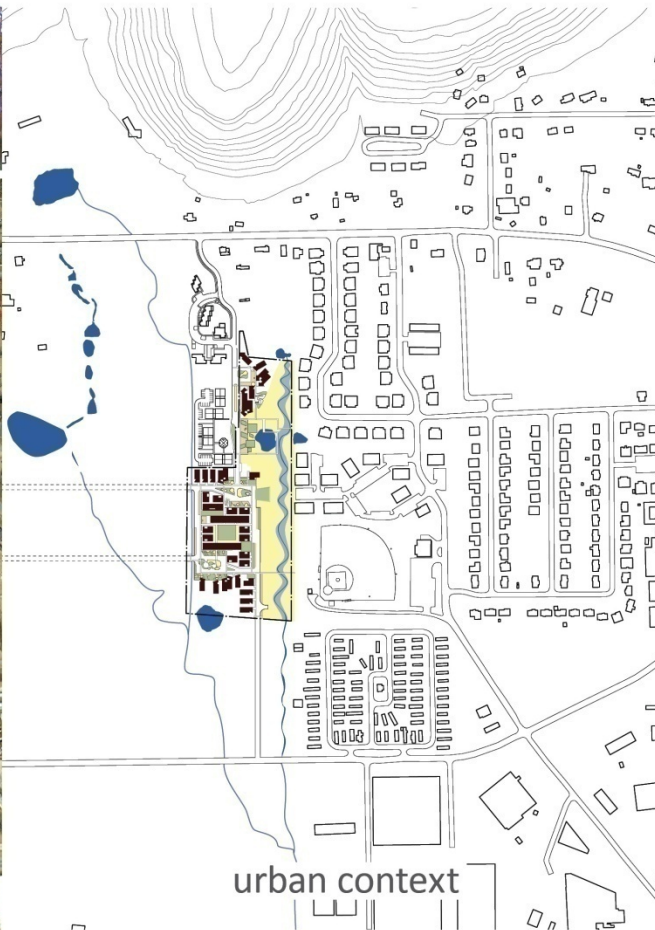


Implementation of Low Impact Development Best Management Practices to Remediate Sediment from Urban Development in Fayetteville, Arkansas

University of Arkansas Community Design Center

shared street to open space

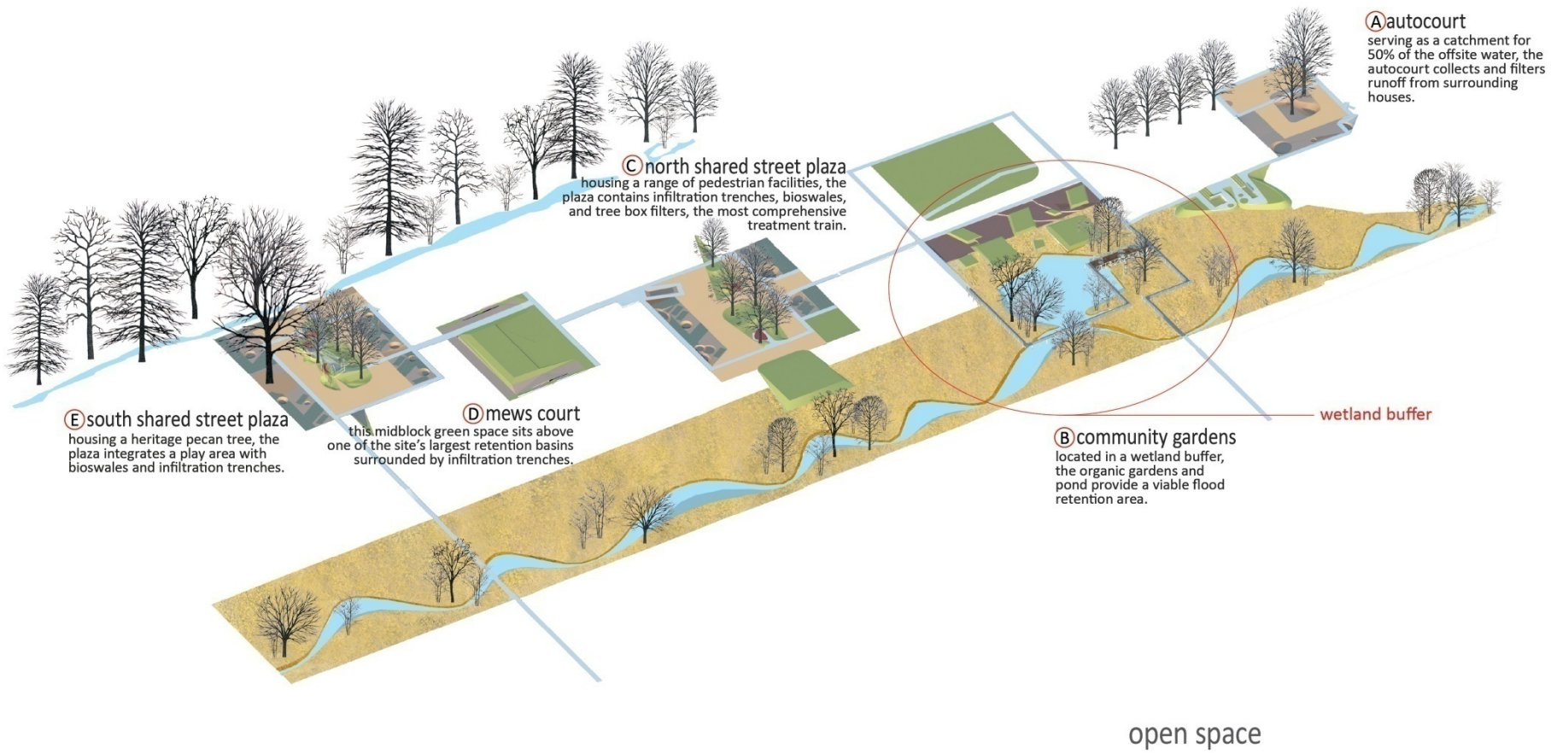


urban context

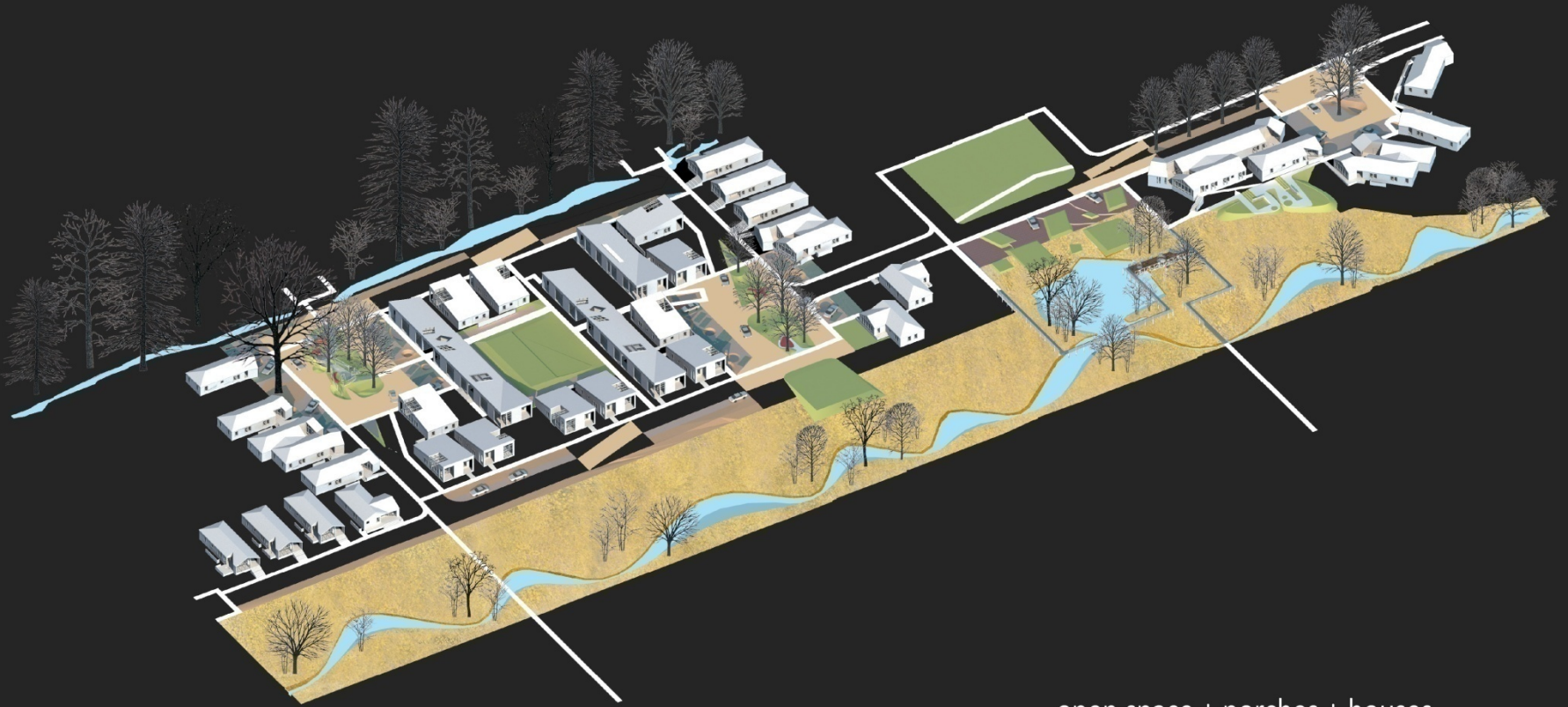


- 12' 80'
- autocourt 1
 constructed stream 2
 LEED-ND wetland 3
 buffer
 community gardens 4
 city park 5
 north shared 6
 street plaza
 mews court 7
 south shared 8
 street plaza
 play area 9
 existing farm pond 10
 existing wetland 11
 boardwalk 12

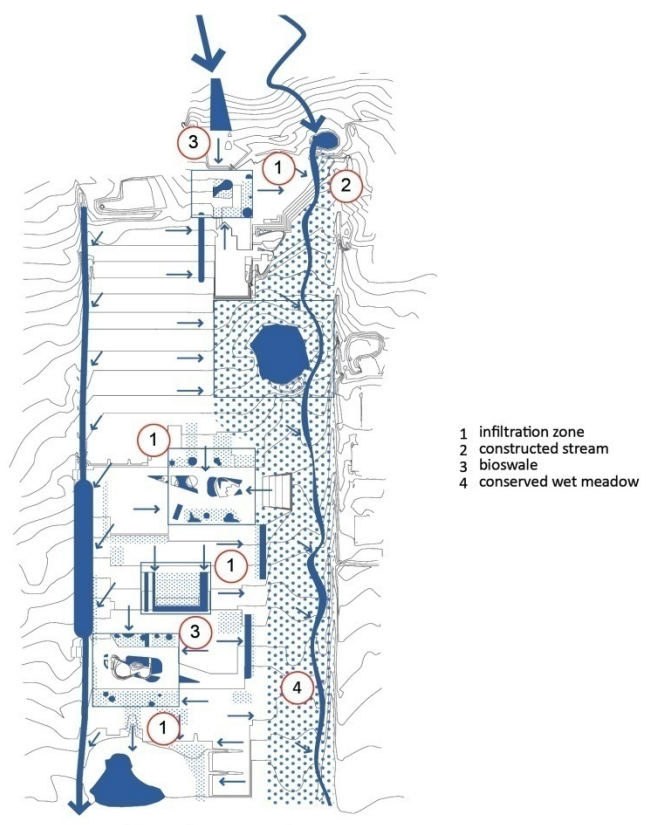
shared street to open space



shared
street to
open space

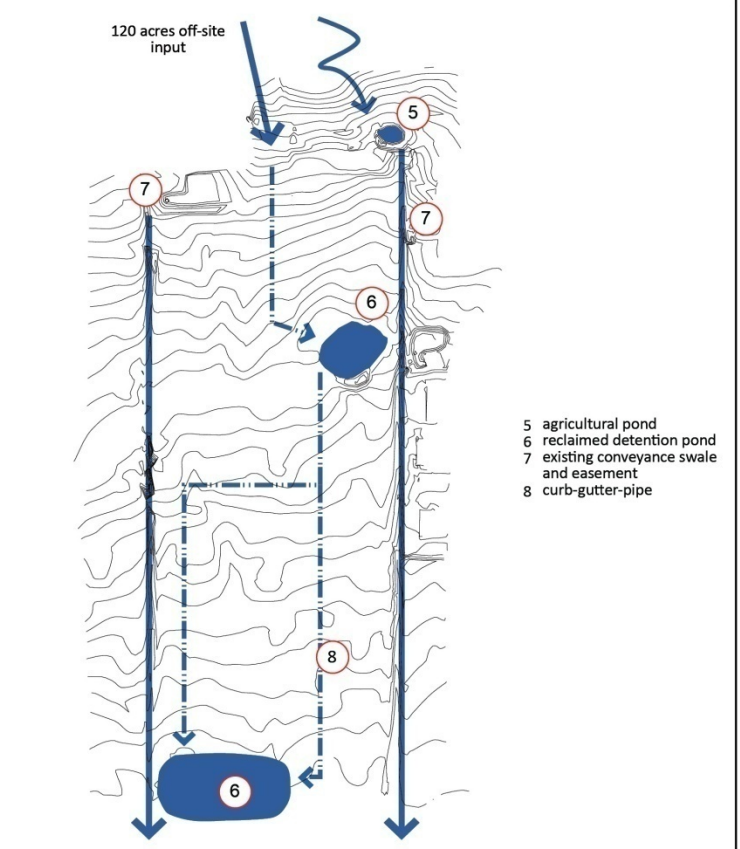


open space + porches + houses



- 1 infiltration zone
- 2 constructed stream
- 3 bioswale
- 4 conserved wet meadow

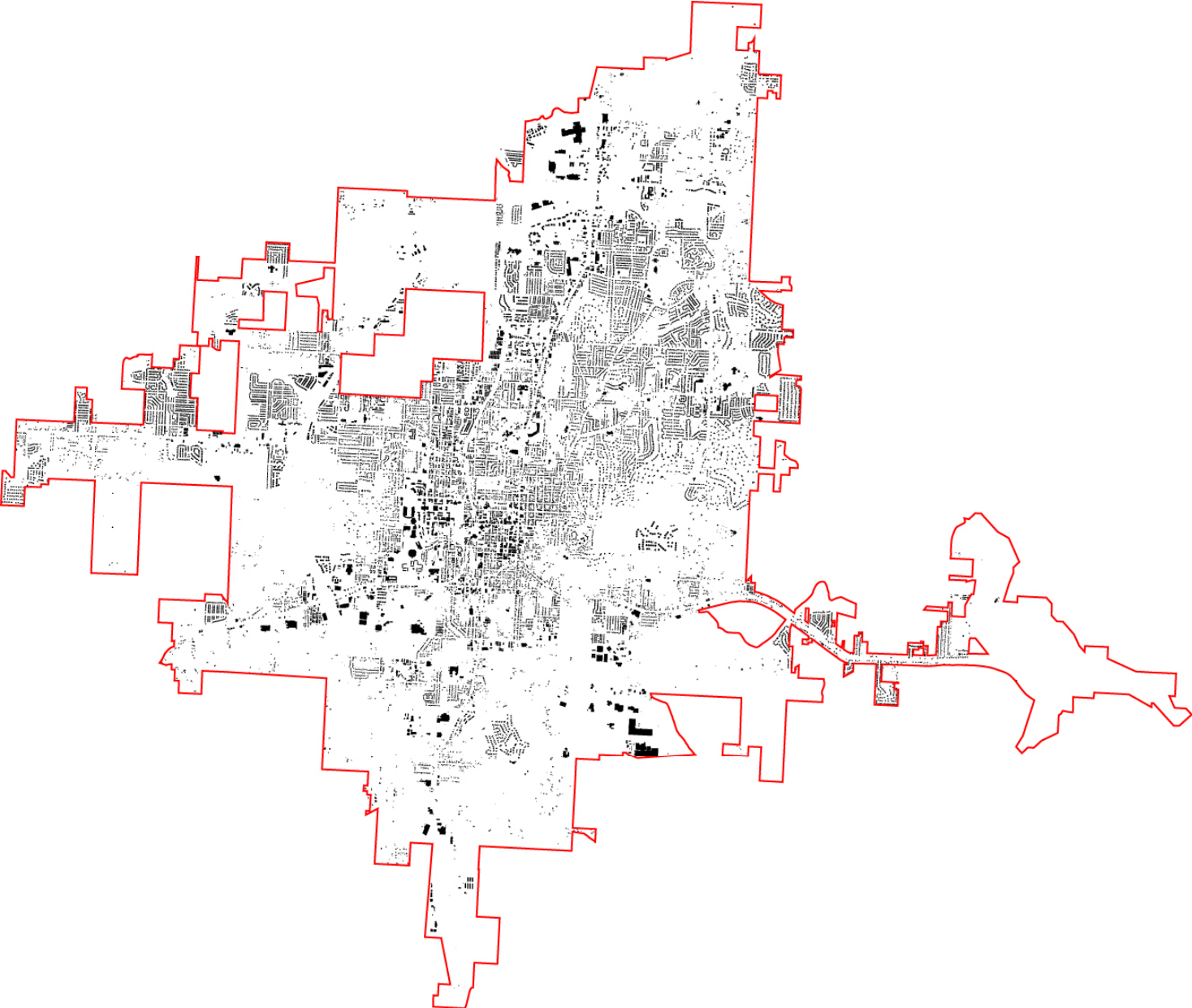
Porchscape's
low impact development solution



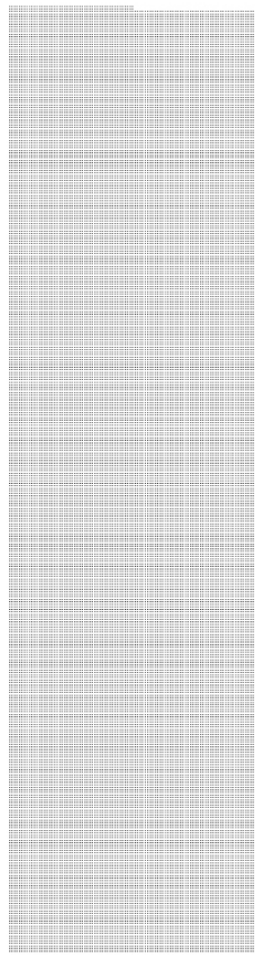
- 5 agricultural pond
- 6 reclaimed detention pond
- 7 existing conveyance swale and easement
- 8 curb-gutter-pipe

conventional pipe-and-pond solution





Current Footprint
of Fayetteville



4 units / acre
9,375 acres

Footprint of 37,500 New Housing Starts
Projected for 2050



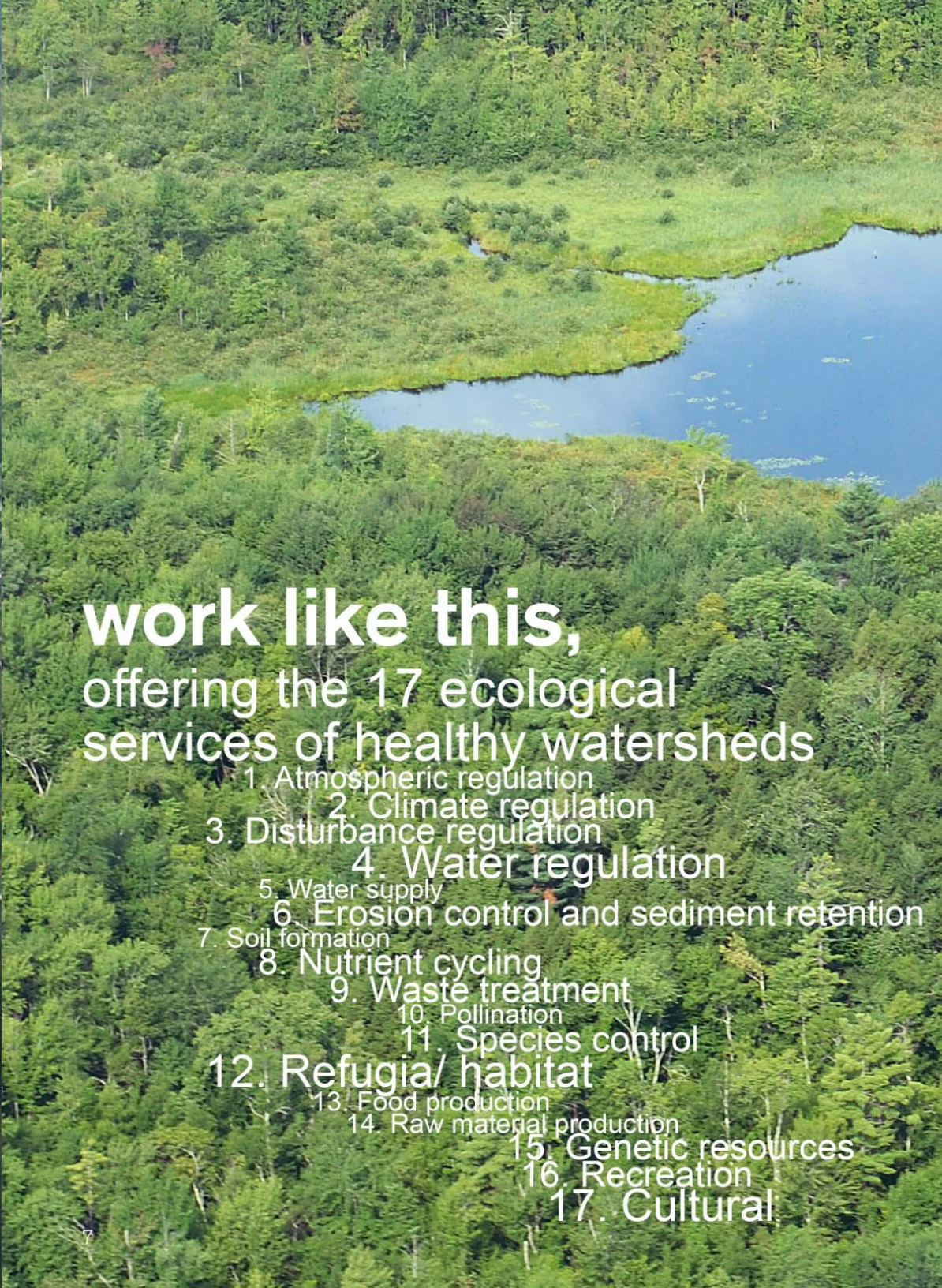
Low Impact Development

a manual for
urban areas





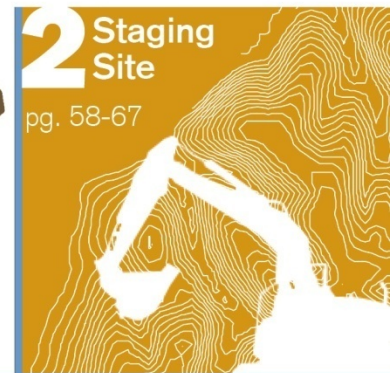
**What LID does is
make this...**

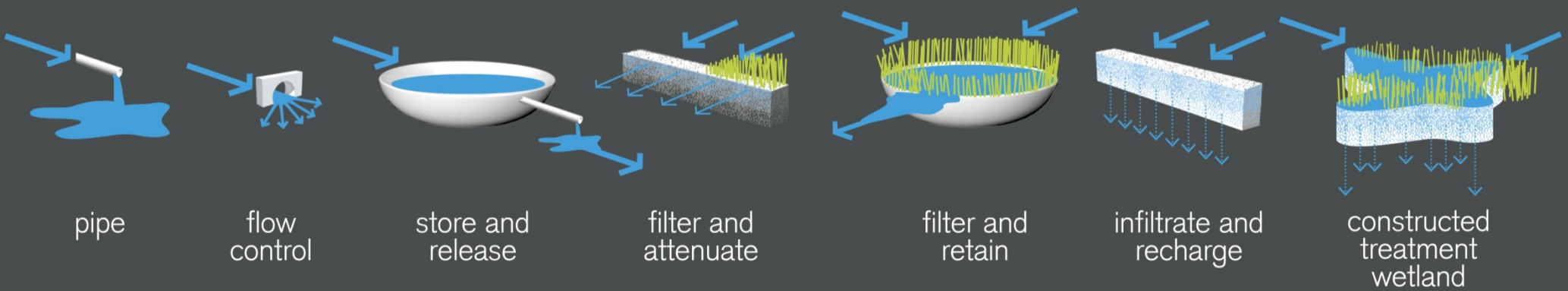


**work like this,
offering the 17 ecological
services of healthy watersheds**

- 1. Atmospheric regulation
- 2. Climate regulation
- 3. Disturbance regulation
- 4. Water regulation
- 5. Water supply
- 6. Erosion control and sediment retention
- 7. Soil formation
- 8. Nutrient cycling
- 9. Waste treatment
- 10. Pollination
- 11. Species control
- 12. Refugia/ habitat
- 13. Food production
- 14. Raw material production
- 15. Genetic resources
- 16. Recreation
- 17. Cultural

How to Implement Low Impact Development: A Three-Step Process

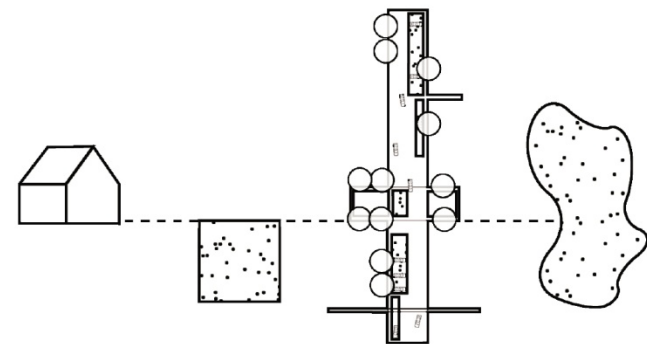




LID Design Elements

Slow ——— Spread ———> Soak

step **3** Designing LID



Building

magnify the benefits of an environmentally passive design within a compact footprint

Property

substitute an ecologically based stormwater treatment system for an otherwise decorative landscape

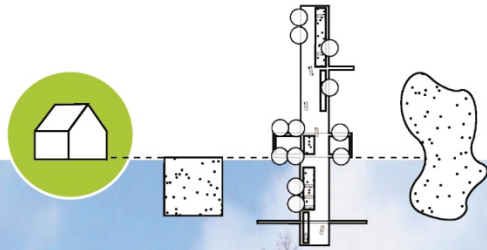
Street

design the street as a garden to achieve traffic calming and stormwater management

Open Space

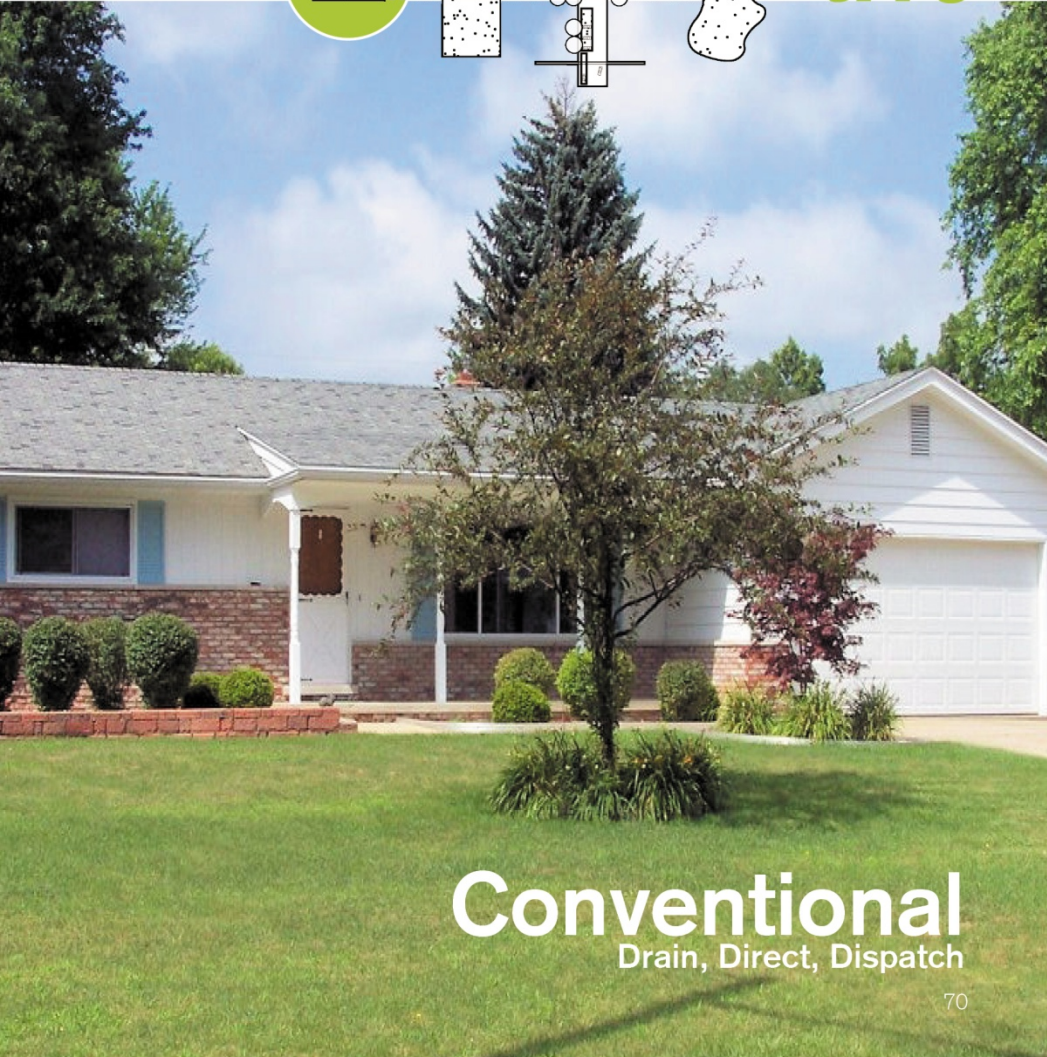
pool otherwise private, backyard amenities into a shared landscape

The Development Transect



the

BUILDING

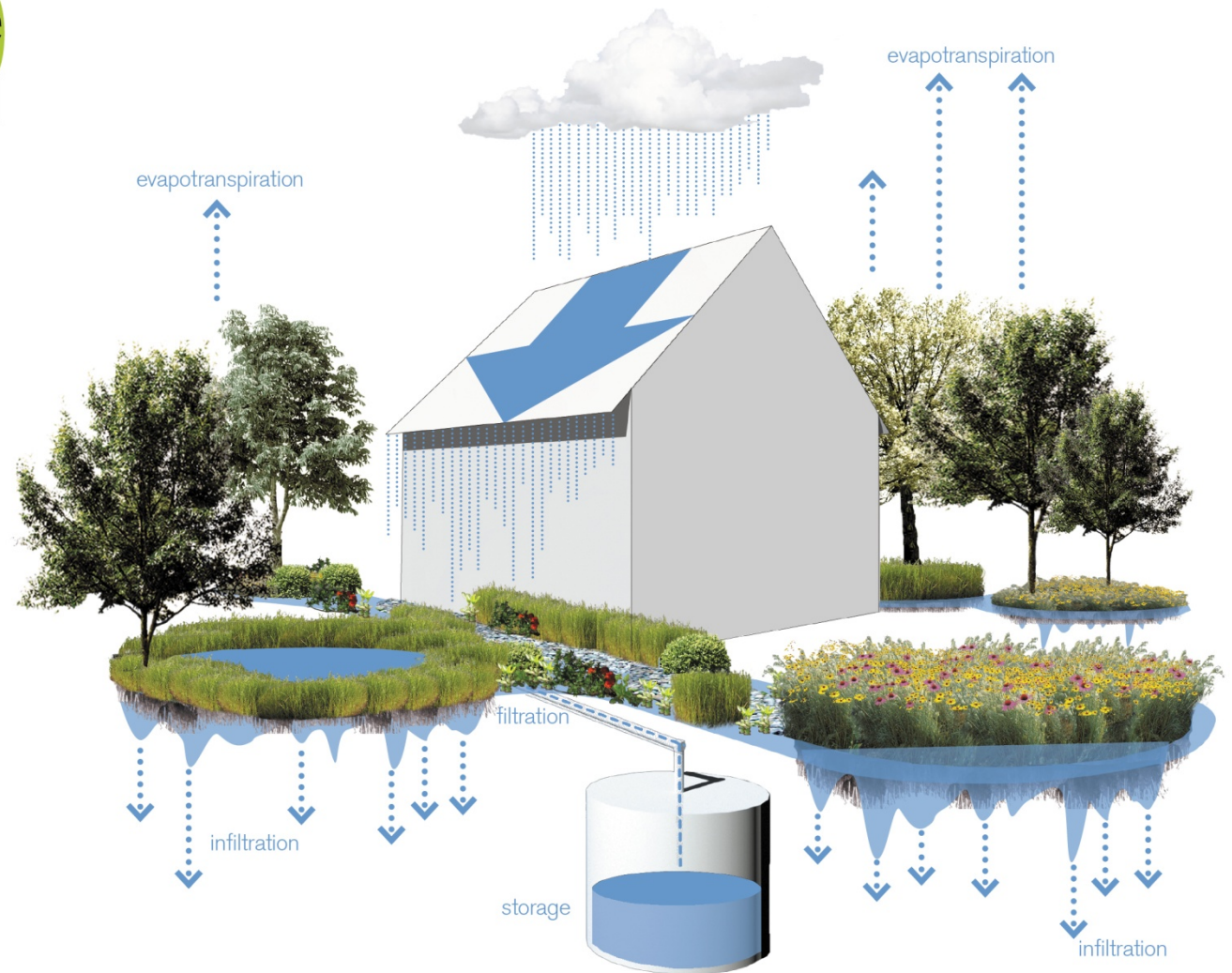


Conventional
Drain, Direct, Dispatch



Low Impact
Slow, Spread, Soak

 **LID** The Building



LID Wall Facilities



Eliminating Gutters Rain Chain

Rainwater Harvesting:

Connecting a rainbarrel to an existing gutter system is the easiest and cheapest solution to harvesting stormwater. However, water must be protected from sunlight to prevent algae build up and screen systems need to be used to keep mosquito larvae from propagation within the system. Cisterns typically store anywhere from 100-2500 gallons and can be used for irrigation on-site, greywater or potable water within the building when combined with a filtration system. BMP: Use a filter system, metal, or green roof and any overflow should be directed to on-site LID facility (see “how to harvest rainwater” in this section).



Vegetal Screen



Vegetal Wall

Disconnecting/Replacing/Eliminating Gutters:

If you have a gutter system and its connected via pipes to the street storm drain, disconnect it and keep stormwater on site. If eliminating gutters, direct and spread runoff into an LID facility. Rain chains offer an alternative solution to gutter system downspouts and increase attenuation of rainwater compared to rainleaders as stormwater sheds to LID facilities.

BMP: Use in tandem with LID facility that infiltrates stormwater on-site.



Stormwater Barrel

Stormwater Cistern

Vegetal Walls and Screens:

Most expensive wall LID facility that can be employed at the building. However, they offer benefits such as higher air quality, reduced heat island, building energy efficiency, and filtration of roof runoff that can be conveyed or harvested.

BMP: Use in tandem with on-site LID facility.

- Storage Capacity: N/A
- Cost: Low
- Durability: 1-5+ years

- Storage Capacity: 100-2500+ gallons
- Cost: Moderate
- Durability: 20-50 years

- Storage Capacity: N/A
- Heat Island Mitigation: High
- Cost: High
- Durability: 30-40 years

Minimum Level of Service

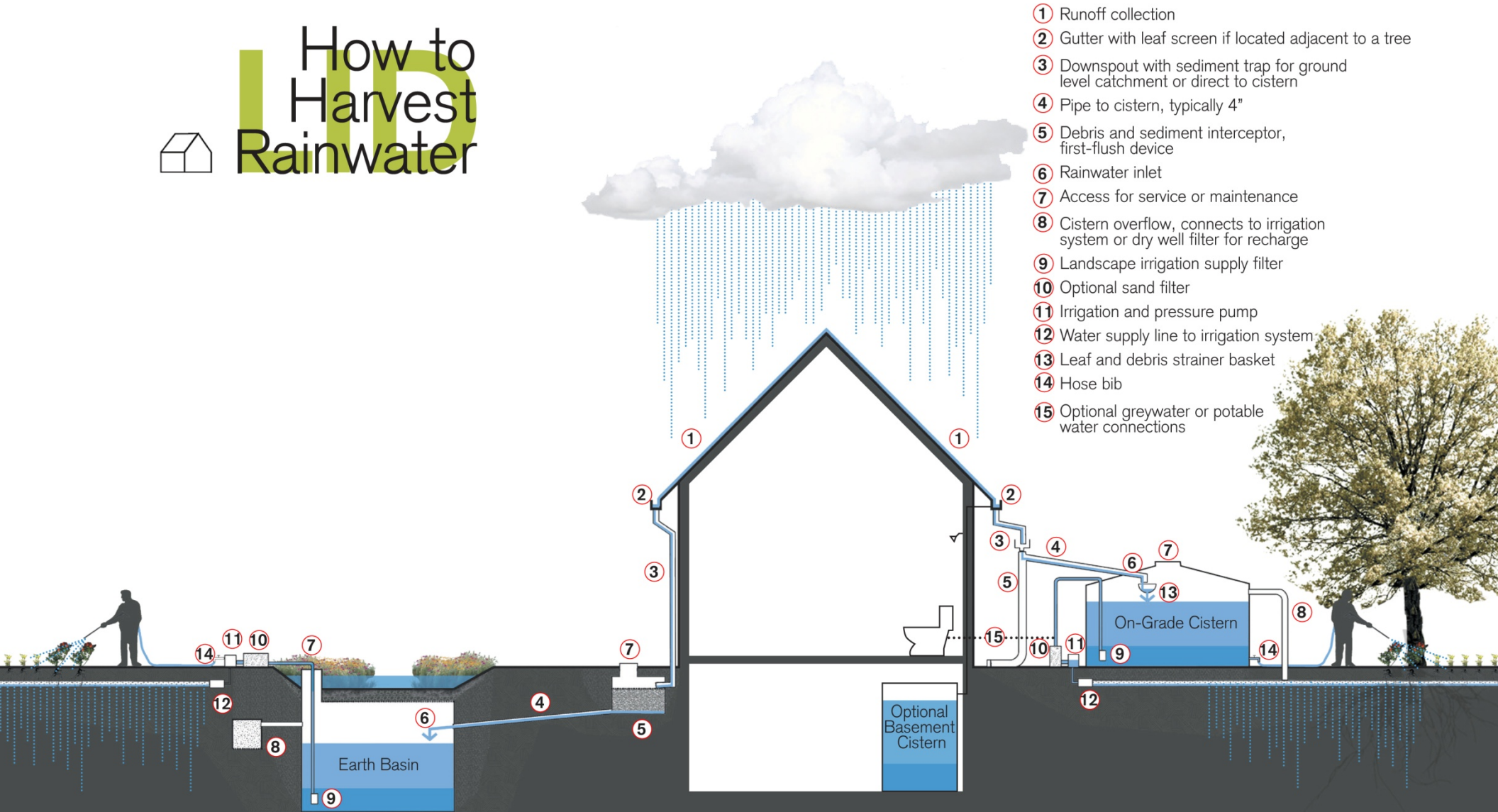
- Storage Capacity: N/A
- Cost: Low
- Durability: N/A

- Storage Capacity: 50 gallons
- Cost: Low
- Durability: 1-5+ years

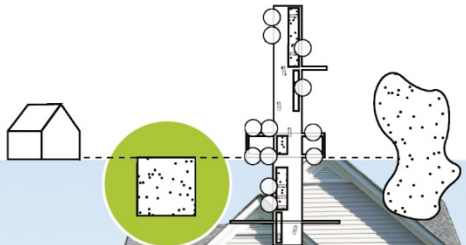
Maximum Level of Service

- Storage Capacity: N/A
- Heat Island Mitigation: High
- Cost: High
- Durability: 30-40 years

How to Harvest Rainwater



- ① Runoff collection
- ② Gutter with leaf screen if located adjacent to a tree
- ③ Downspout with sediment trap for ground level catchment or direct to cistern
- ④ Pipe to cistern, typically 4"
- ⑤ Debris and sediment interceptor, first-flush device
- ⑥ Rainwater inlet
- ⑦ Access for service or maintenance
- ⑧ Cistern overflow, connects to irrigation system or dry well filter for recharge
- ⑨ Landscape irrigation supply filter
- ⑩ Optional sand filter
- ⑪ Irrigation and pressure pump
- ⑫ Water supply line to irrigation system
- ⑬ Leaf and debris strainer basket
- ⑭ Hose bib
- ⑮ Optional greywater or potable water connections



the

PROPERTY



LAWNS



PARKING LOTS

Conventional
Drain, Direct, Dispatch



Low Impact
Slow, Spread, Soak

“...the lawn is one of America’s leading crops.”

- Lawncare is a \$40 billion a year business.
- Suburban lawns receive more herbicides per acre than most farmers spread to grow crops.
- The average lawn consumes more than 10,000 gallons of water per summer.

12.5 % of refuse in landfills comes from food scraps; 12.8% from yard trimmings. Over 25% of all waste is organic material that industrial lawns cannot reuse in a more sustainable manner.



The Industrial Lawn
A Linear Train of Inputs and Wastestreams

The Low Impact Lawn
A Closed, Regenerative Loop

An aerial photograph of a commercial district. The scene is dominated by large, light-colored industrial or retail buildings with flat roofs. Extensive parking lots, filled with cars, surround the buildings. A multi-lane road with a median runs through the center of the area. The overall impression is one of a high-density, car-oriented environment.

If you are wondering why parking lots matter, look around.

Their area is usually one and a half times the size of the building they serve. How can low impact techniques soften the surface?

pheric regulation



flow attenuation



erosion control and sediment retention
infiltration



heat island mitigation



ate regulation



soil formation

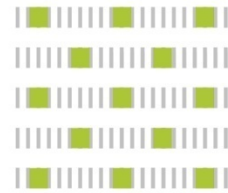
filtration

flow attenuation

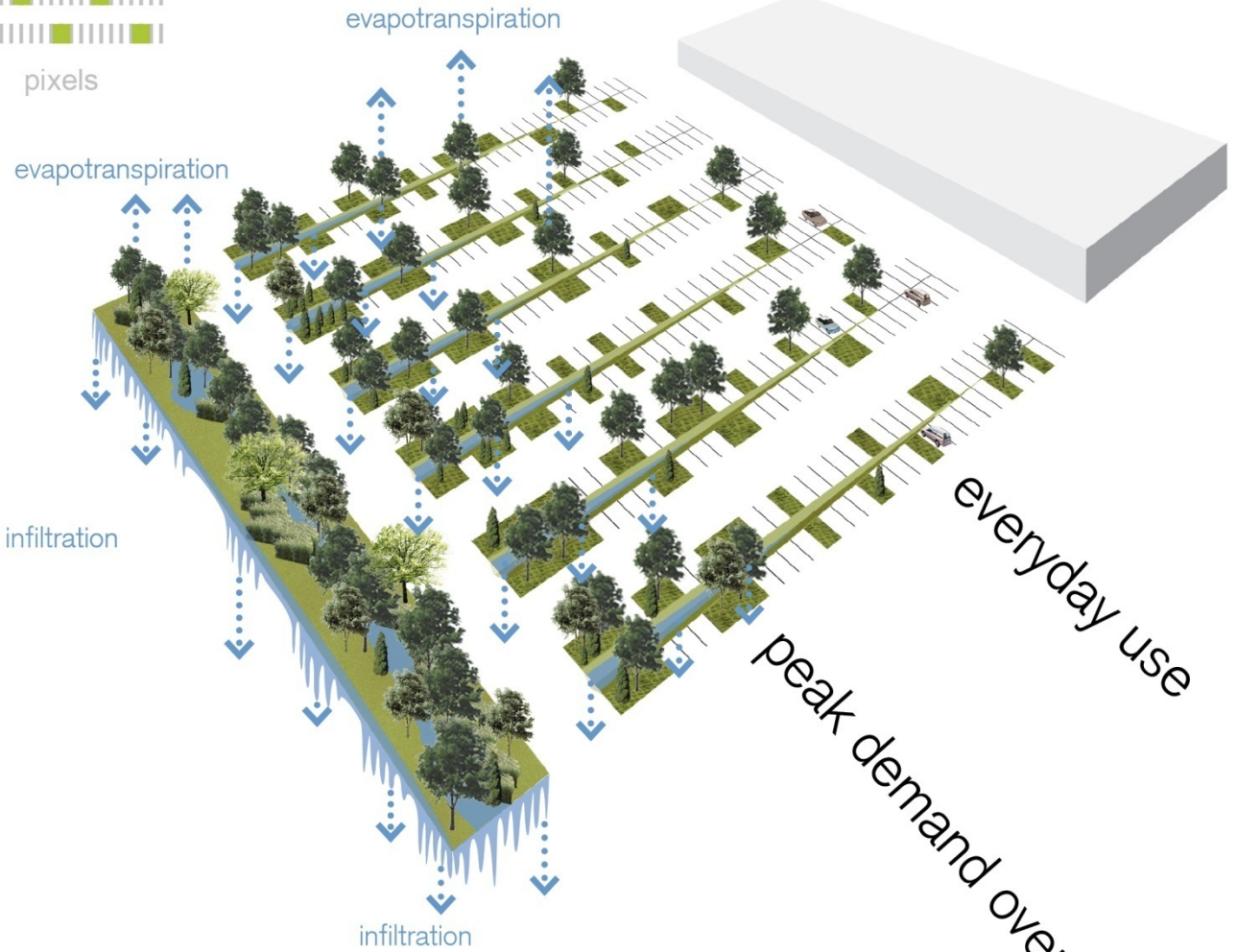
Heifer International

Little Rock, Arkansas

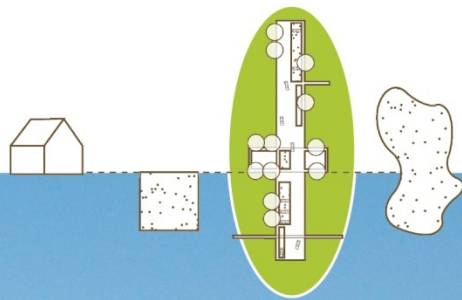
Adapted Big Box Parking



pixels



The Conventional Detention Basin



the

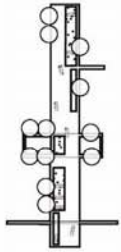
STREET



Conventional
Drain, Direct, Dispatch



Low Impact
Slow, Spread, Soak



LID The Street



How can streets be designed using LID?

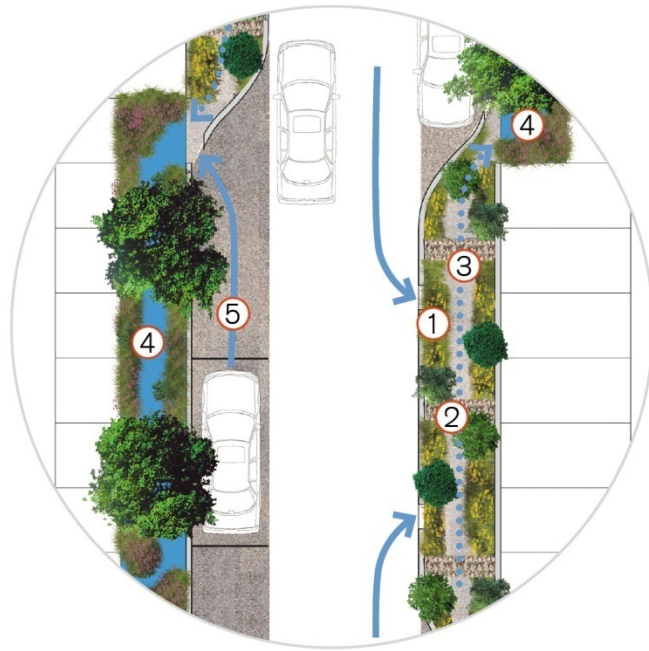


Minimum Level of Service



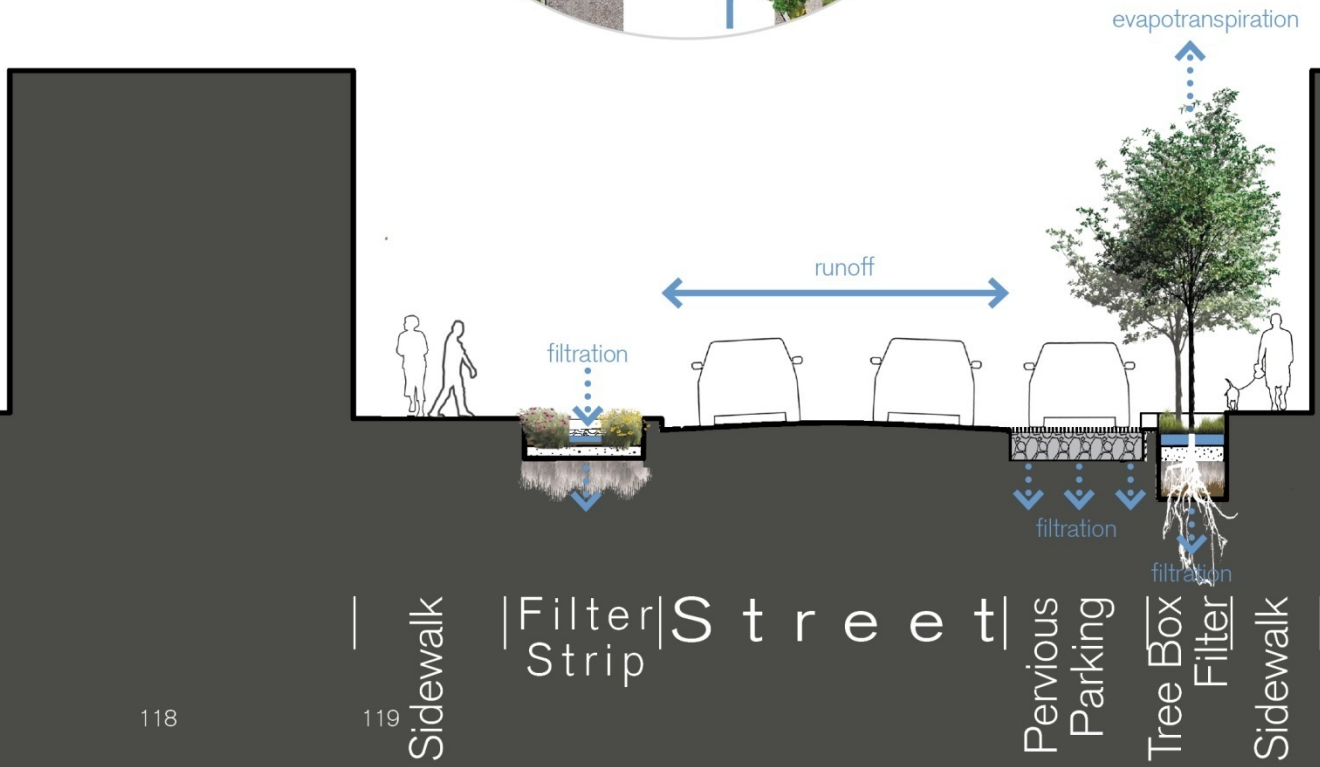
Maximum Level of Service

Let's take a closer look at a few...



Curb Extension

- ① Curb Cut Stormwater Entry
- ② Stone Check Dam
- ③ Dry Swale
- ④ Rain Garden
- ⑤ Permeable Paving



| Sidewalk | Filter Strip | Street | Pervious Parking | Tree Box Filter | Sidewalk |



climate regulation

infiltration

rain garden

shared throughway

flush curbs

single ground surface material
(from building to building)

heat island mitigation

parallel parking

rain garden

infiltration

flush curbs

Willamette Street

Eugene, Oregon

climate regulation

heat island mitigation



indigenous facultative
landscapes

erosion control and
sediment retention

infiltration

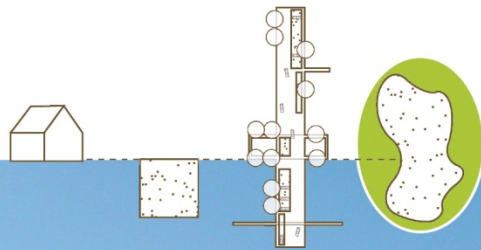
Siskiyou Street

Portland, Oregon

120

121

stormwater entry



the OPEN SPACE



Conventional
Drain, Direct, Dispatch



Low Impact
Slow, Spread, Soak

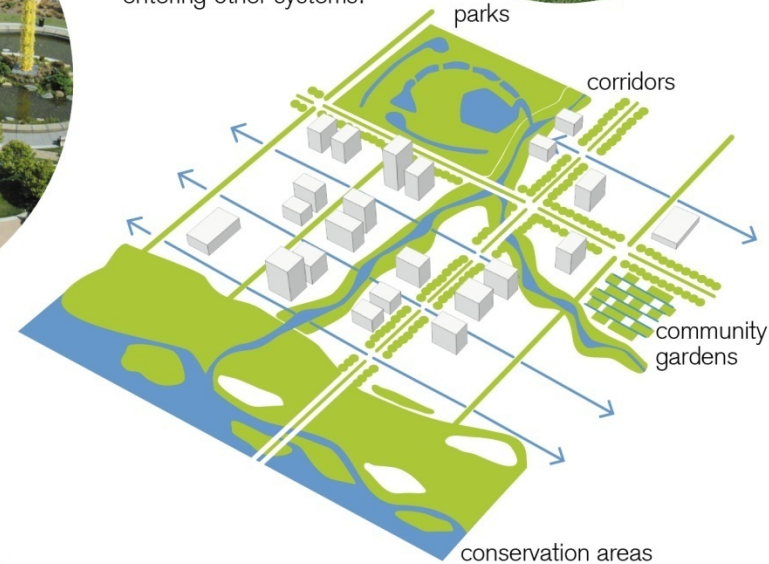


Open Space Hydrology

Parks are areas of land that are set apart for active and passive recreation. Parks can contain high maintenance lawns and impervious surfaces, but have the potential for dealing with large amounts of urban stormwater runoff.



Corridors such as trails, easements, and riparian zones connect other types of open space and built systems. While corridors are meant to convey water to larger open space types, they can aid in slowing stormwater velocity and filtering the water before entering other systems.



Conservation Areas contain many ecological services such as habitat for flora and fauna. They also allow for stormwater filtration and infiltration. Conservation measures should be enacted to preserve these precious resources.



Community Gardens are parcels of land that the public can use to grow flowers, vegetables or fruit. Community gardens represent good economy of scales for harvesting rainwater from roofs and other impervious surfaces.





refugia

filter strip

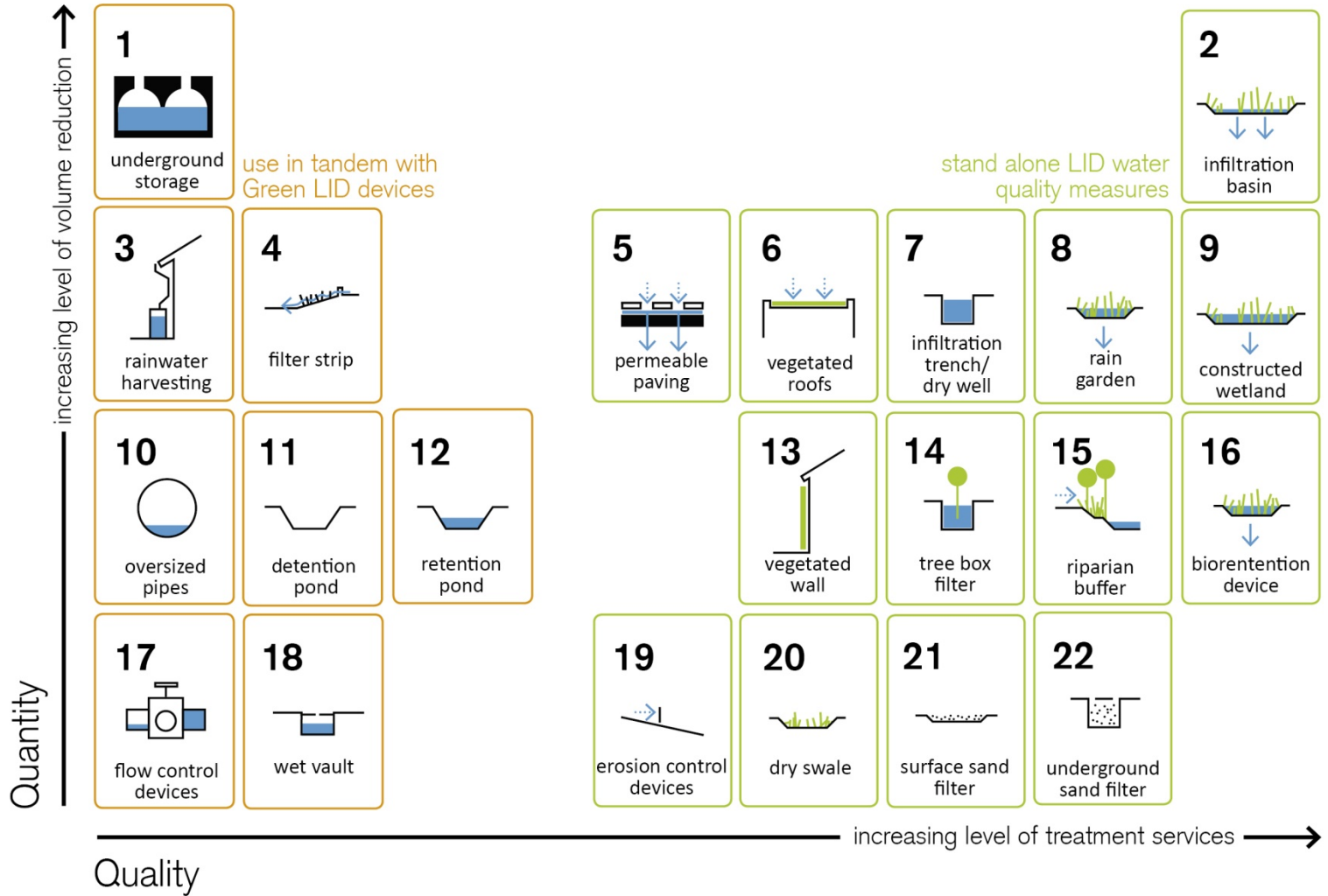
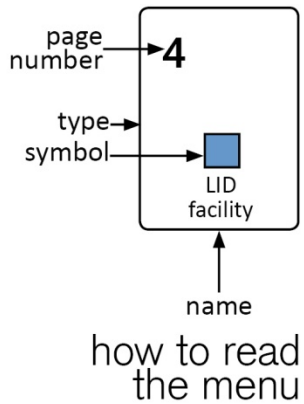
constructed wetland

infiltration basin

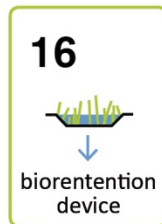
Emerald Necklace

Boston, MA

LID Facilities Menu



- **Level of Service:**
treatment/ conveyance attenuation
- **Location in Treatment Train:**
downstream of filtration components,
but upstream of major treatment
systems and basins
- **Scale:**
2-25' wide with 2-4" water depth
- **Maintenance Regime:**
occasional trash removal and pruning
of vegetation. bioswales require attentive
watering during establishment phase
- **Establishment Period:**
establishment period is typically 1-2 years



bioretention device

A biofiltration device is an open, gently sloped, vegetated channel designed for treatment of stormwater. Examples of a bioretention device are bioswales, rain gardens, and bioretention basins.

The primary pollutant removal mechanisms are filtration by grass blades or other approved vegetation, which enhance sedimentation and trapping and adhesion of pollutants to the grass and thatch. A swale can be designed for both treatment and conveyance of onsite stormwater flow. This combined use can reduce development costs by eliminating the need for separate conveyance systems. Biofiltration swales are best applied on a relatively small scale (generally less than five acres of impervious surface). They work well along roadways, driveways, and parking lots. Swales are more costly to apply in situations where the swale channel would be deep.

