asphalt in place of your impervious sidewalks and driveway.
- Install dry wells in stormwater problem areas, such as under downspouts or where rainwater funnels off paved surfaces.
- Conduct routine maintenance on your Green Infrastructure practice. Remove leaves, sediment, and debris when needed. Have permeable pavement and asphalt cleaned.
- Maintain stormwater infiltration areas in your lawn and avoid soil compaction. Do not drive or park vehicles through these areas.

Stormwater….. Slow it. Spread it. Sink it!

Questions?

georgiagreen@uga.edu

https://site.extension.uga.edu/georgiagreen/



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