Maintaining LID Stormwater Facilities

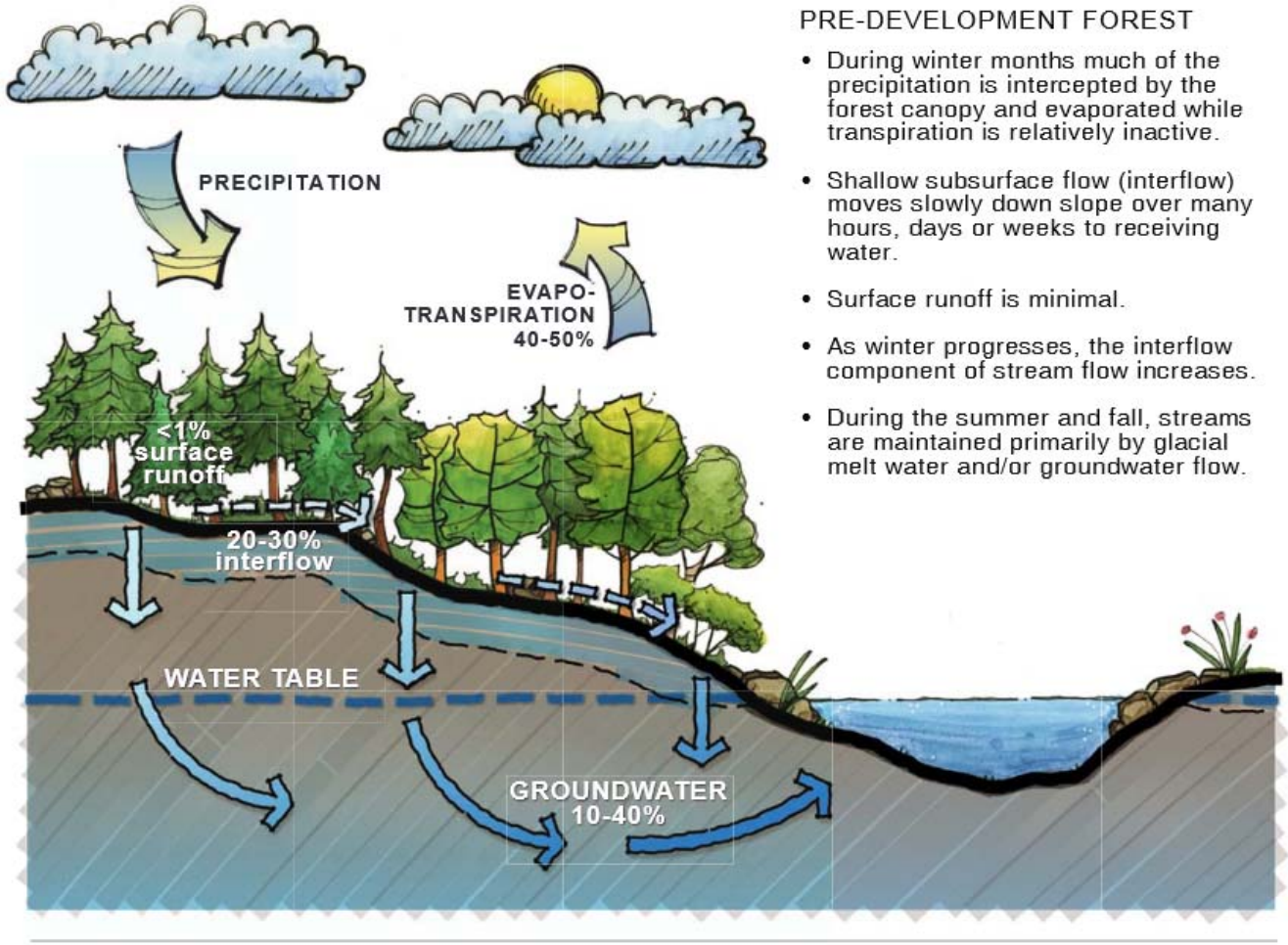
Low Impact Development = LID

- Integrates land use and stormwater management to mimic pre-development landscapes.
- Utilizes infiltration, native plant species to reduce surface flow and remove pollutants.
- Can be applied to new construction or incorporated into retro-fits of traditional stormwater systems.

Limits of Traditional Stormwater Systems

- Buildings and hardened surfaces increase sheet flow and stormwater velocity.
- The increase in surface runoff creates flooding and reduces the filtration of pollutants.
- Stormwater ponds, a frequent component of traditional stormwater systems occupy valuable land and can require expensive maintenance.

Pre-Development Forest



PRE-DEVELOPMENT FOREST

- During winter months much of the precipitation is intercepted by the forest canopy and evaporated while transpiration is relatively inactive.
- Shallow subsurface flow (interflow) moves slowly down slope over many hours, days or weeks to receiving water.
- Surface runoff is minimal.
- As winter progresses, the interflow component of stream flow increases.
- During the summer and fall, streams are maintained primarily by glacial melt water and/or groundwater flow.

Puget Sound lowland forest water budget before developement.
Source: AHBL

figure 1.2

Developed Conditions

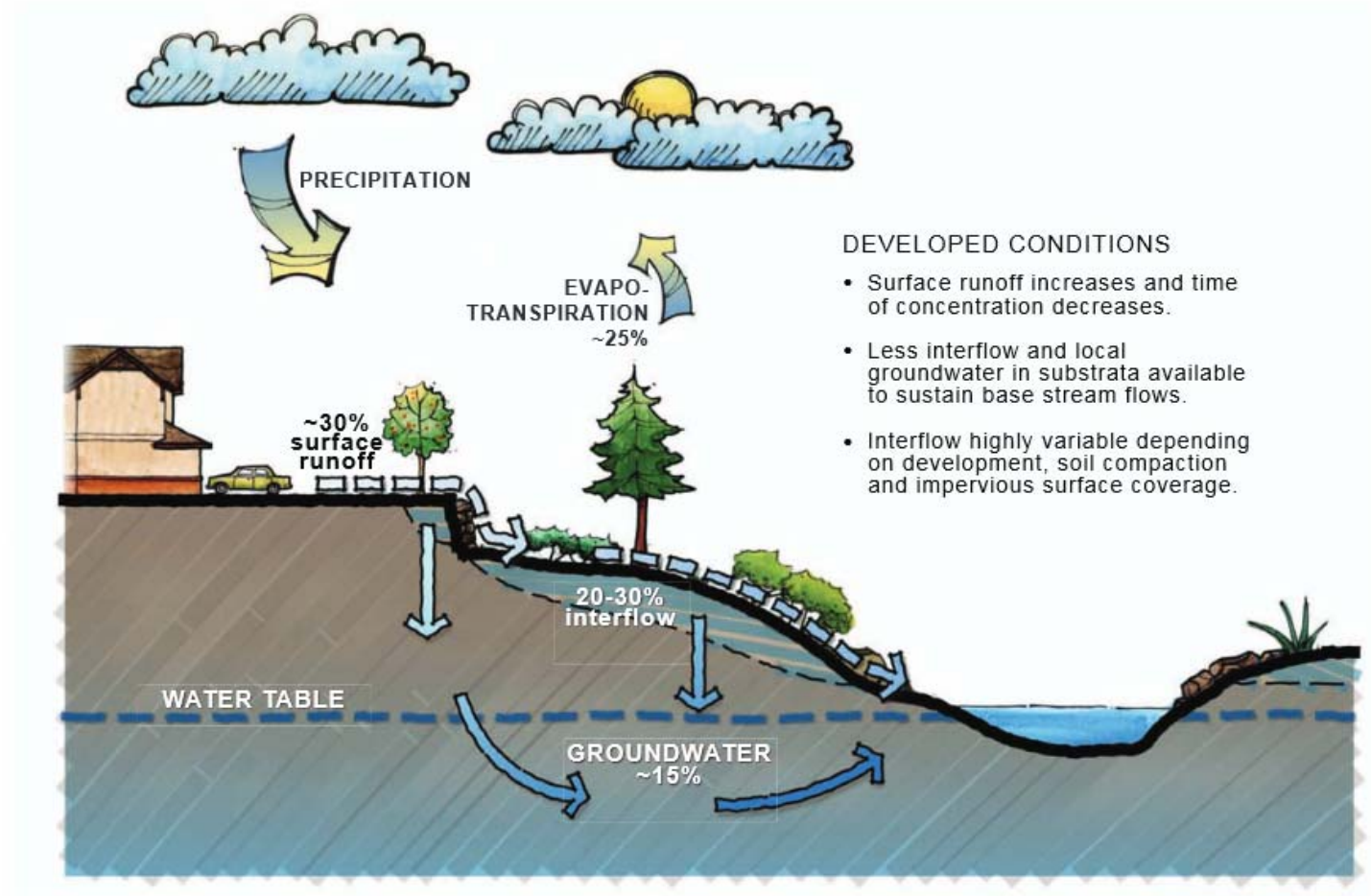
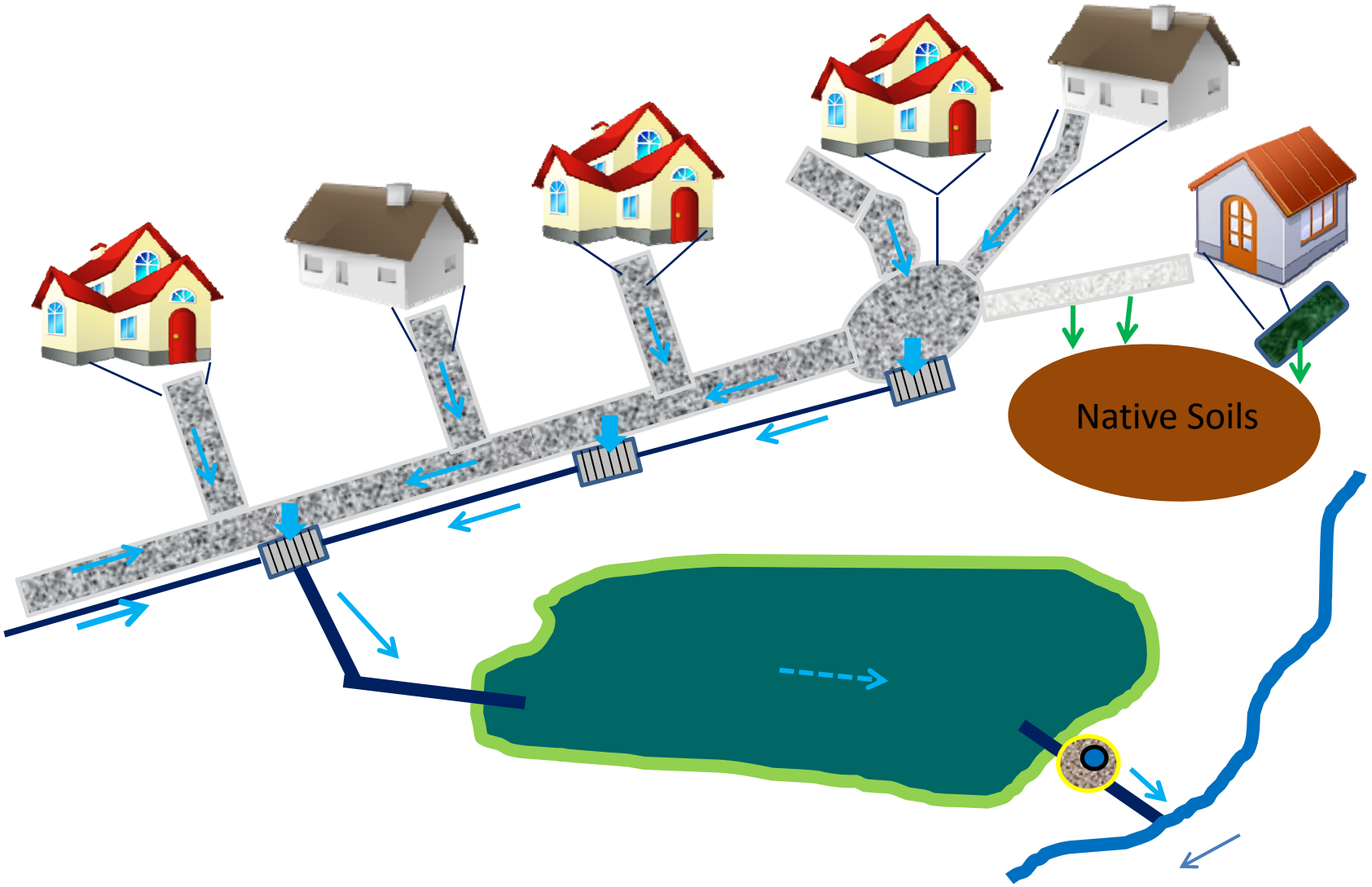


figure 1.3 Water budget for typical suburban development in the Puget Sound lowlands.
Source: AHBL

Traditional Stormwater System with LID/ Bioretention Additions



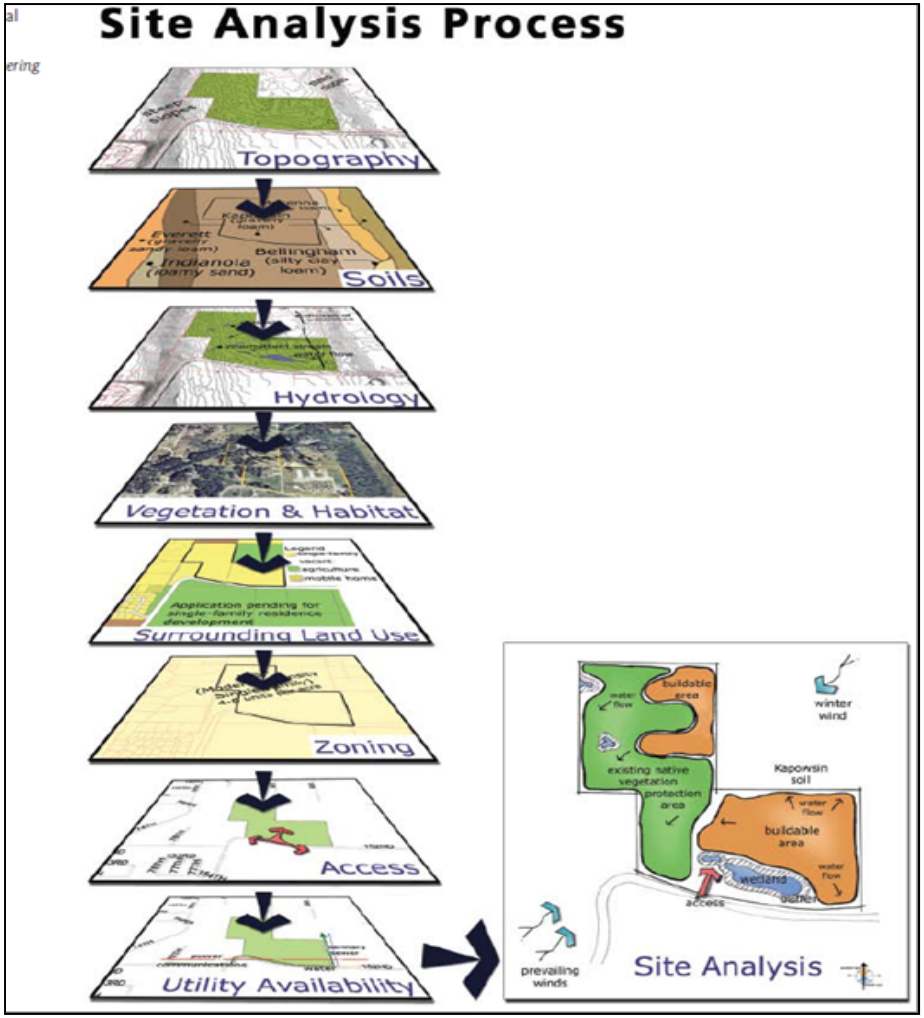
Bioretention and Rain Gardens?

- Bioretention cells and swales frequently use both surface and subsurface components.
- Bioretention cells and swales require designed soil mix (media).
- Rain Gardens rarely use underdrains.
- Rain Gardens can use less restrictive soil mixes than engineered bioretention structures like bioinfiltration cells and swales.

Bioretention Treatment

- Bioretention is a bio-in-filtration Best Management Practice (BMP)
  - Slows water for infiltration into soils
  - Direct water vertically through designed soil mixes (media mixes)
  - Treatment goal = Infiltrate a % of stormwater into soils
- Bioretention is **NOT** a bio-filtration BMP
  - Flow-through system
  - Lateral flow treatment through vegetation as conveyance
  - Treatment Goal = stormwater storage time

Bioretentention Site Planning



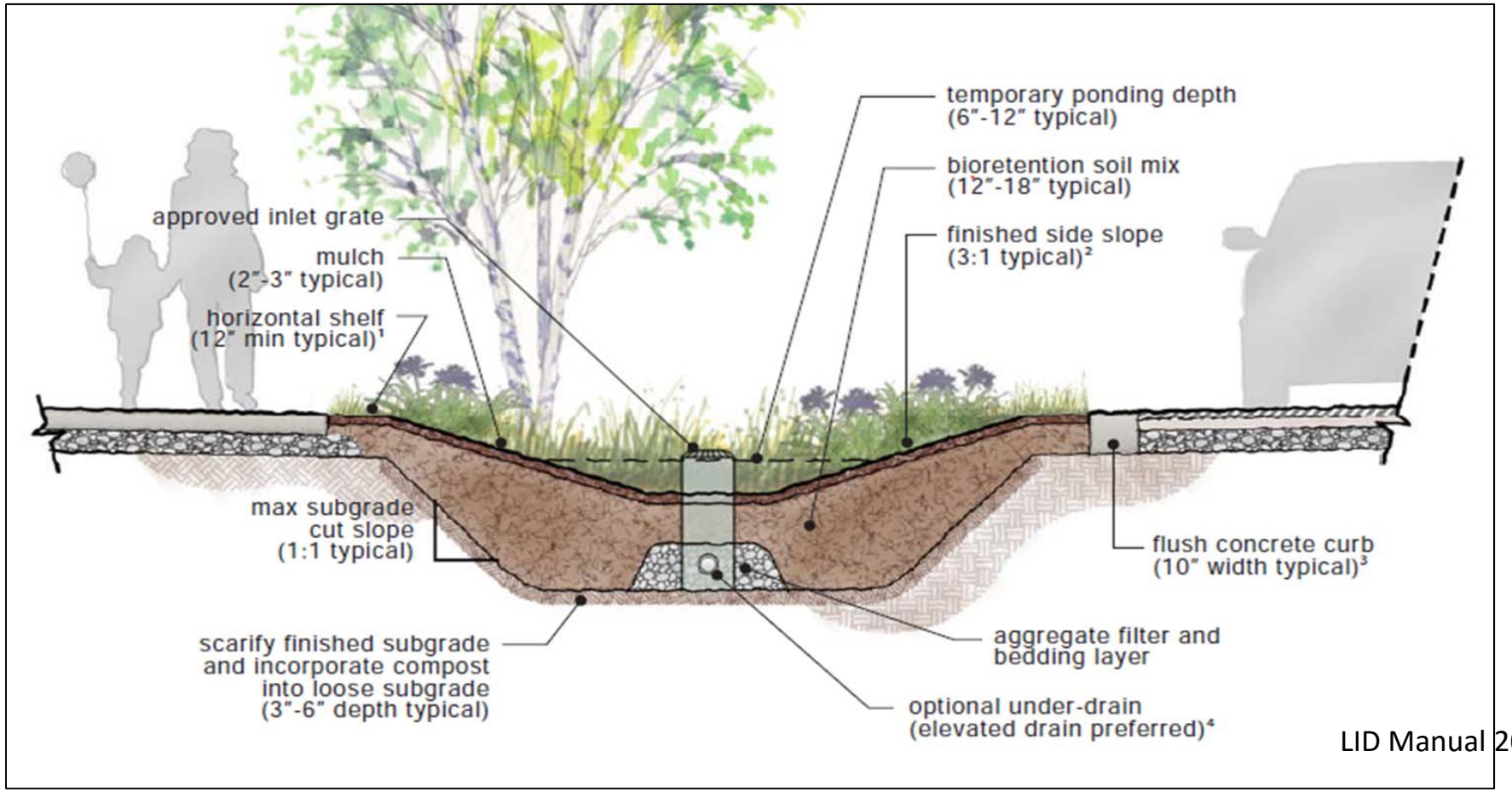
Types of LID Stormwater Structures

LID stormwater structures use the chemical, biological, and physical properties of plants, soil microbes, mineral aggregate and organic matter in soils to remove pollutants from stormwater runoff.

- **Bioretention Cells**
- **Bioretention Swales**
- **Rain Gardens**
- **Pervious Pavement**
- **Rain Water Storage**

Bioretention Cells

Engineered shallow depressions collect stormwater from small contributing areas with plants and soil media designed to **drain at a specific rate** and with specific pollutant removal characteristics. A bioretention cell may have an elevated drain or an underdrain.



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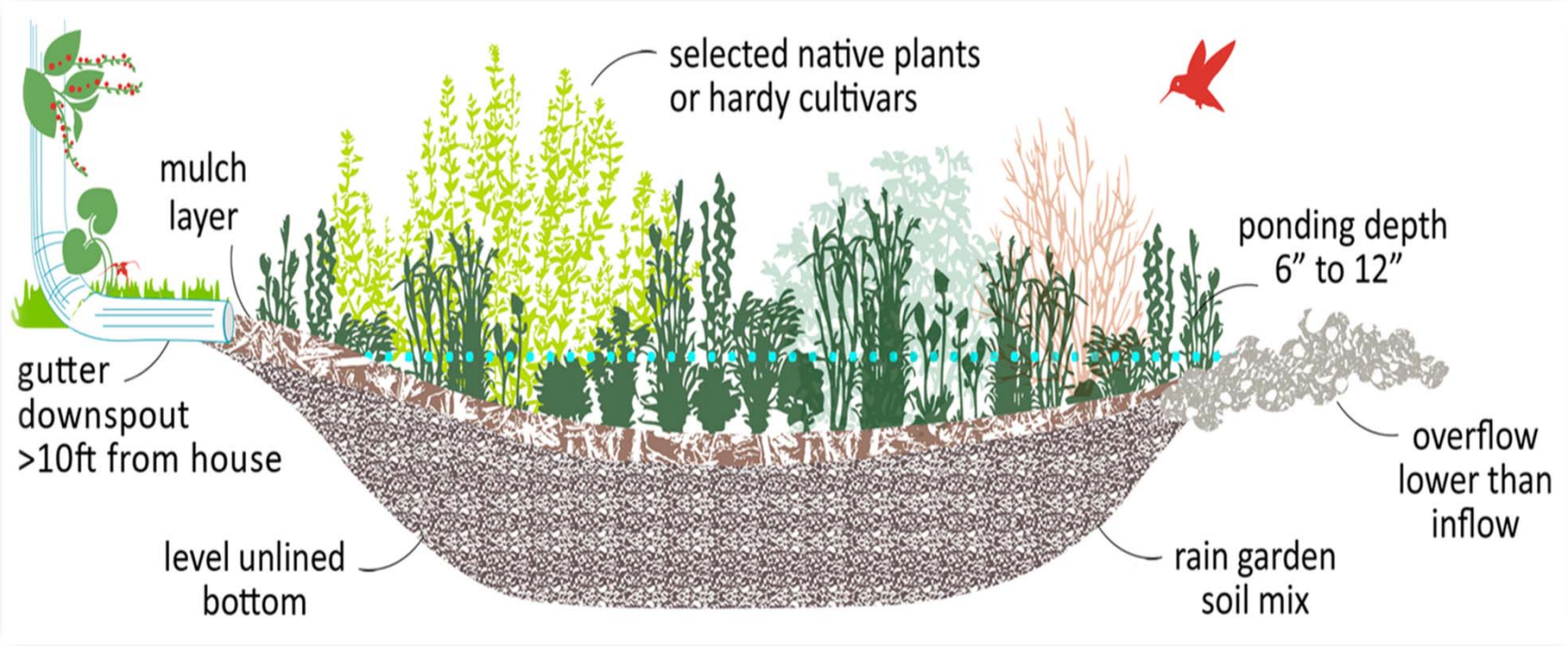
Bioretention Swales

Engineered shallow ditches that treat stormwater from buildings and roads. These engineered structures slow water with precise gradients and plants. Infiltration reduces some of the runoff. A bioretention cell may have an elevated drain or an underdrain.

Rain Gardens

Rain gardens are frequently used in landscaping designs by homeowners seeking to reduce stormwater issues on their property . Rain gardens are not engineered structures but do require careful planning to be effective and keep maintenance minimal.



Do Not Place Bioretentention Facilities:

- Where existing vegetation is already doing the work
- Where soil saturation might cause a problem: close to building foundations, over septic drain fields or shallow utilities, on steep slopes or bluffs
- Where there is poor drainage: low spots, clay soil, high groundwater table
- When a bioretention cell would need an underdrain in nutrient- or metal-sensitive watersheds

Bioretention Facility Functions

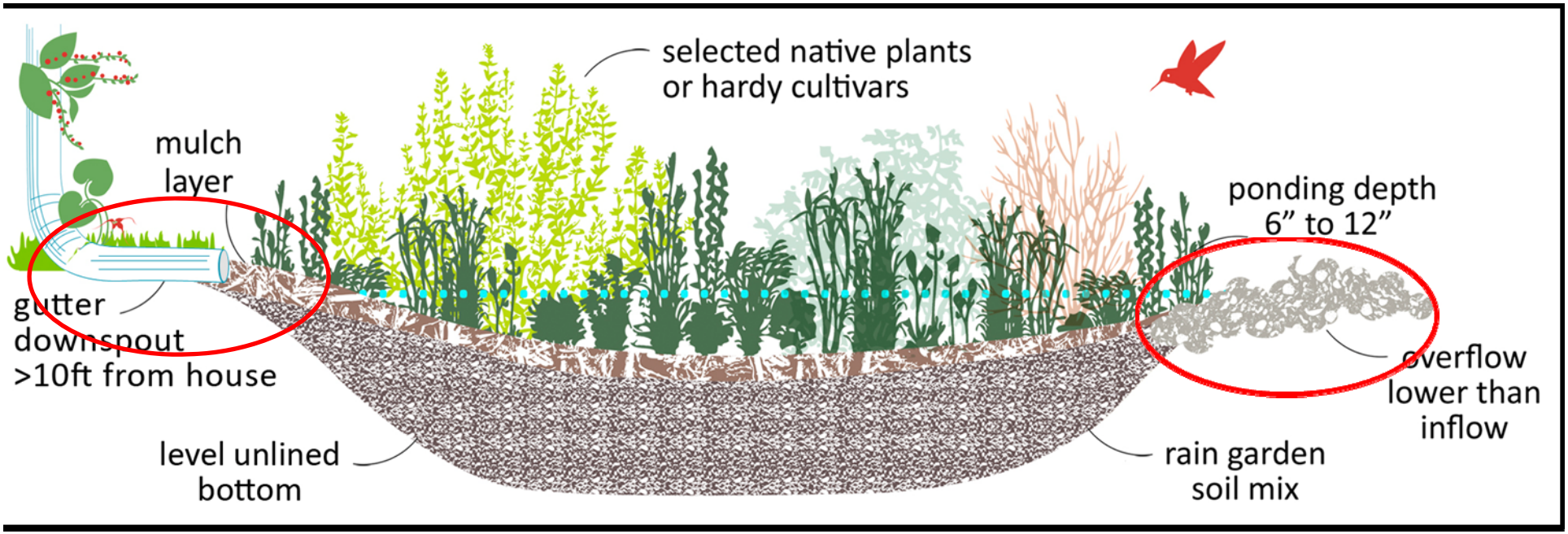
Three Main Functions of Bioretention Facilities

1. ***Interrupt*** the flow of stormwater to reduce erosion
2. ***Detain*** stormwater long enough to **remove** pollutants by breaking them down, filtering them out, or storing them in soil or plants
3. ***Infiltrate*** stormwater to keep it on site to reduce flooding and recharge groundwater

Rain gardens interrupt the flow of stormwater

A rain garden is a flat-bottomed depression where the water can **enter** by gravity from impermeable surfaces such as rooftops, driveways, or lawns

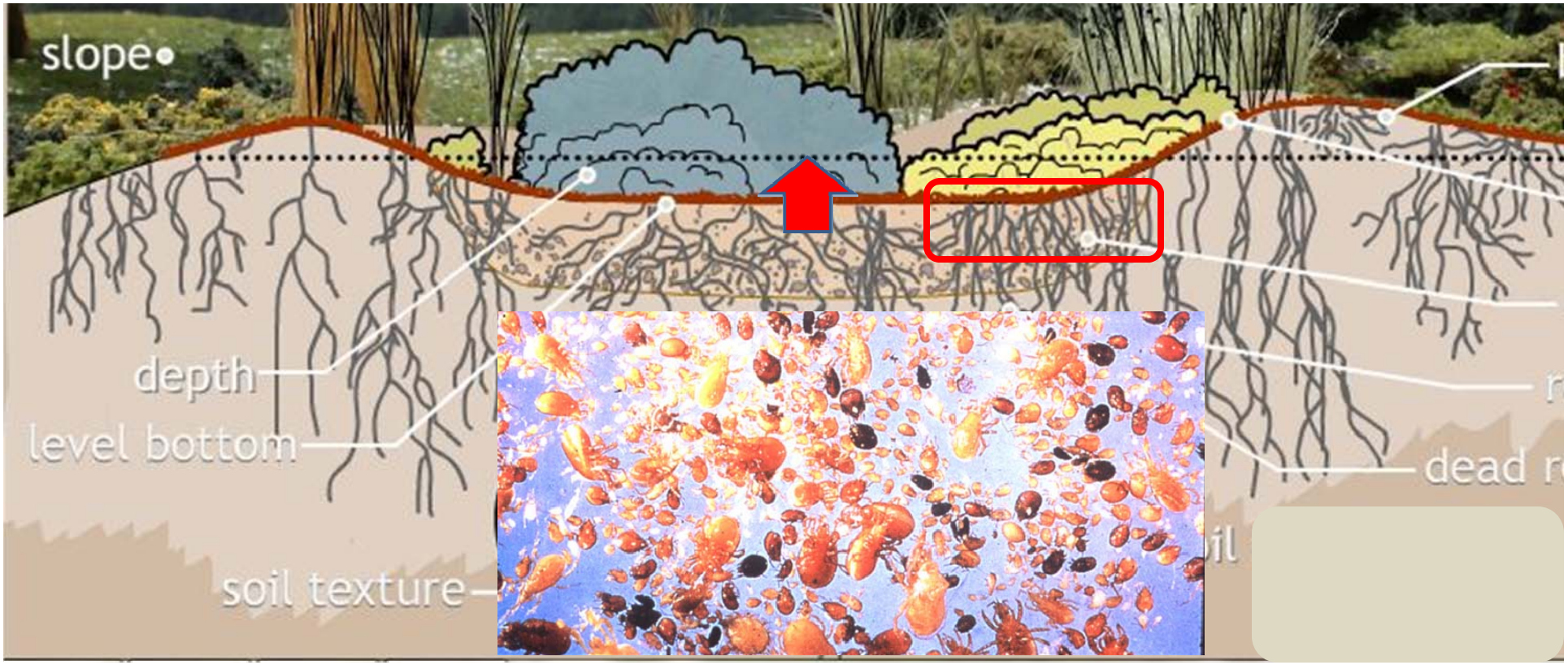
Any excess water in a storm event can **overflow** to a safe place via a drain or rock-lined channel at a lower elevation than the inflow



Rain gardens temporarily detain stormwater to remove pollutants

Stormwater **ponds** in the rain garden to a depth of 6 to 12 inches and drains in 24 to 48 hours

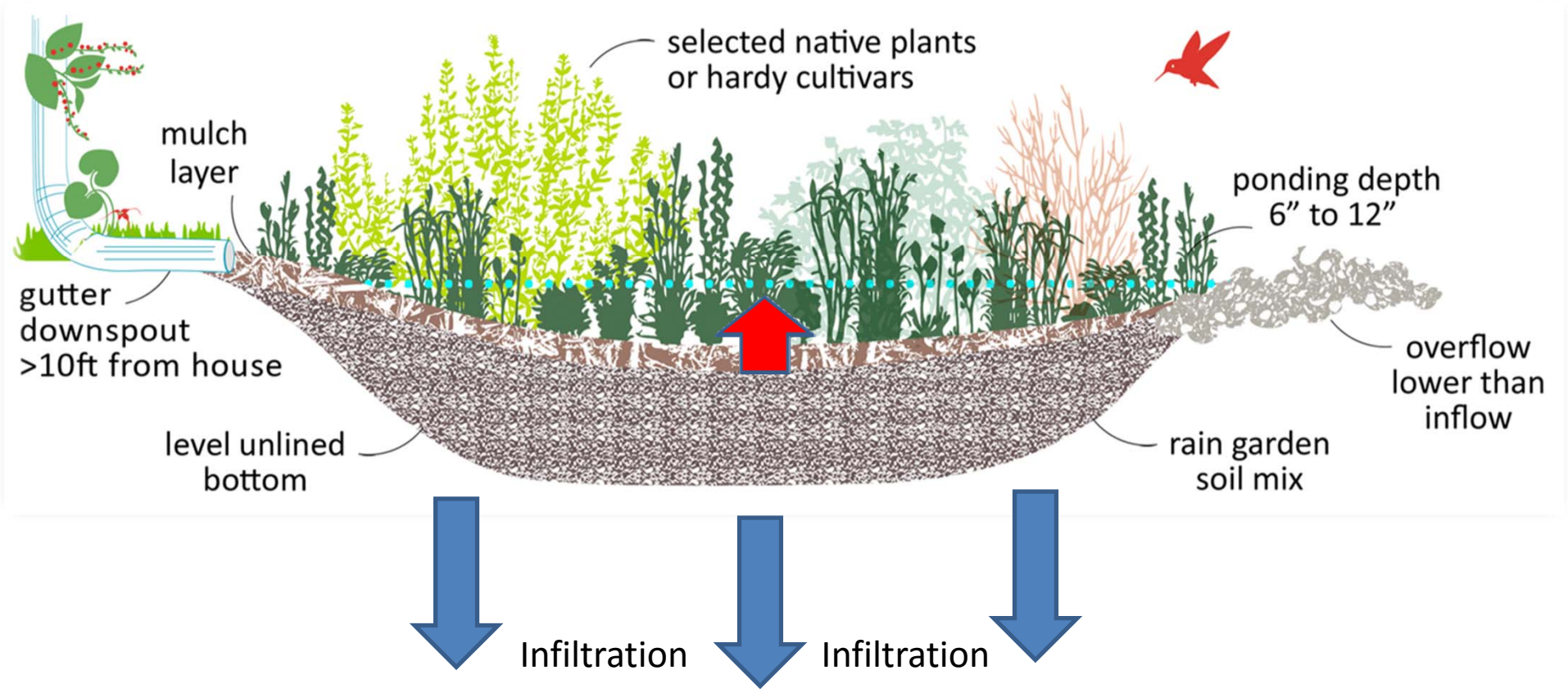
Plants, soil microbes, soil, and mulch **filter, break down, or store** pollutants in the stormwater detained in the garden



Rain gardens infiltrate stormwater

A rain garden sponges up stormwater then **releases** the processed stormwater into the surrounding soil, recharging local groundwater systems.

Rain gardens fill and empty with the cycle of winter storm events.



Bioretention Structures Mimic Forests Floors

Plants of varying heights slow down the rain as it falls

Mulch and debris on the soil surface soften the impact of rain drops

Roots of various depths open up the soil so it can absorb rain water

Maintaining Inlets and Outlets

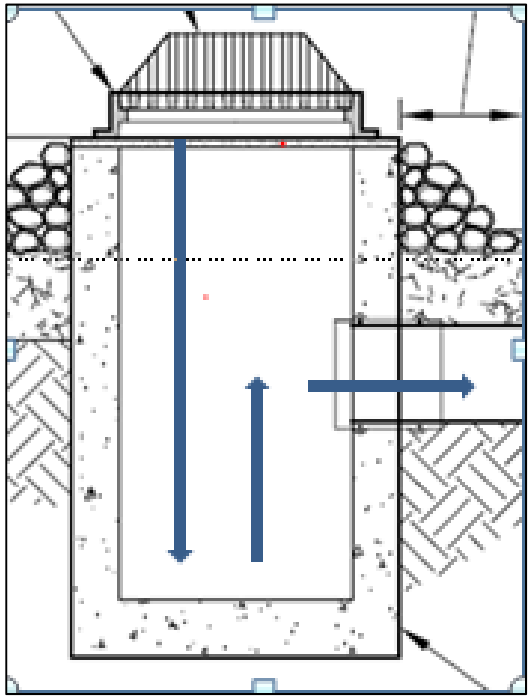
Keep Inlets Clear of Debris

Rounded rocks slow runoff well and are somewhat self-cleaning.

Keep Overflows Clear of Debris

•Bioretention facilities have outlets (overflows) designed to hold storm runoff long enough to allow sufficient removal of pollutants by the soil media, and time for infiltration into the native soil to occur.

•Outlets can range from beehive lid catch basin to a well placed curb cut with rounded rocks to minimize erosion.



Soil Basics: Porous Soil, Keep Out, Keep Planted

- Pick the right soil mix for your location.
- Don’t compact the soil by walking across site unless necessary.
- Work in bioretention site when soil is dry to avoid compaction.
- Plants roots and active microbes help soils drain well; keep good plant and mulch cover in the garden.

Mulch:

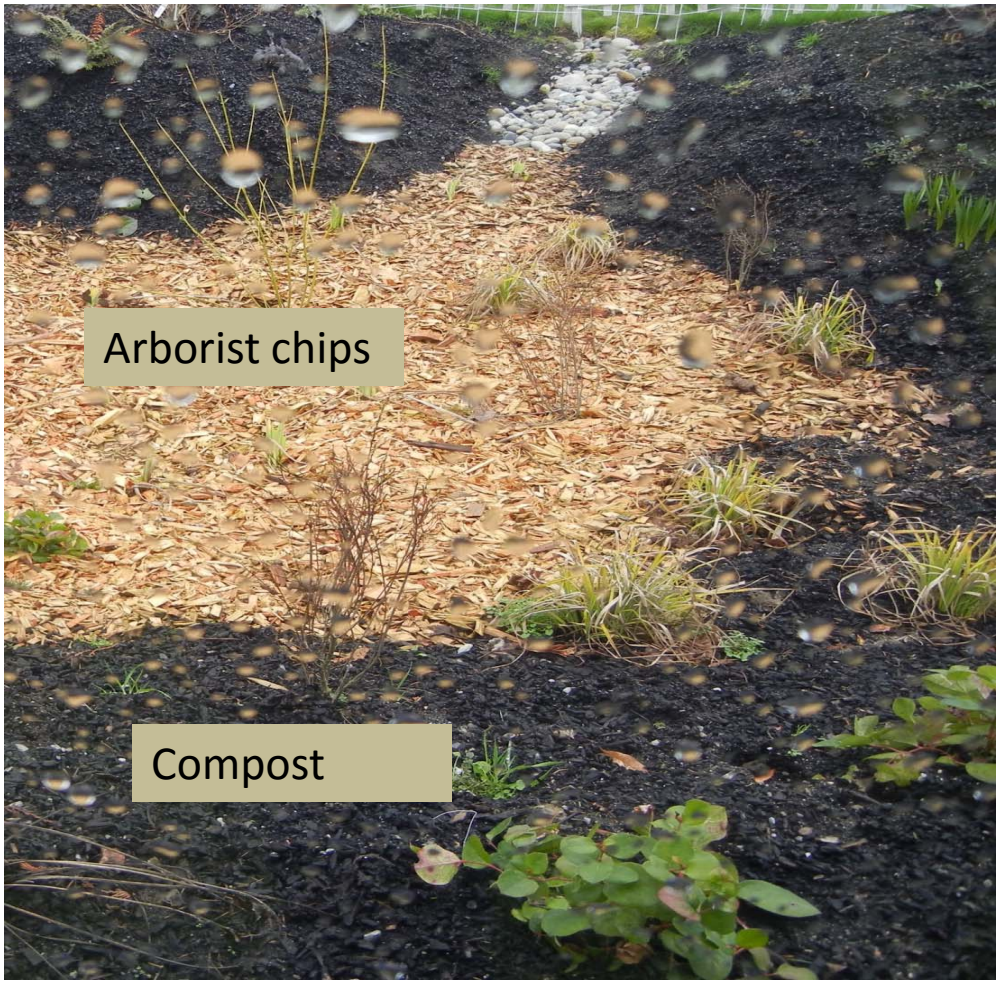
- **Prevents** compaction and erosion in storm events
- **Reduces** compaction when the gardener enters the garden
- **Mediates** soil temperatures to improve microbe habitat
- **Retains** moisture in the dry summer months for the benefit of plants and microbes
- **Provides** nutrition for plants and soil microbes as it decomposes
- **Helps** extract pollutants from stormwater

Wood Chips for Mulch!

- Use arborist wood chips. They absorb water and sink; bark repels water and floats and is more likely to clog inflows or overflows

- Wood chips provide more nutrition than bark, which is essentially sterile

- Wood chips discourage weed germination by tying up nitrogen at the soil surface; compost provides more nutrition for weeds to get growing



Maintain Your Mulch and Ground Cover

- Arborist chips break down, replenish annually to 4-in depth
- Use groundcovers as a living mulch to cover exposed soil
- As rain garden plants mature, there will be less exposed soil and therefore less need for mulch

Pull Those Weeds!

- Plant densely so plants leave no space for weeds
- Weeds rooted in wood chips pull out easily
- Remove weeds when they are small and before they set seed
- Remove invasive or noxious weeds

Pruning and clean-up

- Compact and dwarf varieties; shrubs grow well in a rain garden
- Prune dead, dying, and diseased areas (or remove plant)
- Let plants to grow to their natural form and height
- Leave leaves, twigs, and woody debris on the soil surface; they will add to the mulch layer

Compare dogwoods left and right (regular that needs pruning and dwarf that can be left to grow to its natural size)

Avoid Digging/Tilling

Dig or Till in bioretention facilities only to replace dead plants or clear obstructions.

Digging and tilling:

- Brings weed seeds to the surface
- Disturbs microbial habitat, and
- Increases soil compaction

Fertilizers, Pesticides, Irrigation

No fertilizers:

•Decomposing wood chips add enough nutrition

No pesticides:

•Use mulch to deter weeds and replace diseased plants

Irrigate only to establish plants

Prevent pollution!

- Do not add phosphorus unless there is a proven deficiency. One pound of phosphorus can grow 700 pounds of algae.

- Do not add nitrogen in cold, wet weather. Apply it only when soil microbes are active and when plants are actively growing. Nitrogen dissolves in water, and any nitrogen not metabolized by microbes or not taken up by plants leaches into groundwater

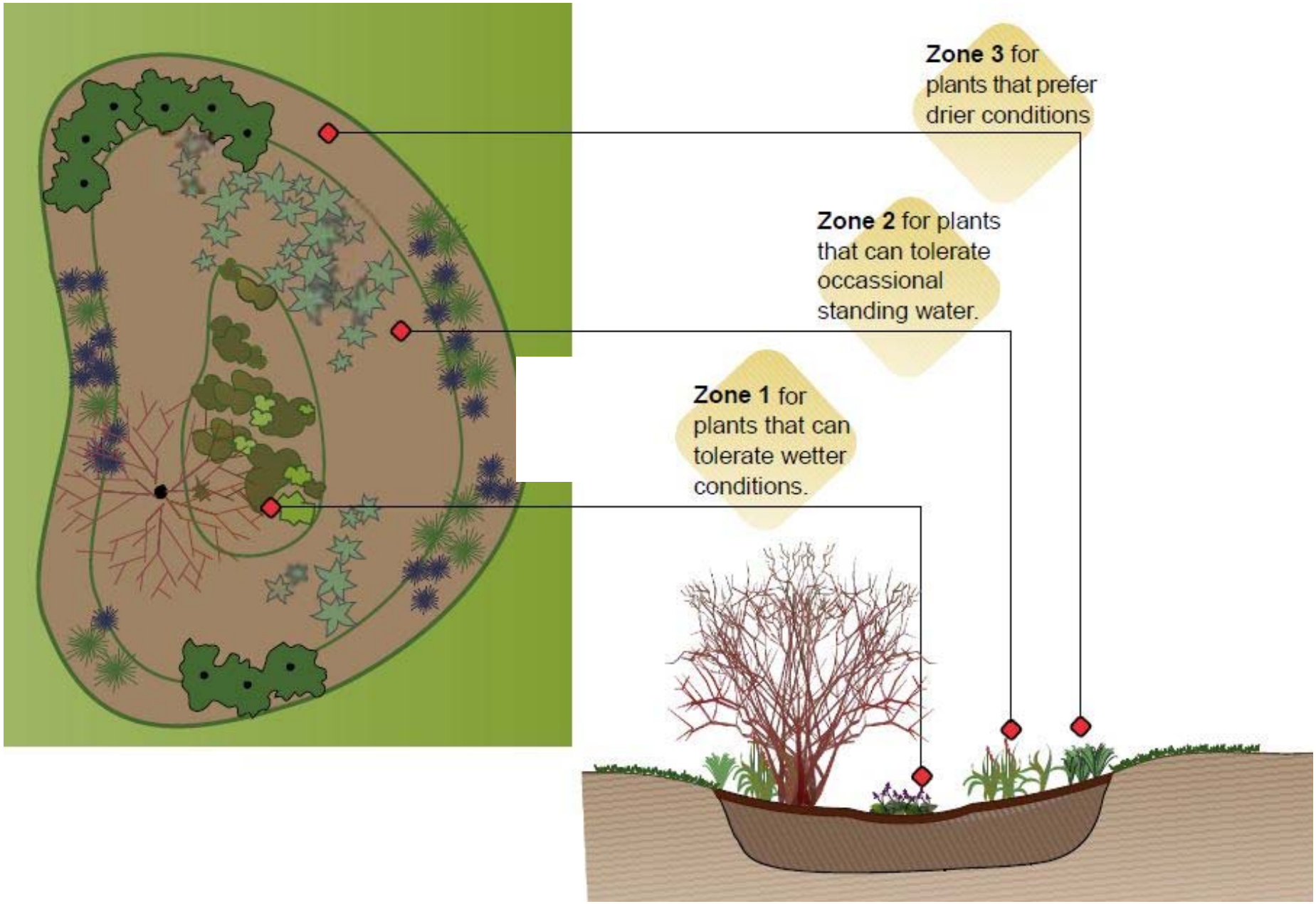
- Keep the use of copper pesticides to a minimum. Even small amounts of copper are detrimental to salmon

- Clean up pet waste

- Do not pile garden waste near water bodies

If you want to add plants to your rain garden:

- Remember that all plants in the rain garden should be drought tolerant.
- Natives or hardy cultivars will work best.
- Evaluate the habitat value and desired effect (formal or informal).
- Add plants in the dry months and irrigate until the winter rains.


Zone 3 for plants that prefer drier conditions
Zone 2 for plants that can tolerate occassional standing water.
Zone 1 for plants that can tolerate wetter conditions.

Zone 1

Ponding area. The more vegetation, the more pollution processing power

Dwarf varieties of dogwood, spirea, willow, and ninebark

Sedges and rushes

Zone 2

- Transition zone, opportunity for wildlife habitat
- Shrubs such as native Oregon grape
- Ferns
- Flowering plants such as camas and columbine

Zone 3

- The top edge. Plants blend into surrounding landscape aesthetic and provide year-round interest
- Shrubs such as spirea and red-flowering currant
- Drought-tolerant sun roses or lavender
- Grasses

Thanks to:

Jane Billinghurst, Master Gardener Volunteer at the Washington State University Skagit County Extension Office for the slideshow format and many images.

For more information

http://www.psp.wa.gov/LID_manual.php