# GUIDE TO GREEN INFRASTRUCTURE ELEMENTS

Green Infrastructure may be employed at site, neighborhood, and watershed scales and may include a variety of techniques. It should be implemented as a part of a low impact development approach and with local conditions and context in mind. Green Infrastructure should be used to complement other elements of traditional stormwater infrastructure, not replace them. Together — when designed and applied properly — gray and green infrastructure can work in tandem to create a unified, balanced drainage network that will deliver sustainable, cost-effective benefits at scale and over time.

Dozens of Green Infrastructure elements were reviewed to arrive at a recommended collection that consider the unique nature of Jefferson Parish's climate, topography, soils, and groundwater conditions. Elements that were heavily dependent upon deeper water tables and surrounding soils with the capacity to receive and transmit stored water and those requiring significant soils manipulation were deemed to not be appropriate for use in Jefferson Parish. This guide includes Green Infrastructure Elements recommended for Jefferson Parish and provides information regarding the function and applicability of each for different site types and constraints.

- Design and construction specifications and details are not provided for simple elements and those that may require unique context applicability or specialized design analysis.
- Those with available design and construction specifications and details are called out with the descriptions.
- Site applicability and limitations are provided in the description for each element.

**Bioretention Areas are shallow basins (bioretention cells) or linear conveyances (bioswales) that utilize vegetation and engineered soil media to slow, filter, detain, and infiltrate stormwater runoff. Bioretention Areas are also referred to as rain gardens or stormwater planters in some settings.**


*Bioretention with High Flow Rate Media Combined with Detention Basin Lined with Turfgrass in a Residential Setting*

The terms, stormwater planter and urban bioretention often indicate that bioretention is being provided inside of a manufactured or site constructed concrete box or basin. Bioretention areas must always incorporate overflow provisions and underdrain that return runoff to the storm sewer system after detention or treatments. An elevated underdrain or one with and upturned elbow at the outlet will promote volume infiltration and some retention. This configuration will also help to denitrify stored water.

Due to the intense rainfall in Jefferson Parish, high flowrate bioretention media products may help to reduce the area and required capacity of urban bioretention elements. As with other infiltrative and below ground elements, groundwater elevations must be sufficiently below the bottom elevation of the storage area to ensure function and effectiveness.

Site Applicability and Limitations: Bioretention may be appropriate for rural, urban, and suburban environments and in varied types of land uses. Bioretention areas typically work in areas where other types of vegetated planters will work as long as runoff can be directed to them. Application areas may include urban planters, street bulb-outs, parking lot islands, roadside swales, and residential yards. Bioretention areas incorporating high flow rate media may be incorporated into Detention Basins for additional storage or runoff. Due to Bioretention Areas typically being depressed below adjacent surfaces, care should be taken to not create a hazard for pedestrians and those entering and exiting parked vehicles.

**Constructed Wetlands are intended to mimic natural wetlands to provide stormwater runoff detention, retention, pollutant removal by filtering and deposition, and some evaporation and evapotranspiration. Constructed wetlands also provide wildlife habitat and educational and aesthetic benefits. Constructed wetlands may also be referred to as stormwater wetlands or extended wet detention ponds.**

Constructed wetlands typically consist of a combination of open water, shallow marsh and semi-wet areas that are located just above the permanent water surface. As stormwater runoff flows through a wetland, it is treated, primarily through gravitational settling and biological uptake. Temporary storage (i.e., live storage) can be provided above the permanent water surface for stormwater quantity control. This allows wetlands to both treat stormwater runoff and manage the stormwater runoff rates and volumes generated by larger

Constructed wetlands are among the most effective stormwater management practices and are typically created by excavating a depressional area to create “dead storage” below the water surface elevation of the receiving storm drain system, stream, or other aquatic resource. A well-designed stormwater wetland can be attractively integrated into a development site as a landscaping feature and, if appropriately designed, sited and landscaped, can provide valuable wildlife habitat.

Constructed wetlands differ from natural wetland systems in that they are engineered facilities designed specifically for the purpose of managing post-construction stormwater runoff. They typically have less biodiversity than natural wetlands in terms of both plant and animal life but, like natural wetlands, require continuous base flow or an elevated water table to maintain a permanent water surface and support the growth of aquatic vegetation.

There are several variations of constructed wetlands that can be used to manage post construction stormwater runoff on development sites, including *shallow wetlands, shallow extended detention wetlands and pocket wetlands*.

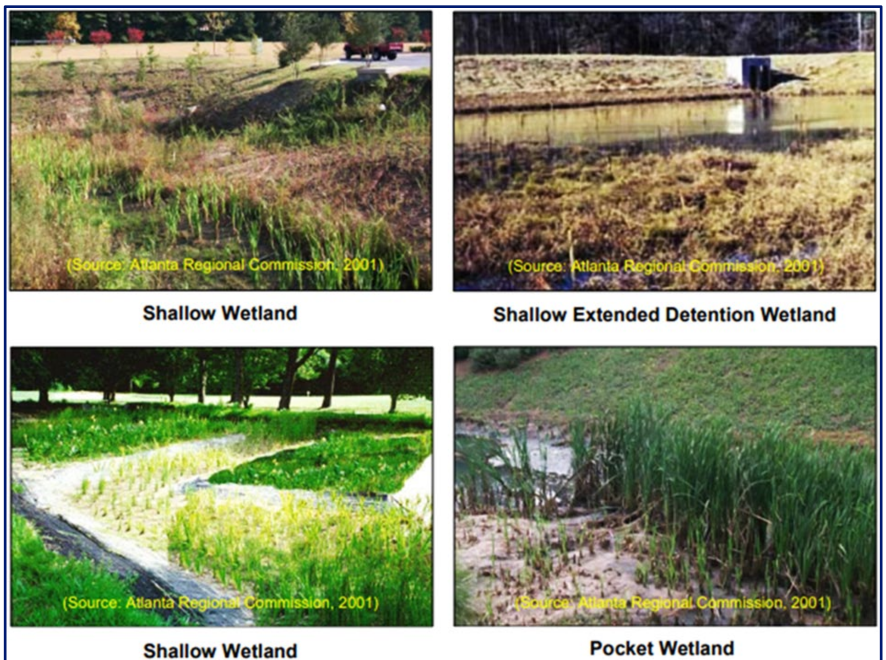
A brief description of each of these design variants is provided below:

a. **Shallow Wetlands:** In a shallow wetland, most of the storage volume provided by the wetland is contained in relatively shallow high marsh and low marsh areas. The only deep-water areas found within a shallow wetland are the forebay, which is located at the entrance to the wetland, and the “micropool,” which is located at the outlet. One disadvantage to the shallow wetland design is that, since most of the storage volume is provided in the relatively shallow high marsh and low marsh areas, a large amount of land may be needed to provide enough storage for the stormwater runoff volume generated by the target runoff reduction rainfall event.

b. **Shallow Extended Detention (ED) Wetlands:** A shallow extended detention wetland is essentially the same as a shallow wetland, except that approximately 50% of the stormwater runoff volume generated by the target runoff reduction rainfall event is managed in an extended detention zone provided immediately above the permanent water surface. During wet weather, stormwater runoff is detained in the extended detention zone and released over a 24-hour period. Although this design variant requires less land than the shallow wetland design variant, it can be difficult to establish vegetation within the extended detention zone due to the fluctuating water surface elevations found within.

c. **Pond/Wetland Systems:** A pond/wetland system has two separate cells, one of which is a wet pond and the other of which is a shallow wetland. The wet pond cell is used to trap sediment and reduce stormwater runoff velocities upstream of the shallow wetland cell. Less land is typically required for pond/wetland systems than for shallow wetlands or shallow extended detention wetlands.

d. **Pocket Wetlands**: Pocket wetlands can be used to intercept and manage stormwater runoff from relatively small drainage areas of up to about 10 acres in size. In order to ensure that they have a permanent water surface throughout the year, they are typically designed to interact with the groundwater table. A contributing drainage area of 5 acres or more is typically needed to maintain a permanent water surface in pocket wetlands




*Constructed Wetlands Variation*

Site Applicability and Limitations: Constructed Wetlands are appropriate for rural and suburban environments. Contributing drainage area of 25 acres or more is typically needed for shallow and shallow extended detention wetlands. Five to 10 acres or more is typically needed for pocket wetlands. Constructed wetlands are ideal for use in flat terrain and may be suitable for areas with shallow groundwater levels. Poorly drained soils (i.e., hydrologic soil group C or D soils) are necessary in areas with deeper water tables to maintain a permanent water surface. Manufactured linings are also available to ensure impermeability when needed.

**Detention Basins are facilities intended to provide temporary storage and release of stormwater runoff to mimic predevelopment runoff characteristics.**


*Innovative Above Ground Detention Area in Retrofitted New Orleans Stormwater Lot*

Unlike Retention Basins, Detention Basins are designed to fully drain after a rain event. Detention Basins may be in the form of above ground open facilities or subsurface vaults or tanks that may or may not also promote infiltration. Above ground basins are typically lined with vegetation and employ near-flat bottoms to slow flows of runoff and promote pollutant deposition, filtering, and surface infiltration. Detention areas may serve multiple uses such as parks and ball fields.

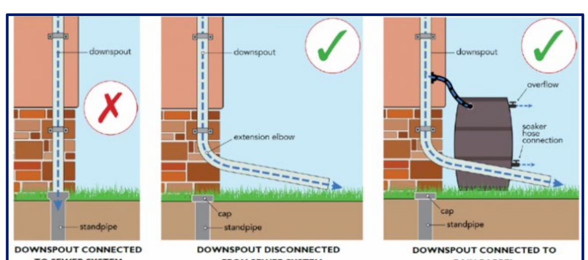
Subsurface detention is traditionally implemented where adequate land for an above-ground detention basin is not available. Both above and below ground detention basins must be sited sufficiently above the groundwater table to not allow infiltration *into* the storage area.

Site Applicability and Limitations: This Green Infrastructure element can be applied at neighborhood, street, and regional scales when physical space is available. Space may be increased by placing the detention basin underground, provided the groundwater elevation is at a suitable distance below the basin. Bottomless underground detention may be used to provide infiltration where soils and groundwater conditions are favorable.

Local Green Infrastructure Case Study: **Pontiff Playground**

*Function: Stores stormwater and reduces area flooding by up to 6 inches.*


**Downspout Disconnection diverts rooftop runoff from direct discharge into a storm sewer system and spreads flows across lawns, vegetated areas, and other pervious areas, where runoff may be slowed, filtered, and possibly infiltrated before reaching collection systems. This seemingly insignificant element, if applied across a neighborhood or community can provide meaningful relief to a struggling closed storm sewer system.**




*Downspout Disconnection*
*Source: DCWater.com*

No design or construction specifications and details are provided for this simple Green Infrastructure element.

Site Applicability and Limitations: Downspout discharges should be directed away from foundations and walkways. Splash protection should be provided at the outlet and flows should be diverted from areas that may be more susceptible to soil erosion. Positive drainage should be provided away from buildings. Downspout disconnection may also be used to direct runoff into other elements of Green Infrastructure, including cisterns for water harvesting.

**Green and Blue Roofs provide stormwater capture, detention, and other water quality-related benefits on the roofs of buildings and structures using some or all of the available rooftop area. Green Roofs incorporate vegetation and a growing medium, planted over a waterproofing membrane. Green Roofs may also include additional features such as a root barrier and drainage and irrigation systems.**

Blue Roofs only collect and detain runoff using dams and weirs only. They provide benefits associated with managing stormwater runoff quantity, but do not contribute much to water quality improvements. Green Roofs serve several purposes, such slowing, storing, and removing pollutants from rainwater, providing insulation, lowering urban air temperatures, improving air quality, creating a habitat for wildlife, and providing a more aesthetically pleasing landscape.

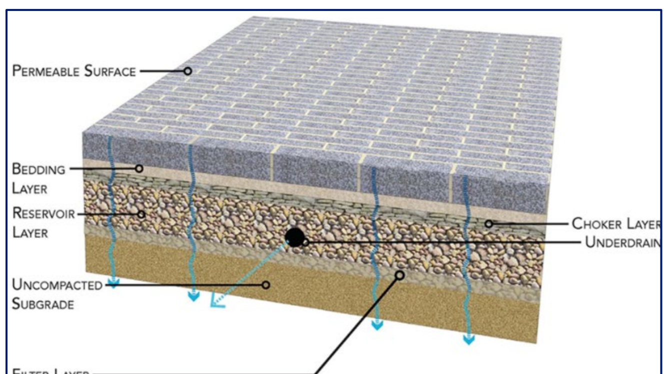
Green Roof- Sewage and Water Board of New Orleans

Green and Blue Roofs are suitable for new development and building retrofit (with supporting structural analysis) and may be used in combination with Rainwater Harvesting.

Due to the sensitive nature of attaching additional structure and adding weight to existing or new rooftops, experienced specialty design and engineering professionals and local building codes should be consulted for implementation this element of Green infrastructure. No design or construction specifications or drawings are provided for element.

Site Applicability and Limitations: Appropriate for rural, urban, and suburban environments. Vegetation may be difficult to establish in the harsh growing conditions found on rooftops in Jefferson Parish. Green roofs can be difficult to install on rooftops with slopes steeper than 10%.

**Permeable Pavements are porous surfacing materials, pavers, or blocks that enable stormwater runoff to move below the surface for detention and/or subsurface infiltration. In addition to intercepting surface flows, Permeable Pavements also may provide an amount of pollutant removal as the runoff passes through them. Permeable Pavements are commonly used on roads, paths, and parking lots subject to pedestrian and light vehicular traffic.**



*Permeable Pavement Typical Cross-Section*
Source: District Department of Transportation

Parking stalls, cycle-paths, service or emergency access lanes, road and airport shoulders, and residential sidewalks and driveways are potential application areas for Permeable Pavements. Structural subsurface materials must be designed to provide detention and promote infiltration for expected flows, and to have the capacity for supporting expected surface loads. Subsurface materials must always incorporate underdrain that returns runoff to the storm sewer system after detention or treatments. Overflow provisions are also recommended and may be in the form of traditional stormwater inlets or curb cuts that drain to other green or gray stormwater infrastructure.

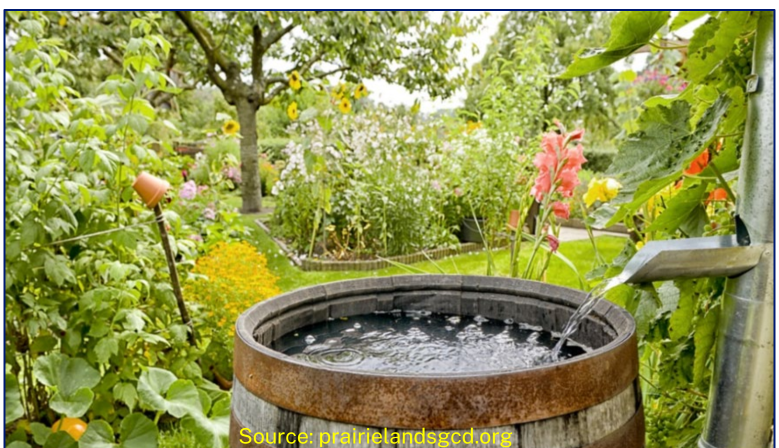
An elevated underdrain or one with and upturned elbow at the outlet of the subsurface storage will promote volume infiltration and some retention. Groundwater elevations must be 18" below the bottom elevation of the storage area. Permeable Pavements require regular maintenance cleaning and work best where they only accept runoff from impervious areas.

There are a variety of permeable pavement surfaces available in the commercial marketplace, including pervious concrete, porous asphalt, permeable interlocking concrete pavers, concrete grid pavers and plastic grid pavers. Permeable Pavements should be designed and installed only by experienced personnel with consideration given to both the storage capacity of the system, and the structural capacity of the underlying soils and the underlying stone reservoir. Product manufacturers should also be consulted for specification of proprietary materials.


*Types of Permeable Pavers*

<u>Site Applicability and Limitations:</u> Permeable Pavements are appropriate for urban development and redevelopment sites to construct sidewalks, parking lots, overflow parking areas, private streets and driveways and parking lanes on public streets and roadways. Dedicated specialty cleaning equipment is required to maintain most types of permeable pavement materials.

**Rainwater Harvesting is the ancient stormwater management practice of intercepting, diverting, and storing rainfall to provide detention and potential reuse. Stored water may be used for irrigation, firefighting, toilet flushing, and other non-potable uses. Typically, gutters and downspout systems are used to collect rainwater from roof tops and direct it to a storage tank or cistern.**




*Residential Rainwater Harvesting*

Runoff may also be collected from plazas and other areas where permeable pavements have been applied. Harvested stormwater may be stored above or below the ground. For the element to be a benefit to Parish stormwater management efforts, the cistern must be drained or emptied in some fashion in between storm events. Pretreatment or filtration may be required depending on the type of reuse.

*Urban Trees and Vegetation in New Orleans*

Due to rainwater harvesting and reuse being such a context-specific element of green infrastructure, no design or construction specifications or drawings are provided for this element.

Site Applicability and Limitations: This Green Infrastructure element is appropriate for rural, urban and suburban environments. It can be used on nearly any type of new or redevelopment site. The purpose for the collection and reuse will drive the capacity and space needs.

**Retention Basins are facilities intended to provide temporary storage and release of stormwater runoff to mimic predevelopment runoff characteristics. Unlike Detention Basins, Retention Basins are designed with a stored volume surface elevation that is above the bottom elevation of the basin. Linings and other provisions may be necessary to ensure that collected and stored water is retained.**

Urban Retention Basin in Railroad Park, AL

Site Applicability and Limitations: Retention Basins are often implemented as neighborhood or community ponds to provide aesthetic benefits in public spaces and common areas of developments. Areas with highly variable groundwater levels should be avoided due to the potential for the intended permanent water levels to drop during dry seasons, or basin linings floating as the groundwater level rises during wetter seasons.

**Urban Reforestation involves planting trees, shrubs, and other vegetation, typically on a large scale, in urban environments. Urban Reforestation provides abstraction of rainfall which helps to minimize the volume of runoff by providing surfaces to wet, processes to evaporate, and places for storage.**

The vegetation also provides surface roughness and irregularities that increase the time of concentration of runoff. Non-stormwater-related benefits include air and surface temperature cooling and air quality enhancement. Urban Reforestation can also help to increase property values and enhance sense of place in urban environments.

No design or construction specifications and details are provided for this simple Green Infrastructure element.

<u>Site Applicability and Limitations:</u> Context is important when selecting plant types and densities. Plant heights, widths, root growth, shading, and leaf litter should be considered and weighed against land use, maintenance availability, and community benefits.

**Vegetated Swales and Areas are shallow conveyances and open spaces typically lined or stabilized with turfgrass. These more traditional elements provide a benefit over impervious channel linings and pavements by increasing the time of concentration of runoff by reducing runoff velocities and helping to remove suspended and floating pollutants through filtering and deposition. Vegetated areas may also be referred to as Vegetated Filter Strips, although technically that element typically incorporates infiltration trenches and/or level spreaders to help disperse flows.**

Vegetated Swales and Areas can provide pre-treatment of runoff before it enters other Green Infrastructure Elements or traditional storm sewer systems. Existing Vegetated Swales and Areas may be preserved on public or private properties through Low Impact Development approaches and even enhanced for improved effectiveness. The shear capacity of conveyance linings and slope coverings must be verified for adequacy against the shear energies of anticipated flows.

No design or construction specifications and details are provided for this simple Green Infrastructure element.

<u>Site Applicability and Limitations:</u> Appropriate for residential, commercial, industrial, and other land uses in rural and suburban environments.



*Vegetated Swales and Areas*