DESIGNING FOR IMPACT

LID TOOLBOX

A Regional Guide to
Low Impact Development

SPIDER LILY

As a native plant, the Spider Lily is commonly found along roadsides and in moist soil conditions. Spider Lily is mostly evergreen in this region and flowers during the summer months.

Common LID applications of Spider Lily include bioswales, rain gardens, constructed stormwater wetlands, vegetated swales, and vegetated filter strips.

LID TOOLBOX

WHAT DOES LID LOOK LIKE ?

LID practices mimic the natural processing of stormwater runoff and can create more attractive communities. Most LID techniques and strategies are applicable throughout the Houston-Galveston region.

- **Vegetated Filter Strip**
- **Vegetated Swale**
- **Bioretention Systems**
  - Rain Garden
  - Bioswale
  - Stormwater Planter Box
- **Permeable Pavement**
- **Constructed Stormwater Wetlands**
- **Rainwater Harvesting**
  - Cistern
  - Rain Barrel
  - Underground Storage
- **Green Roof**

Vegetated Swale and Native Plantings, Federal Reserve Bank of Dallas, Houston Branch

(Image: Asakura Robinson)

VEGETATED FILTER STRIP

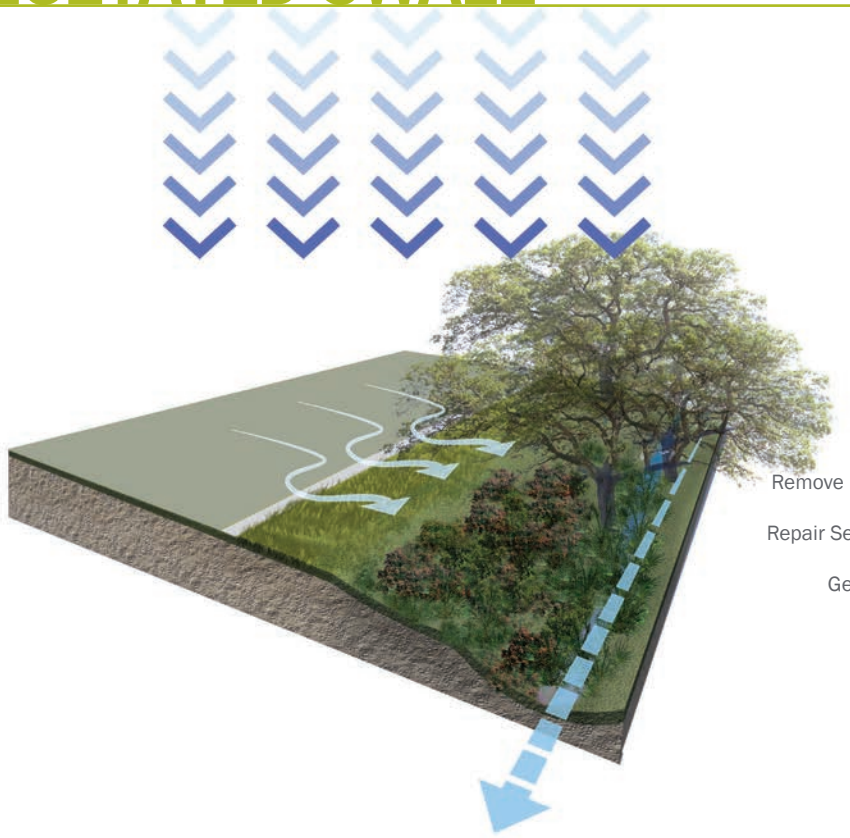
A vegetated filter strip is a band of vegetation, usually a mix of grasses and native plants that acts as a buffer between an impervious surface and a waterway. They are designed to slow runoff from adjacent impervious surfaces, filter pollutants, and provide infiltration (depending upon the permeability of underlying soils). They can also provide aesthetic benefits, stormwater storage, and wildlife habitat. In addition to stormwater management, vegetated filter strips can add recreational value with opportunities to incorporate trails into their design.

Filter strips are best suited on sites that naturally support dense vegetation. Filter strips are best used in treating runoff from roads, roofs, small parking lots, and other small surfaces.

Vegetated Filter Strip, Lone Star College Victory Center

(Image: Asakura Robinson)

VEGETATED SWALE



RELATIVE COST

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MAINTENANCE ACTION

	Annually	Semi-Annually	Monthly	As needed
Pruning	●	●	●	○
Weeding	●	●	●	○
Mowing	●	●	●	●
Water	●	●	●	●
Remove Trash	●	●	●	○
Remove Dead Vegetation	●	○	○	○
Repair Erosion	●	○	○	○
Repair Sediment Build Up	●	●	○	○
Repair Ponding	●	○	○	○
General Inspection	●	○	○	○

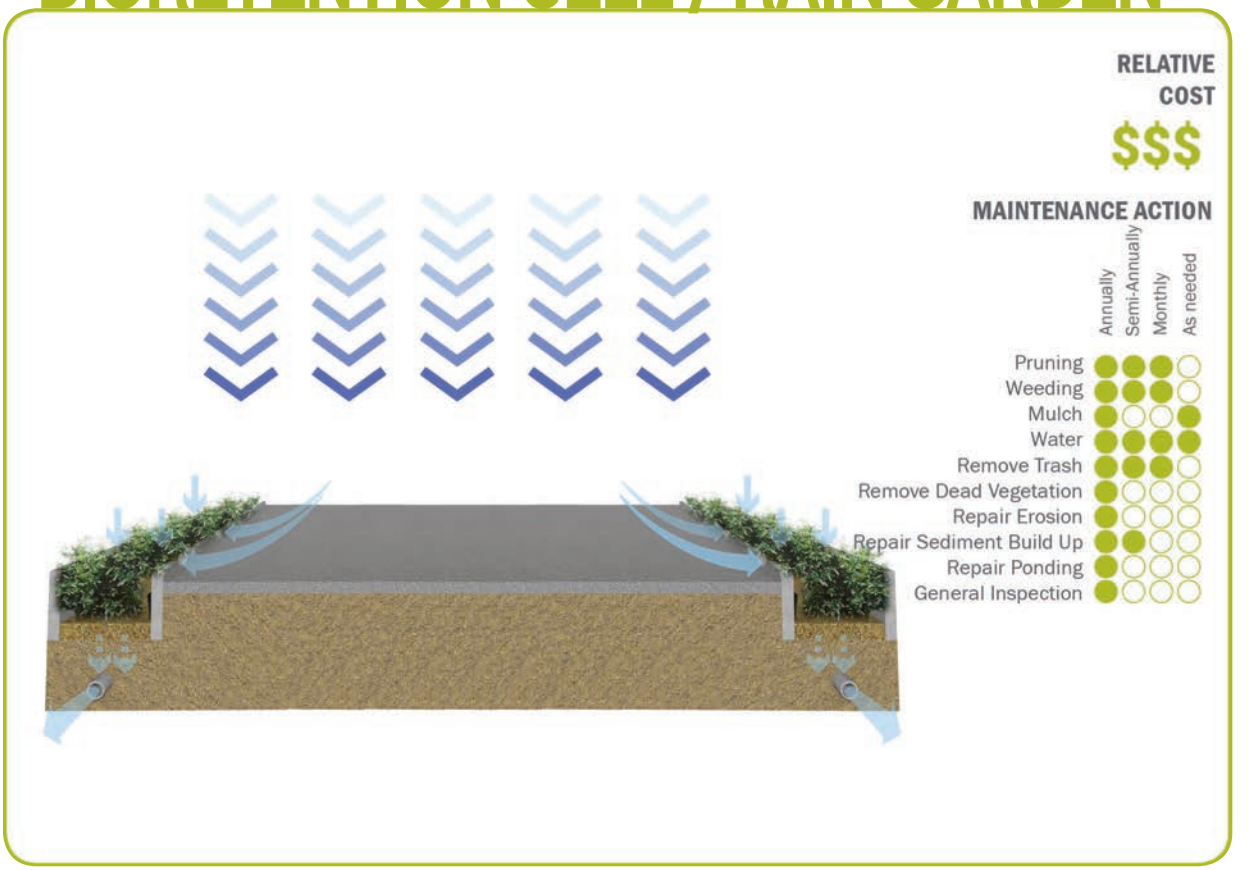
A vegetated swale is a wide, shallow channel with vegetation covering the sides and bottom. Swales are designed to convey and treat stormwater, promote infiltration, remove pollutants, and reduce runoff velocity. Vegetated swales mimic natural systems better than traditional drainage ditches.

Vegetated swales can be used on sites that naturally cultivate a dense vegetative cover and have an appropriate area, slope, and infiltration potential. Swales are most effective when used in a treatment train with other LID techniques. They are widely used to convey and treat stormwater runoff from parking lots, roadways, and residential and commercial developments and are compatible with most land uses.

Vegetated Swale, Federal Reserve Bank

(Image: Asakura Robinson)

BIORETENTION CELL / RAIN GARDEN



Bioretention cells, or rain gardens, are vegetated depressions layered with **engineered soil media** that filter pollutants, increase the time water stays on the site, and provides stormwater storage. These systems usually have an underdrain to ensure the cell drains in a reasonable time period. Although they are applicable in most settings, rain gardens are best used on small sites, urban areas, suburban areas, and parking lots.

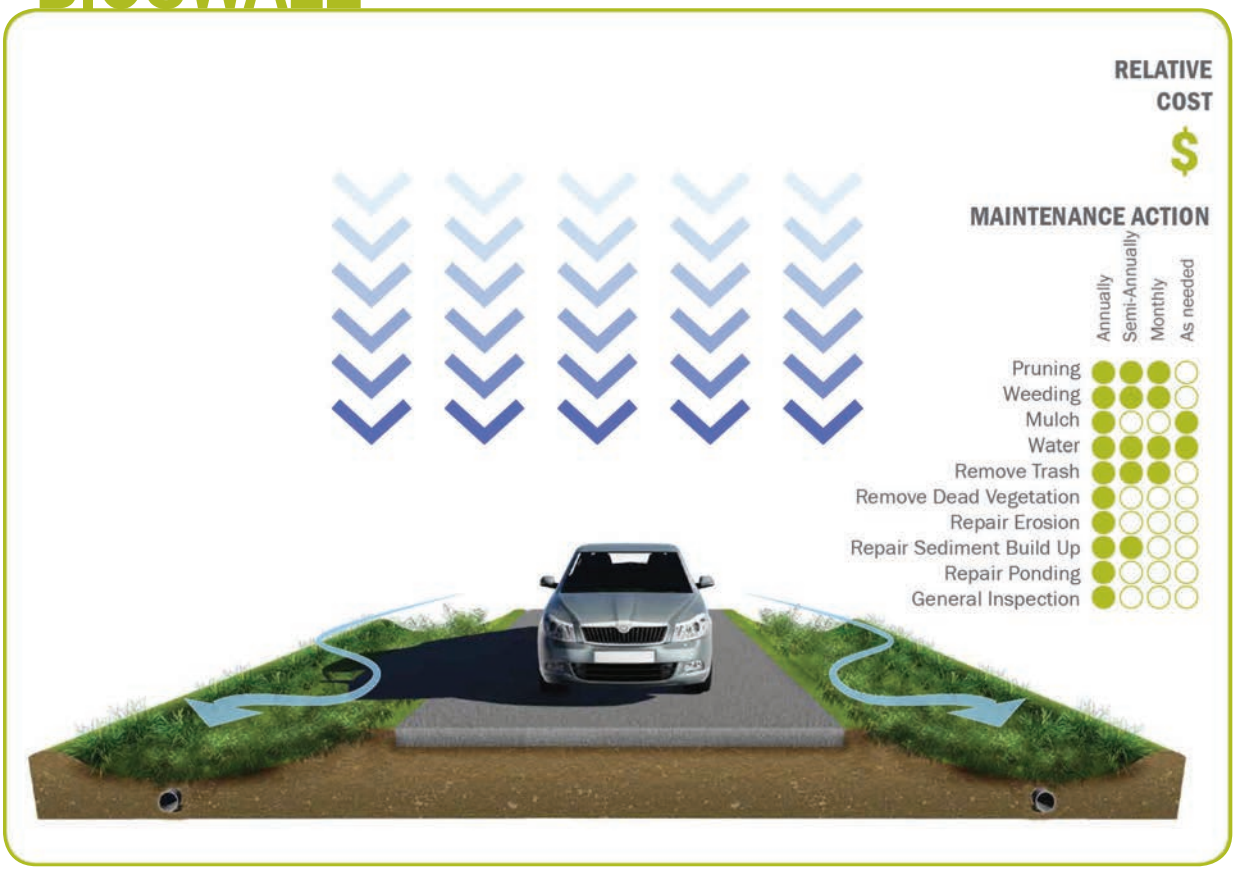
Rain Garden, Kempwood Manor

(Image: EHRA)

Rain Garden, Dickinson Library

(Image: Asakura Robinson)

BIOSWALE



Bioswales are similar to bioretention cells in design and function but are linear elements that can also be used for conveyance and storage in addition to their **biofiltration** function. They can be used anywhere and are best used on small sites, in urbanized and suburban commercial areas, residential areas, and parking lots.

Bioswale, Bagby Street

(Image: H-GAC)

Bioswale, Houston Permitting Center

(Image: H-GAC)

STORMWATER PLANTER BOX

A stormwater planter box is a bioretention system enclosed in a concrete container that contains porous soil media and vegetation to capture, detain, and filter stormwater runoff. Stormwater planter boxes are lined, contain an underdrain, have various small to medium plantings, and are installed below or at grade level to a street, parking lot, or sidewalk.

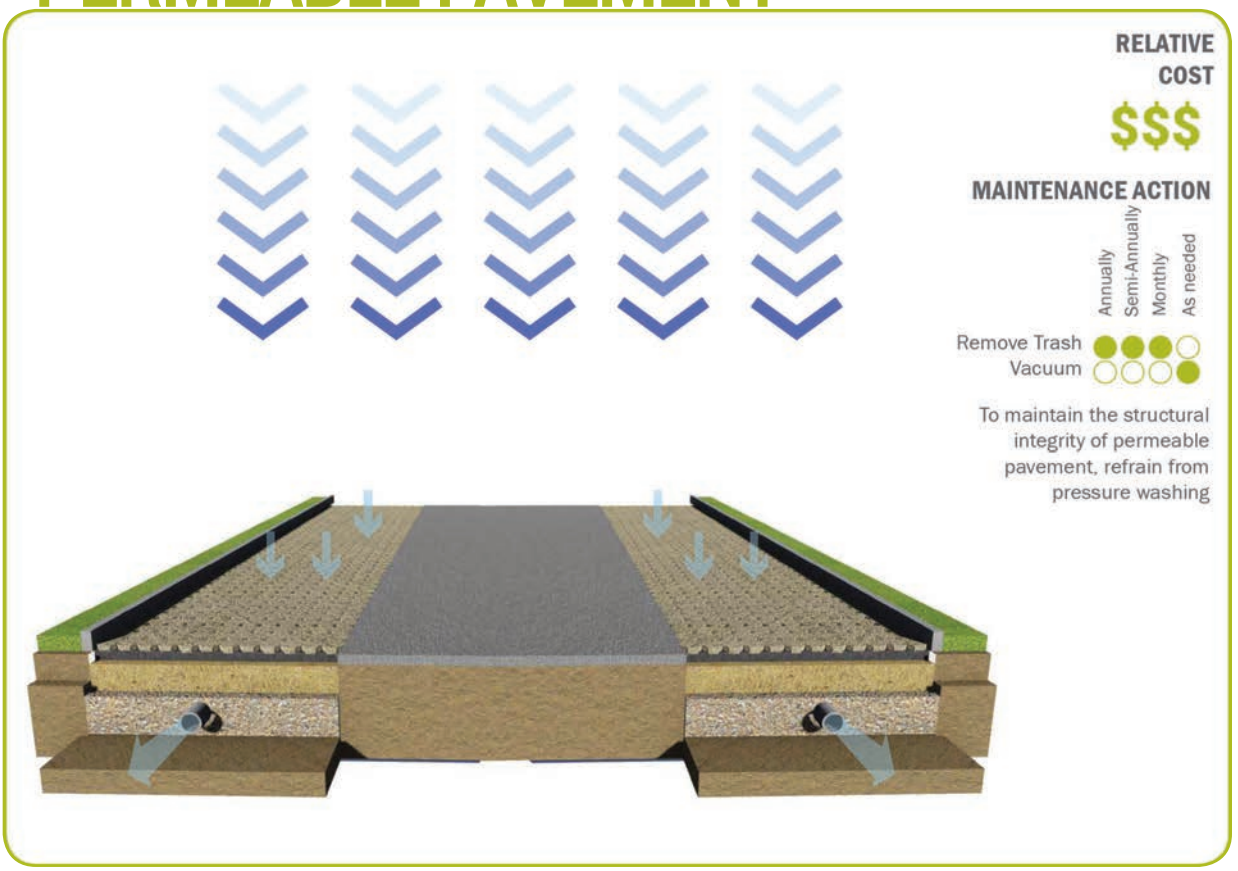
Runoff is directed to the stormwater planter, where water is filtered by vegetation before percolating into the ground or discharging through an underdrain. The stormwater is also used to irrigate the tree or other vegetation in the planter box.

In addition to stormwater control, stormwater planter boxes offer on-site stormwater runoff treatment and aesthetic value. Stormwater planter boxes are optimal for urban or streetscape environments.

Stormwater Planter Box, Darling Street

(Image: Jones + Carter)

PERMEABLE PAVEMENT



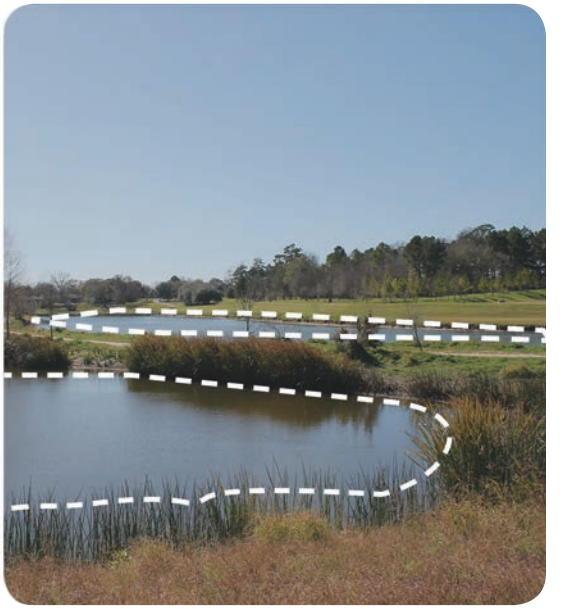
Permeable pavement is a durable, load-bearing paved surface designed to allow water to pass through and into an underlying rock base. Due to the prevalence of clay soils in this region, runoff flows through the permeable pavement and is directed to an underdrain, subsurface detention, or rainwater harvesting system. Permeable pavement allows for streets, parking lots, and sidewalks to mimic pre-development runoff conditions while sustaining the functional attributes of the site area they replace. Permeable pavements reduce pollutant loads and control runoff volume and peak flow rates. Permeable pavement includes a wide range of materials, such as permeable stone pavers, porous asphalt, and porous concrete. These materials can be used as a substitute to conventional pavement on parking areas, roadways, playgrounds, and plazas.

Permeable Pavement, Kempwood Manor

(Image: H-GAC)

CONSTRUCTED STORMWATER WETLANDS

Constructed stormwater wetlands are manmade shallow-water ecosystems designed to treat and store stormwater runoff. These wetlands allow pollutants to settle out or to be treated by vegetation. Runoff is slowly discharged over one to three days. Wetlands provide plant and wildlife habitat and can be designed as a public amenity. While constructed stormwater wetlands have limited applicability in highly urbanized settings, they are a desired technique on larger sites with relatively flat or gently sloping terrain. They are also well-suited to low-lying areas, such as along river corridors.



Stormwater Wetlands, Mason Park

(Image: H-GAC)

RAINWATER HARVESTING

Rainwater harvesting systems are above- or below-ground storage containers that capture and store runoff to be used for irrigation and other nonpotable uses. Rainwater harvesting systems are an appropriate LID technique for highly urbanized areas, where impervious surfaces are unavoidable and site constraints limit the use of other LID practices. These systems are also a sustainable building practice that reduce demand on municipal water resources. Systems range in size and complexity and include rain barrels, cisterns, and underground storage.

RAIN BARREL

Rain barrels are small systems that guide runoff through a downspout into a barrel that usually holds less than 100 gallons. Rain barrels are typically installed and maintained by single-family homes.

Rain Barrel, Ghirardi WaterSmart Park

(Image: H-GAC)

Rain Barrel, Residence in Houston

(Image: Asakura Robinson)

CISTERN

Cisterns are large rainwater systems installed above or below ground with a much larger capacity than rain barrels. They can store water from multiple downspouts and pavement areas.

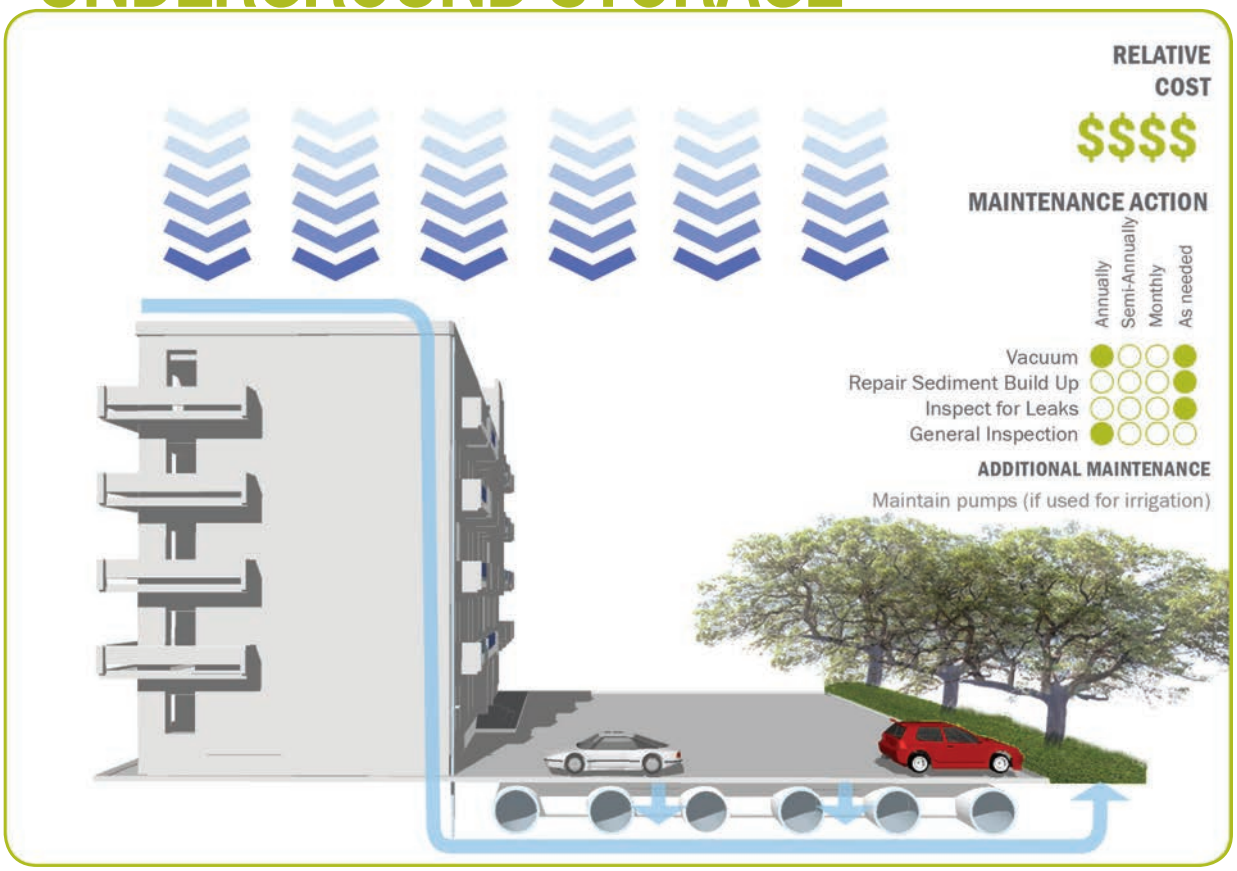
Cistern, Houston Arboretum

(Image: Asakura Robinson)

Cistern, Grocery Store in Houston

(Image: H-GAC)

UNDERGROUND STORAGE

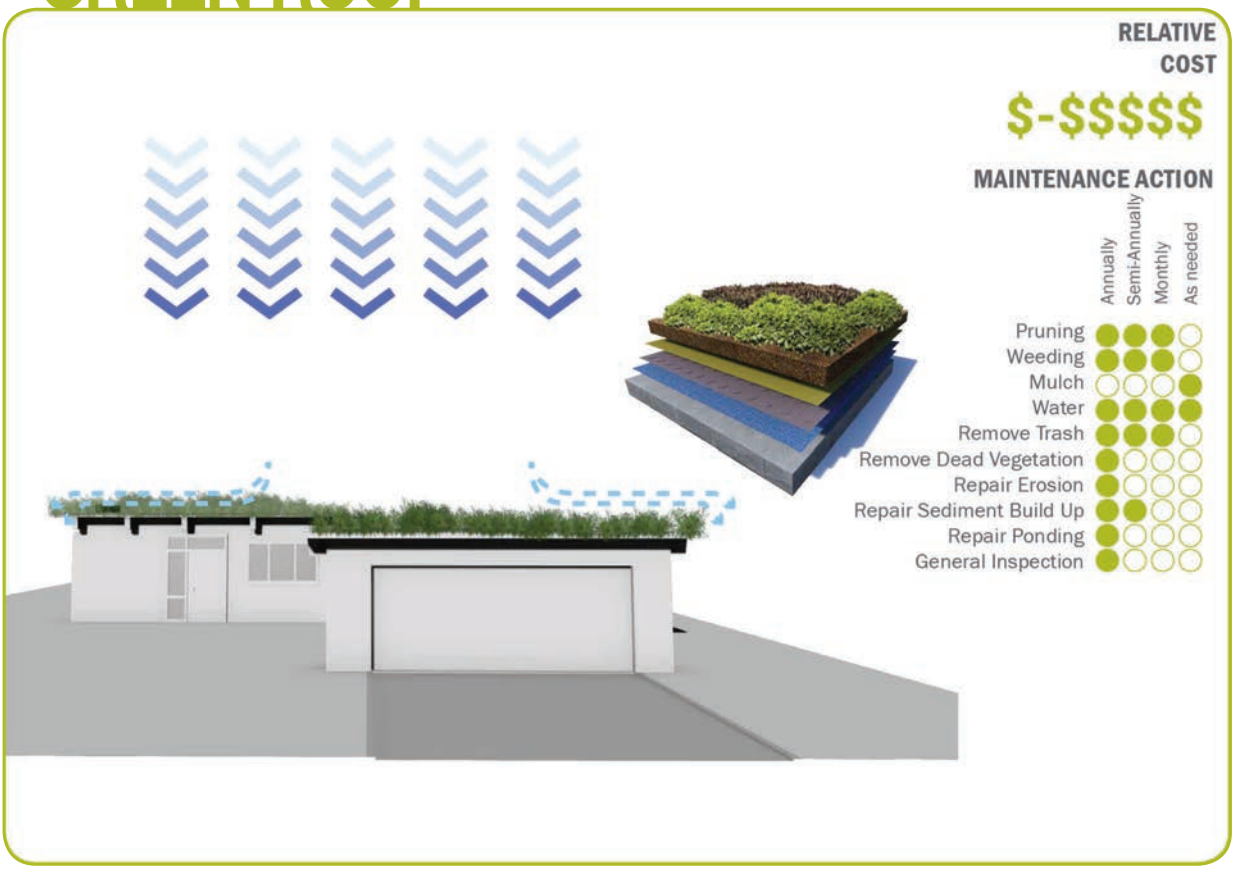


Underground storage systems capture and store runoff below grade in large chambers. The stored runoff is usually used for irrigation. If the soils are suitable, a portion may also infiltrate into underlying soils. Underground storage may be used for stormwater detention instead of surface ponds. If used under parking, this method of detention can increase the land available for development.

Underground storage tank, Birnamwood Drive

(Image: Harris County Public Infrastructure Department)

GREEN ROOF



A green roof is a vegetative layer grown on a rooftop that filters, absorbs, and/or detains rainfall. The green roof system typically contains a soil layer, a drainage layer, and an impermeable membrane. Water is captured and detained in the soil and dispersed through **evaporation or transpiration** by the plants. Green roofs reduce volume and peak rates of stormwater and enhance water quality. Other benefits include reduction in **heat island effect,** extension of roof life, recreational and gardening opportunities, air and noise quality improvement, and reduced building heating and cooling costs. [xii] They can be integrated into new construction or added to existing buildings, including buildings with flat and sloped roofs. This practice is effective in urbanized areas where there is little room to accommodate other LID systems.

Green Roof, Houston Permitting Center

(Image: H-GAC)

PUTTING IT ALL TOGETHER

HOW LID BMPS CAN FUNCTION TOGETHER

SUSTAINABLE SITE DESIGN

Sustainable site design incorporates approaches which reduce impacts of new and redevelopment projects by conserving natural areas and better integrating LID stormwater treatment into the site plan. The aim of sustainable site design is to increase the environmental values of the site while retaining and enhancing the purpose and vision of the developer. Many sustainable site design concepts employ non-structural on-site treatment that can reduce the cost of infrastructure while maintaining or increasing the value of the property relative to conventionally designed developments.

There are three techniques that accomplish the goals of sustainable site design as they pertain to the mission of LID:

CLUSTER DEVELOPMENT

Cluster development is a LID practice that places buildings in a concentrated manner to minimize land development impacts, reduce impervious surfaces, and preserve open space. The residual space can be used as a stormwater management tool, used as a public amenity, and/or used for additional units.

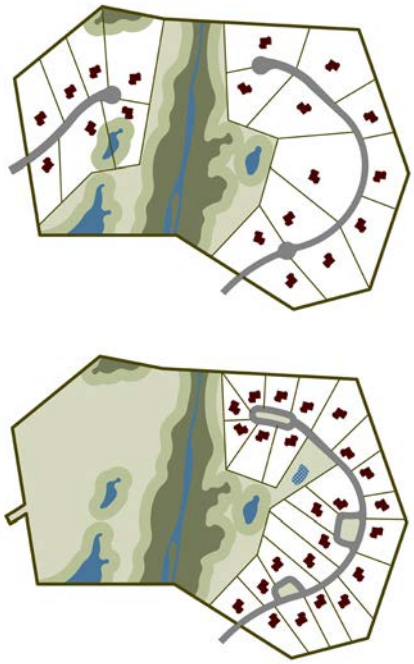
MINIMIZE PAVEMENT WIDTHS

Minimizing pavement widths is a LID practice that decreases the total amount of impervious area associated with land development projects, including streets and parking lots. Traditionally, roadways have been designed to be wider than necessary for vehicle usage.

By reducing roadway widths, more pervious area is available to capture and distribute stormwater. Also, construction and infrastructure costs will decrease.

OPEN SPACE PRESERVATION

Open space preservation is a LID practice that encourages the conservation of natural areas to assist in maintaining a site's natural hydrology. Preserved open spaces allow for infiltration, reduce runoff, and filter pollutant loads from stormwater runoff. Open spaces can also reduce the need to construct structural stormwater infrastructure.



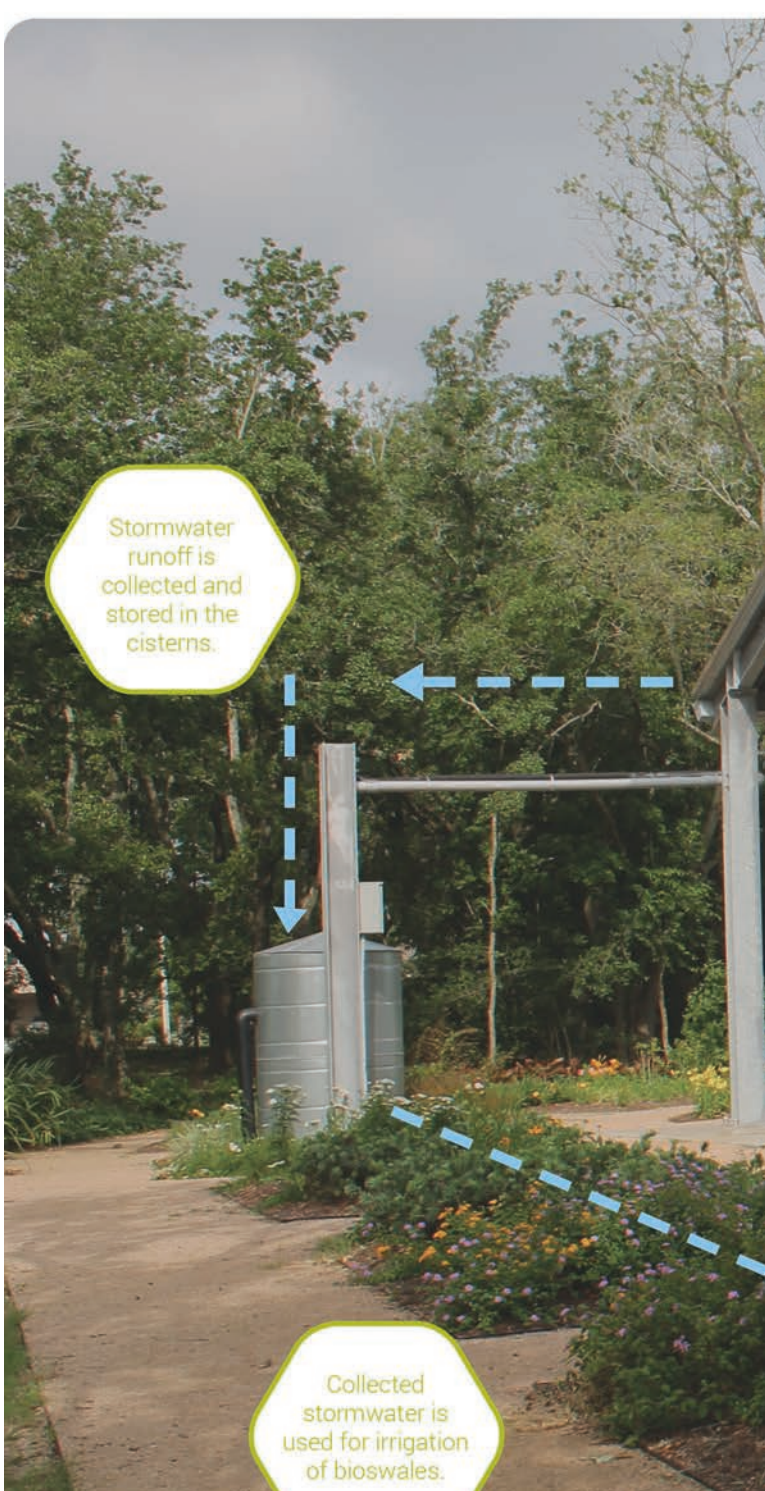
Sustainable Site Design

(Image: Design Workshop)

TREATMENT TRAIN

A treatment train consists of multiple LID stormwater practices installed in a series. Implementing a number of practices together provides the opportunity to include a variety of processes (sedimentation, filtration, etc.) to treat runoff, which optimizes pollutant removal. The use of multiple systems provides a level of redundancy, so at least partial treatment is being achieved even if one system is not functioning properly.

The configuration for a treatment train can take many different forms. Common applications include the use of a vegetated swale to convey stormwater to or from other LID BMPs, such as bioretention cells. Swales can provide some level of pretreatment when installed upstream of other facilities and allow for infiltration. If there is excess runoff at the end of a treatment train, the treated stormwater could then be connected to the storm sewer. Treatment trains should be designed with maintenance considerations in mind. This includes reducing velocity and erosion.



Treatment Train, Ghirardi WaterSmart Park

(Image: H-GAC)


Rainwater and stormwater runoff can be redirected before entering the drainage system, allowing excess water to be utilized rather than discharged.
Sloped edges direct stormwater into the green roof system.
Stormwater runoff is collected and channeled into the cisterns.
Native Plants that have adapted to the climate can survive with minimal maintenance or supplemental watering, and provide food and habitat for birds and insects.

Houston-Galveston
Area Council

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