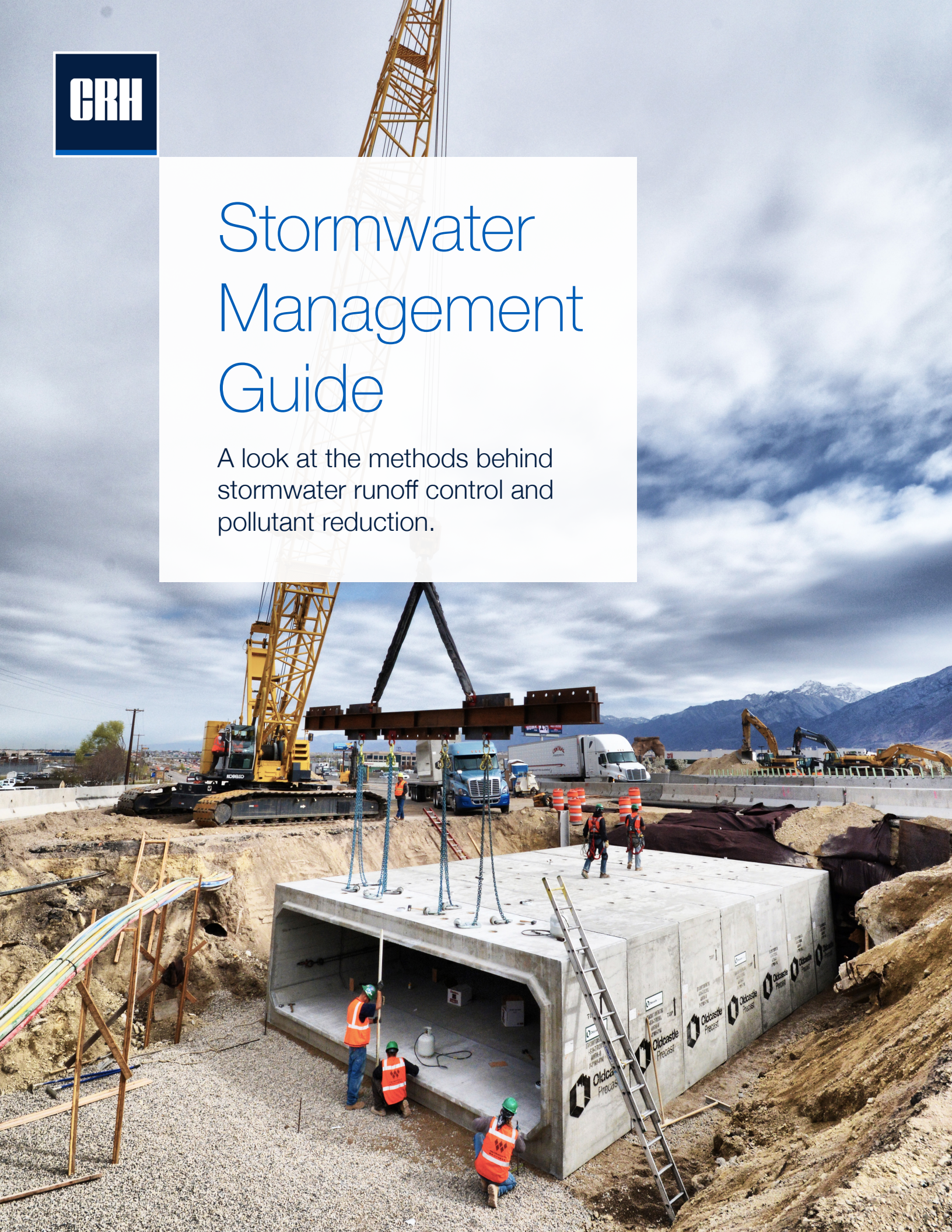




Stormwater Management Guide

A look at the methods behind stormwater runoff control and pollutant reduction.



Introduction

Designing a project site to maintain its normal stormwater flows and reduce pollutants after development is essential. The right plan prevents flooding, habitat degradation, erosion, and pollution in our waterways. Whether your project is a re-development, new development, or an urban retrofit, there are a variety of tools and techniques that can be used to meet water protection programs and regulations.

The recommended best management practices (BMPs) for stormwater runoff are to treat rain water where it falls. The three criteria used to accomplish this are:

Volume: Reduce or delay the volume of stormwater that enters the sewer system.

Peak Discharge: Reduce the maximum flow rate into the combined system by decreasing the stormwater volume and lengthening the duration of discharge. This inherently lowers the frequency of combined sewer overflows.

Water Quality: Improve water quality through pollutant reduction, using filtering and biological and chemical processes.

This guide highlights the methods behind stormwater runoff volume control, pollutant reduction, and maintenance, allowing you to:



Meet Regulatory Permitting Requirements.

Each municipality has its own set of minimum BMPs for residential, industrial, and commercial activities that impact stormwater runoff.

The National Pollutant Discharge Elimination System (NPDES) was created by the Clean Water Act in 1972 and enables smaller governments to perform the permitting, administrative, and enforcement aspects of the program.

Operators who do not meet permitting requirements can be held legally responsible for not complying with their requirements.



Meet Low Impact Development (LID) Requirements.

According to the EPA, LIDs are a variety of systems and practices that use natural processes to protect water quality and associated habitats.

With regards to stormwater, LID uses nature to manage stormwater as close to its source as possible and maintain a watershed's hydrologic functions.

Examples include designing sites to minimize land disturbance, using vegetated swales, permeable pavement, and rainwater harvesting.



Earn Points Toward LEED Credits.

The U.S. Green Building Council (USGBC)'s Leadership in Energy and Environmental Design (LEED) rating system allows projects to pursue certification and earn points across several categories.

While there are several stormwater-oriented credentials available to earn, the overall intent of them is to minimize disruption to the natural hydrology of the site and to reduce pollutants.

Stormwater

Runoff Volume Reduction

Stormwater runoff is the excess water that flows over the ground surface, usually created when rain falls onto rooftops, roads, driveways, parking lots, and other paved surfaces. This runoff can lead to habitat degradation and erosion of local channels. Whether the rain is falling on the streets, a parking lot, or roofs, the water is unable to soak into the ground and follow its natural path to the water table or streams. Capturing and controlling release of runoff can avoid problems and allow for groundwater recharge and replenishment of local aquifers.

An alternative to a controlled release of water back into the ground is harvesting the stormwater – along with greywater – and reusing it for landscape irrigation, toilet flushing, and cooling towers, among other things. Such solutions can help meet project or jurisdictional LID requirements or can help earn points towards LEED credits.

Building information modeling (BIM) and geographic information systems (GIS) planning tools support the design of LID methods, such as swales, rain gardens, and pervious pavement. These tools provide new stormwater management options for the development community and will assist with site planning, facility design, and engineering method selection.

Controlling stormwater runoff can help reduce water pollution, drought, and public health concerns, causing stormwater management solutions to become even more critical as part of the site design. **Below we look at some methods that can help manage stormwater runoff.**

Infiltration Trenches

Infiltration trenches are shallow (3- to 12-foot) excavated trenches filled with aggregate that collect runoff during a storm and slowly release it into the soil.

Such trenches are best used with another runoff reduction method as they usually don't do a great job of handling large volumes of water beyond a frequent "one-year event" storm.

According to the EPA, however, their use is restricted by concerns about potential groundwater contamination and clogging if not properly maintained. Each state provides a stormwater manual or specific infiltration trench requirements, which you should consult in the planning process.





Underground Storage

On-site tanks, cisterns, or basins are placed underground to collect stormwater runoff and control volume. They can be made from concrete, plastic, steel, or fiberglass, and depending on the project's requirements and structural efficiency, they can be traffic-rated and placed under parking lots and roadways.

The stored water can be detained and released at a controlled rate into local aquifers or the sewer. Depending on regulatory requirements, the stored water can also infiltrate back into the groundwater supply or be retained and reused for harvesting applications. Underground storage tanks can also have treatment solutions that addresses water quality issues for varying jurisdictions.

Permeable Pavement and Concrete Systems

Permeable pavement rapidly allows drainage of stormwater off streets, parking surfaces, driveways, and more. Water passes through a layer of permeable concrete, followed by an aggregate sub-base over undisturbed soil. In some cases, the water runs freely to the underlying ground below. In other situations, a reservoir stores the runoff temporarily before allowing it to infiltrate into the soil.

While the appearance is very similar to traditional concrete or asphalt, permeable pavement is made without fine materials. It incorporates void spaces that allow water to pass through for storage and infiltration into the soil.

Stormwater Management Objectives:

- Water quantity
- Retain/infiltrate runoff volumes and peak flows
- Imitate pre-development conditions
- Control amount of impervious cover
- Reduce stormwater utility fees
- Capture percentage of storms
- Control specific nutrients and metals

Permeable Pavers

Pavement that is impervious to water is the primary source of runoff. Permeable pavers have voids between the individual pavers, and are an ideal way to give precipitation access to the soil for infiltration. Such pavers are made from a system of varying sized aggregate underneath that filter and direct water to local groundwater supplies. Permeable pavers can be used for primary parking, overflow parking, walkways, plazas, driveways, and patios.

Using permeable pavers with a stormwater storage facility below grade can provide a more complete LID system that keeps runoff on the site and allows for harvesting as needed.



Permeable pavement can earn LEED credits for controlling the quantity of runoff and improving water quality.

Green Roofs

Vegetation on “green” roofs allows for infiltration and evapotranspiration of stored water. According to Green Roofs for Healthy Cities, the amount of water retention varies by season, as well as the depth of the growing medium and the number of plants. Instead of running off, the substrate captures the rain water allowing the plants to utilize it, subsequently returning it to the atmosphere through evaporation and transpiration. If runoff does occur, the vegetated roof operates as a natural filter. A green roof also moderates the flow of any runoff into the sewer system helping to prevent system overloads.

Depending on the design and integration, green roofs can contribute to credits in the LEED rating system for the following categories: Sustainable sites, materials resources, water efficiency, and more. However, such systems may require different structural requirements for live and dead loads, so the appropriate assessment must be completed.

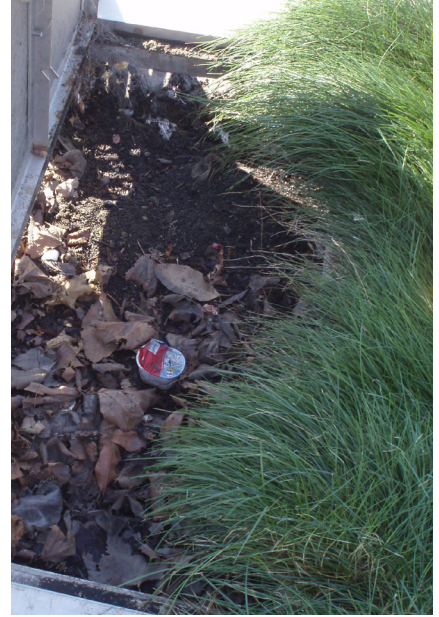


On average in summer, a vegetated roof retains 70-90% of precipitation and 25-40% in winter.

Pollutant Reduction

When building the infrastructure that helps with increased urbanization, we want minimal impact on the surrounding environment. During a rainstorm, when water flows over paved surfaces, it picks up pollutants which eventually make their way downstream to our local waterways. The volume of runoff created from sprawling communities is hard to avoid, but manageable. As are the methods we use to reduce pollutants. As the number of vehicles on our roadways climbs and the number of people grows, the amount of pollutants that accumulate must be addressed. Developers have a responsibility to do so.

The size and type of pollutants that come off of our paved streets, parking lots, and rooftops include sediment, metals, nutrients, petroleum hydrocarbons (oil and grease), trash, and more that can affect wildlife and habitats downstream. Since stormwater is one of the biggest sources of pollutants, the most efficient way to tackle it is by treating rainwater where it falls. Just like when reducing stormwater runoff, there are different BMPs that need to be followed. Your local jurisdictional requirements will determine what you need to do for your project. **Below we look at types of pollutant filtration and reduction systems.**



Inlet filtration and trash capture

Stormwater is one of the biggest sources of pollutants as it can pick up a variety of contaminants in many sizes. Some of the most visible culprits are trash and debris like food wrappers, cigarette butts, leaves, and more.

Some drain trash capture devices and guards are located where the water is first captured and block the largest debris from continuing to travel with the stormwater. Filters and guards capture coarse sediment, trash, total suspended solids (TSS), and petroleum hydrocarbons. These devices can look like baskets, and are located where the water is first captured as they trap the largest debris that stormwater picks up.

Hydrodynamic separation

Hydrodynamic separators also remove trash and debris along with sediment and oils. They allow stormwater to flow-through the unit during high flows while capturing pollutants in a settling or separation unit.

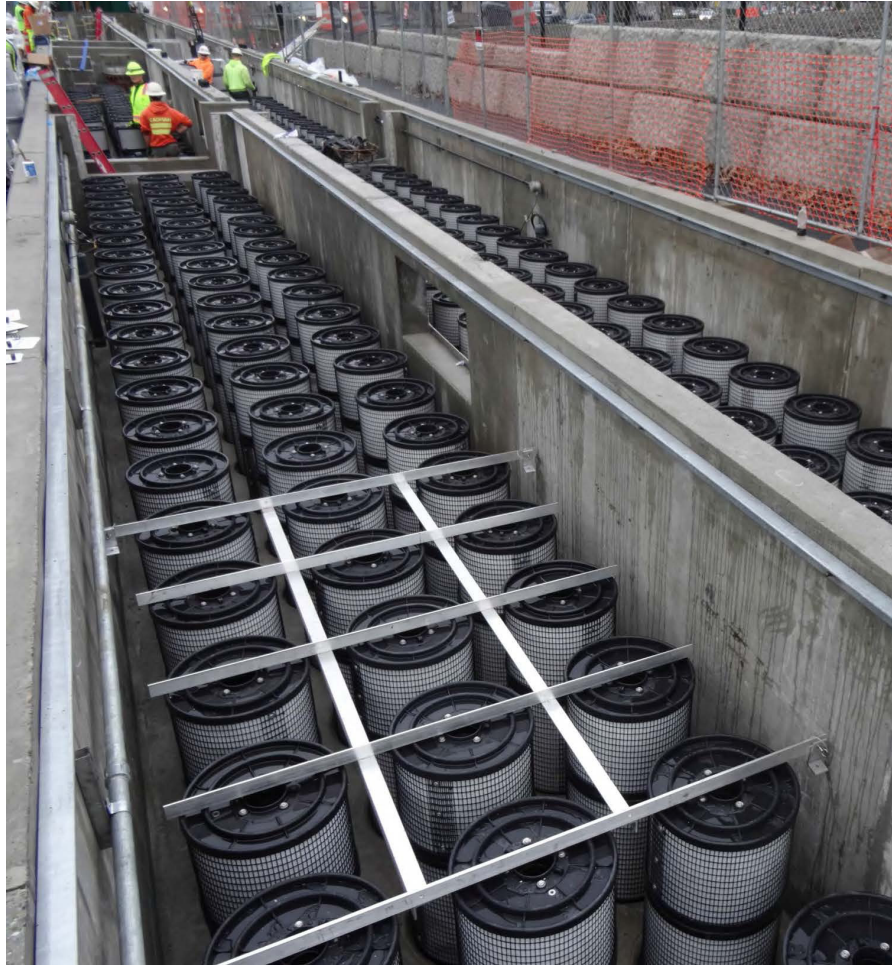
Through the use of vortex cylinders, settled particles are collected in the isolated bottom storage compartment, minimizing re-suspension, while floating debris and oils are retained in the upper storage areas. They can be used alone or in conjunction with other stormwater management devices as a pre-treatment.



Media filtration

Media filtration systems capture and retain sediment, TSS, oil and grease, phosphorus, metals, and more. They use a mix of media often contained in cartridges to remove the smaller pollutants. These devices often have pre-treatment chambers and replaceable cartridge filters that help reduce the total downstream pollutant discharge load in stormwater runoff. These systems can be designed as catch basins or manholes or even large custom vaults.

The PerkFilter™ by Oldcastle Infrastructure, a CRH company, is a media-filled, cartridge filtration system that removes TSS, metals, nutrients, gross solids, trash, debris, and petroleum hydrocarbons. The number and size of cartridges is tailored to accommodate the water quality flow rate and to meet the specific needs of the site.



Bioretention and biofiltration

A great solution for LID requirements are bioretention and biofiltration. These processes remove contaminants and sediment from stormwater runoff through the use of natural products such as filtered soils, vegetation, aggregates, and mulch. These systems can also be incorporated into your landscape design as they can be designed as planter boxes, trees, swales, and more.

BioMod® Modular Bioretention System, also by Oldcastle Infrastructure, uses biological uptake to remove pollutants with layers of aggregate, bioretention media, plants, and more. A wide variety of plants and trees specified by the designer may be used.



System Maintenance

Having volume and pollutant reduction in place isn't always enough to meet regulations, LID requirements, or earn LEED credits. Often, Federal, State and Local jurisdictions require installed stormwater management systems to be properly maintained and serviced on a regular basis. The importance of this maintenance is to make sure all pollutants are removed from stormwater before entering downstream receiving waters. And, if the systems are not properly and regularly maintained, the systems could back up, causing flooding or forcing pollutants to bypass the treatment areas and flow downstream as if there were no treatment device installed at all.

Routine Maintenance

Depending on the type of system you have, it's important to select a well-seasoned company or stormwater expert who is familiar with your local requirements and a variety of management practices. This will eliminate the guesswork on your end. Factors to consider when maintaining your stormwater management system include:

- **Regulations:** In addition to regulations that require you to maintain your system, collected materials (trash, debris, and sediments) need to be properly disposed of. Keep in mind that some materials found in stormwater systems may contain hazardous wastes. It's best to let a professional company ensure the waste is disposed of properly and in a manner that follows the guidelines of your local jurisdiction.
- **Timing and Frequency:** The timing and frequency at which you need to perform maintenance may differ based on the type of system and your location. A regular "recurring" basis may mean a full clean-out annually or bi-annually, but filters may need to be changed more frequently. Also, the amount of runoff and volume of debris (cans, leaves, paper, cigarettes, etc.) can impact frequency. Depending on the average seasonal rainfall your area gets, it might be necessary to have service completed before the weather changes.
- **Configuration:** Depending on the style, material, and modular-configuration, there are attributes that dictate how the system must be maintained. For instance, in underground units made up of a single detention tank, a long-handled net can be used to retrieve the bulk of trash and debris. In larger, multi-unit systems, there may be passage ways or doorways with corners where a person must enter and vacuuming must be done to remove sediment. Make sure these technicians are trained and certified in confined-space operations to properly work on your systems. For above ground trash captures, a shovel may be all that is needed.
- **Vegetation:** Some bioretention/biofiltration systems use vegetation to help remove pollutants. These may require periodic irrigation to establish and maintain trees, grasses, or shrubs. Irrigation requirements are ultimately dependent on climate, rainfall, and the type of vegetation selected. In some units, pollutants such as trash, debris and coarse sediment are retained within a pre-filter chamber for easy removal by hand or with conventional vacuum equipment.



Inspections

Making sure you follow municipal and state regulations is key. Whether you are a municipality-owned facility or a private HOA, a thorough inspection of the system can protect everyone's interests. Plus, it is often a state or local requirement.

It's important to schedule an inspection even if the system is new to establish a baseline that future inspections can be compared to. In addition to keeping your system running properly, regular inspections can allow you to budget for future maintenance and possible failure.

A Certificate of Compliance should be issued after each inspection to keep record that the system is being properly maintained. If a certificate is not issued, then you have no way of proving you passed the examination and run the risk of being fined in the future.



Indicators Identified During an Inspection:

- Slow draining outlet pipes
- Concrete damage
- Standing water
- Erosion
- Invasive vegetation (in bioretention/biofiltration systems)
- Excessive sediment load
- A clog

Conclusion



Whether you are designing a new development, a re-development or an urban retrofit, knowing what methods and techniques are available to meet stormwater regulations is essential. If you use some of the previous best management practices and work within the landscape, focus on prevention, and keep it simple, you will be closer to meeting your LID requirements and earning LEED credits.