LID REPORT

Image/detail/specification

Describe how the LID works

Describe how it is constructed and what is involved in the construction process

Pros and Cons

Cost

Pollutant Removal (make sure to include sources)

Expected/ required maintenance schedule

Sizing: How much water can a certain practical size handle

Make sure to cite sources and state assumptions. This should be a professional report.

LID for Parking Lots

Storm Tech Infiltration Chambers

Overview: StormTech Chambers are designed primarily to be used under parking lots, roadways, and heavy earth loads. Theses injection molded polypropylene chambers are embedded underground in a layer of clean, crushed, angular stone. Storm water is collected and should be pre-treated before entering the polypropylene chambers. The chambers store and infiltrate the storm water as the water percolates through the clean stone into the underlying soils.

Application: Storm Tech Chambers should not be used in areas where the seasonally high water table is within two feet of the infiltration chamber (NCDWQ). An underdrain should be required in soils of low permeability (<15 mm/hr). The StormTech filtration system is best suited to locations where space is at a premium and the system's relatively expensive installation cost can be offset by increasing available space for development (UNH).

Construction: The area must be excavated and lined with a nonwoven geotextile fabric to prevent fines intrusion into the angular stone. A layer of nominal ¾-2" clean, crushed, angular stone is placed over the entire bottom surface of the bed to a minimum thickness of 6". StormTech Chambers are laid out over the stone bed, including an isolator row wrapped in woven geotextile, and an access manhole containing a high flow weir which diverts the first flows to the isolator row. Embedment stone is placed around the chambers to a minimum cover of 6" over the top of the chambers and then covered with nonwoven geotextile. Granular fill material is placed over the geotextile such that a minimum cover of 18" is achieved. Care should be taken during construction not to drive heavy equipment over the chambers before the required coverage is achieved.

Cost: The AAAE estimates StormTech installation cost at $6.00 per cubic foot (AAAE).
Mountainland Supply Company lists SC-40 51.0" x 30.0" x 85.4" Chambers (75 ft^3 total storage-including rock) at $500 per unit.
The cost to install a StormTech Isolator Row system large enough to treat runoff from one acre of impervious surface is approximately $34,000 (UNH).

Pollutant Removal: If the infiltration system is installed with a pre-treatment unit and isolator row, the system removes 80% of total suspended solids and 80% of oil and grease (ADS). The University of New Hampshire found that the isolator row removes significant amounts of Phosphorous, Suspended Sediment, Suspended Solids, Turbidity, and Zinc (UNH).

Maintenance: StormTech recommends that the isolator row be inspected every six months for the first year and then annually for following years. If inspection reveals that sediment has accumulated to a depth of 3 inches, cleanout should be performed using a JetVac. StormTech recommends that the length of the isolator row be limited to 175 feet.

North Carolina Division of Water Quality (NCDWQ). 2007. Stormwater Best Management Practices Manual. Raleigh, NC.

Advanced Drainage Systems (ADS). http://www.ads-pipe.com/products/water-quality/ads-hdpe-water-quality-unit-wqu.

University of New Hampshire Stormwater Center (UNH). 2009 Biannual Report. Durham, NH.

R-Tanks

Overview: R-Tank modular units are a space-efficient method for storing and infiltrating runoff. The modular units are 95% void space, which is used to store water. The exterior of the units is 90% permeable, which allows for effective infiltration. Before entering the R-Tank units, storm water should be pre-treated at the inlet to remove pollutants, silt, and debris in order to prevent clogging of the system.

Application: R-Tank modules should not be used in areas where the seasonally high water table is within two feet of the infiltration chamber (NCDWQ). R-Tanks are effective under parking lots, streets, driveways, and fields.

Construction: The area must be excavated with a 2-foot perimeter around the R-tanks and at least 4" below the R-tanks. For infiltration, the base of the excavation should not be compacted, but must support a minimum of 2,000 psf (Installation Guide). The minimum 4" base should consist of course sand or washed angular stone, placed and rolled but not compacted. The excavation should be lined with a geotextile fabric to prevent fines intrusion into the modules. Maintenance ports should be installed such that the distance between ports does not exceed 50 feet. The perimeter of the excavation should be backfilled with a free draining backfill to 95% compaction to ensure stability. In all load bearing applications, a geogrid is required to be placed 12" above the R-Tank (Installation Guide). The R-Tanks should have a minimum of 20" of cover of free draining backfill (Infiltration Systems).

Cost:

Pollutant Removal:

Maintenance: R-Tanks should be inspected very six months for the first year of operation, and then annually during subsequent years. The R-Tank System should be back-flushed once sediment accumulation has reached 6" or 15% of the total system height (Maintenance). To back-flush the R-Tank, water is pumped into the system through the Maintenance Ports as rapidly as possible. The turbulent action of the water moving through the R-Tank will suspend sediments which may then be pumped out. One disadvantage of R-Tanks compared to StormTech Chambers is the R-Tanks require more maintenance since they do not isolate sediment to one row of the system like StormTech.

ACF Environmental. 2017. R-Tank Infiltration Systems

ACF Environmental. 2017. R-Tank Installation Guide

ACF Environmental. 2017. R-Tank Operation, Inspection, and Maintenance

Porous Pavement

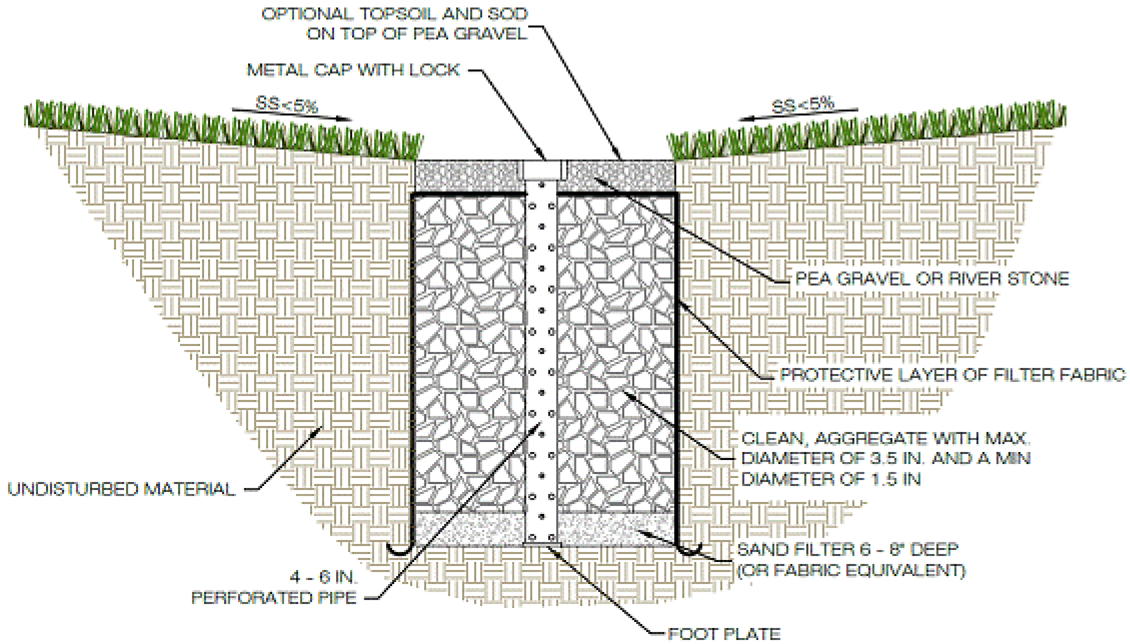
Porous Asphalt

Pavers

Porous Concrete

The pavement must be constructed with sufficient underlying drainage and pore space that water is not stored in the pavement, which would lead to freeze-thaw cracking. The pavement must be kept clear of debris which would clog the pore space of the pavement.

Infiltration Trenches



Overview: Infiltration trenches are a cheaper infiltration method alternative to StormTech Chambers or R-Tanks. Infiltration trenches consist of an excavation willed with washed angular stone, surrounded by a geotextile fabric to prevent fines intrusion. The stone trench generally contains about 40% void space, which is used to temporarily store runoff before it infiltrates into the subsurface. Infiltration trenches should include swales or filter strips or other pretreatment devices to remove silt and debris to prevent clogging of the pore space.

Application: Infiltration trenches should not be used within 2 feet of the seasonally high water table or within 200 feet of a 20% slope (Virginia DEQ). Infiltration trenches are most effective for infiltrating water from rooftop runoff or from small impervious surfaces with light sediment loads and minimal oil and grease buildup (small parking lots). They should not be used to drain pervious areas since pervious areas will contribute silts which will clog the system. Infiltration trenches are viable options where the measured soil permeability rate exceeds ½ inch per hour (Virginia DEQ). Trenches should be located at least 150 feet away from drinking water wells and at least 10 feet down-gradient and 100 feet up-gradient from building foundations to avoid seepage problems (Metropolitan Council).

Construction: The site should be excavated to an appropriate depth and lined with a filter fabric to prevent fines intrusion and encourage pollutant removal. The trench should include an observation well so that infiltration may be monitored. The base of the excavation should consist of a 6-8" thick sand filter beneath the backfill of washed angular stone. The stone should be covered with a permeable filter fabric and then a layer of pea gravel or river stone. This LID should include a pretreatment structure such as a grass channel or filter strip, a grassed swale, or a sediment forebay. When used to drain small parking lots, the system should be designed such that sheet flow runs of the pavement over a vegetated filter strip onto the infiltration trench, where it will fill the pore space and infiltrate into the subsurface.

Cost:

Pollutant Removal: Infiltration trenches purportedly remove 80-100% of TSS, 40-60% total Phosphorous, 40-60% total Nitrogen, 80-100% Zinc, and 80-100% Lead (Department of Environmental Resources).

Maintenance: Infiltration trenches must be cleared of obstructions, debris, and trash on a regular (monthly) basis. The trench observation well should be checked after storm events to ensure that water is draining from the system. The area should be checked for erosion around the inflow in order to avoid silt clogging of the system.

Treatment of rooftop runoff and runoff from small impervious surfaces with light sediment loads and minimal oil and grease buildup.

Storm water is routed from the parking lot or other impervious surface and spread into sheet flow using a level spreader. The runoff then flows over grassed swale to an infiltration trench, which is an excavated trench backfilled with an aggregate material to permit the filtration and percolation of water into the subsoils.

Virginia DEQ Stormwater Design Specification No. 8. 2011. *Infiltration Practices*.

Metropolitan Council of the Twin Cities Area, Barr Engineering Company, Minneapolis (Minn.). 2001. *Minnesota Urban Small Sites BMP Manual.*

Department of Environmental Resources: The Prince George's County, Maryland. 2007. *Bioretention Manual.*

Swales

Curb cuts to allow water from the parking lot to pass into the swales, which will convey the water to a retention basin.

Swales are open channels or depressions with dense vegetation used to transport, decelerate, and treat runoff. In parking lots, they are designed to help direct water into bioretention areas. In Bluffdale, dry swales, bioswales, and grass channels are applicable. Swales are limited by steep slopes. If the slope exceeds 3 percent, incorporate check dams to decrease the velocity and promote infiltration. Vegetated swales shall in no case exceed 6 percent.

When designing a parking lot area, landscapers should use native trees and shrubs rather than non-indigenous species, which are more suitable to local climates and, therefore, require less irrigation.

Vegetated Buffer Strips

Vegetated filter strips are flat pieces of land with low slopes, and should be designed to encourage natural sheet flow of stormwater as opposed to channeled runoff. Vegetated filter strips are well suited for low-density development or areas with less concentrated amounts of runoff. They function by using soil and vegetation to remove pollutants from stormwater runoff, and often are incorporated to pre-treat and remove sediment before water enters infiltration devices such as bioretention areas.

Bioretention Basins/Rain Gardens

Bioretention treatment areas consist of a grass buffer strip, shallow ponding area, organic layer, planting soil, and vegetation. These areas are typically used in parking lot islands. Bioretention areas are well-suited for parking lots in denser, urban areas with less available open space.

Oil/Grease Separator

Separates grease and oil from water before flow into LID structures or elements. These should be installed at the inlet at the edges of parking lots.

Vortex (hydrodynamic) Separator

Works well in areas of high grade, high velocity. Water spins around and thus mechanically separates out solid contaminants (does not filter dissolved contaminants).

LID for Residential Developments

Site Design Principles

Roads should be designed to follow the natural crown of the land.

Disturbance of natural areas should be limited.

Natural contour of the land should be used for bioretention areas.

Preserve vegetation, particularly mature trees.

Dry Well

Dry wells are excavated pits filled with aggregate stone to hold water until it can infiltrate into the ground. They should be designed with emergency overflow structures that drain to public storm water conveyances to accommodate runoff from major storms. Dry wells should be installed near the downspouts from roofs in order to infiltrate rooftop runoff into the ground.

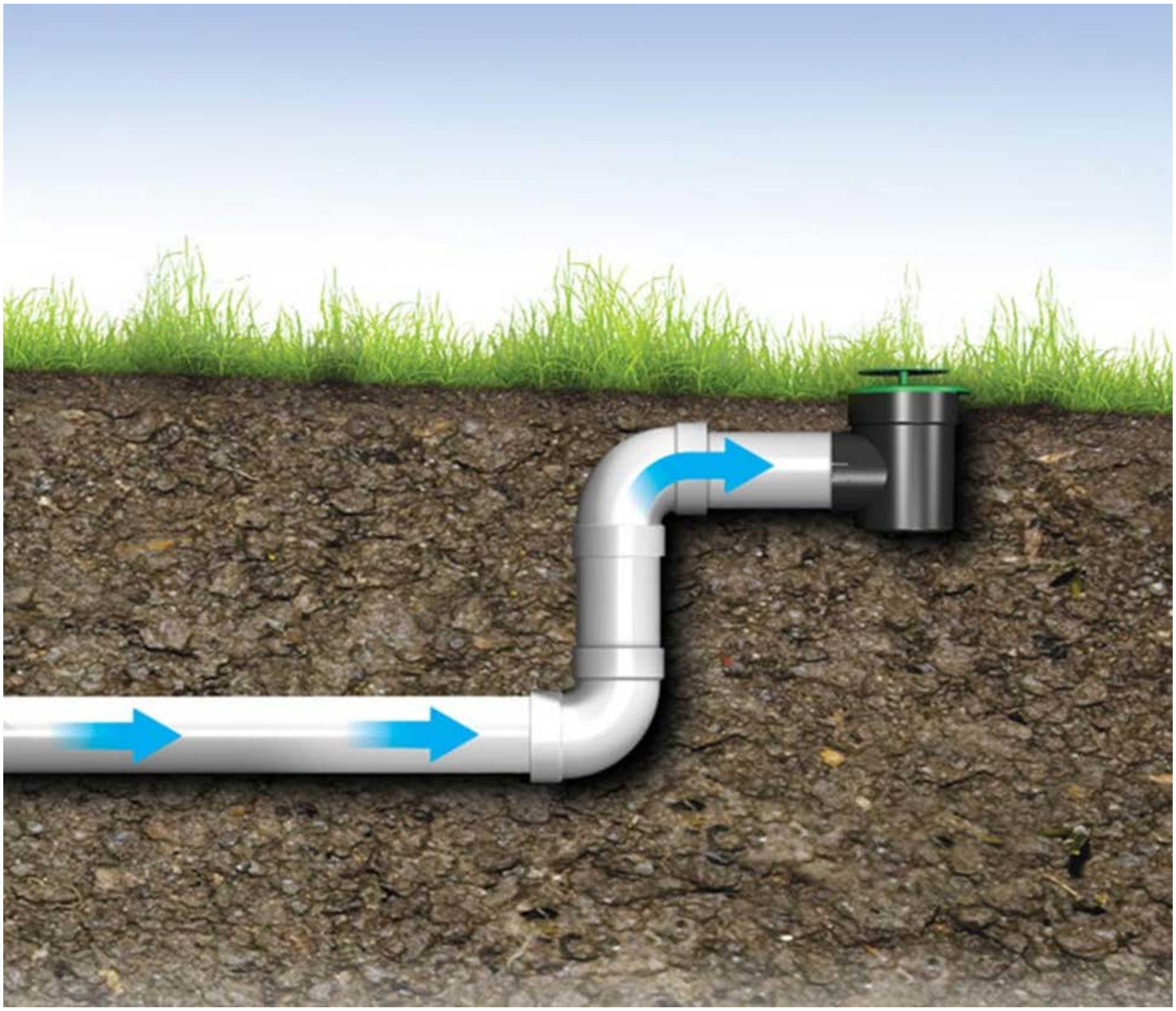
Bioretention Basin

Bioretention areas are shallow, topographic depressions filled with engineered soils and vegetation that retain, treat, and infiltrate water. These can be used in all different types of developments. In residential developments, the basin should be located a distance away from houses to increase flow paths and treat runoff from rooftops and driveways.

Rain Gardens

Rain gardens are constructed near roof downspouts and consist of shallow depressed areas with layers of compost or mulch and native plants used for evapotranspiration. Studies indicate that rain gardens can function well even in clay soils if they are designed properly to avoid clogging, use proper plants, and use soil amendments as necessary. These are effective for pollutant removal, infiltration, and evapotranspiration.

Pop-up Emitters



Overview: Disperses rainwater from the gutter throughout the lawn. PVC pipe runs from the roof downspout to the pop-up emitter, which pops up as pressure increases, spreading the water over an area of the lawn. Good for soils with poor drainage

Application: Best used in combination with water storage system (rainwater collection) so that rainwater may be utilized during dry times. If legally limited to 200 gallons of water storage (a possible situation given Utah's rainwater collection laws) an overflow can be implemented so that during a storm even that exceeds the 200-gallon capacity, water still flows through the pop-up emitters and saturates the lawn, rather than becoming heavy runoff.

Construction: Installed similarly to an ordinary sprinkler system, with lower cost and lower maintenance parts. With enough water storage (see rainfall capture below), this system can entirely replace a conventional lawn irrigation system.

Cost: To have this system installed professionally, it will likely cost around $2500 on a ¼ acre lot, with cost increasing on larger properties.

Pollutant Removal: By capturing the rainwater shortly after falling, it will have little time to collect pollutants, with the exception of the first few minutes of rainfall, which may collect debris off of your roof. Any remaining pollutants will be sufficiently removed as the water infiltrates into the soil.

Maintenance: Maintenance will be minimal. No pump will be needed, as water pressure produced by elevation will be used to disperse the water through the lawn, regardless of whether the water originates directly from roof runoff or longer term storage tanks. Unlike an ordinary sprinkler system, a small leak is not a huge deal, as the water will still infiltrate into the soil in accordance with this LID.

Rainfall Capture

Overview: Utah allows for the direct capture and storage of rainwater on land owned or leased by the person responsible for the collection. According to Senate Bill 32 (2010), a person registered with the Division of Water Resources may collect and store no more than 2,500 gallons of rainwater. If unregistered, no more than two containers may be used, and the maximum storage capacity of any one container shall not be greater than 100 gallons. It is important to remember that when a property exchanges ownership, the new owner must register with the Utah Division of Water Rights in order to legally utilize rainwater harvesting.

https://waterrights.utah.gov/forms/rainwater.asp

Application: A properly installed and utilized rainwater capture system can effectively eliminate runoff in a 90th percentile storm event, with a modest 1500 square foot roof (about average) producing 561 gallons of runoff in Bluffdale. A large home with a 3000+ square foot roof could still have runoff effectively managed with just a 1500-gallon tank. Large businesses and office buildings however, may struggle to capture all roof runoff with a 2500-gallon tank, with the maximum roof size being approximately 6700 square feet. Even if a structure is larger than that, however, rainwater storage is still a viable option as it will take load off of other LIDs that have been implemented in the area, all while being put to good use irrigating when it is dry. All water collected on a property may only be used on that property.

Construction: Construction would be very simple compared to other LID options. All that would have to be done is install a tank of appropriate size (based on roof area), ensure that rain gutters all flow into the storage tank, and connect the storage tank to a pump (or just keep it elevated) and connect that to the home’s sprinkler system.

Cost: For an average household, a 1500-gallon tank would cost approximately $750, the gutter work would cost approximately $1500, and installing sprinklers would cost approximately $3000. Much of this work would be done regardless of utilizing rainwater harvesting, so the additional cost to implement this LID would only be approximately $1000 per household, and save the homeowner costs in irrigation water in the long run.

Pollutant Removal: Because this LID directly utilizes rainwater, no additional pollutant removal needs to be considered.

Maintenance: Just like any house, the gutters will need to be cleared periodically. The tank may also need to be occasionally cleaned, and sprinklers serviced, but these are largely maintenance issues to be expected with the ownership of any home.

Wetlands

Wetlands can be used in high water table areas, creating land that is permanently wet and vegetated accordingly. These remove pollutants and provide recreation and aesthetic appeal. They also serve as detention basins for storm water.

LID for Roadways

Traffic Circles at intersections and Cul de Sacs

Bioretention planters are constructed in the center of cul de sacs, traffic circles, or roundabouts. The intersection is graded so that storm water flows in to the center bioretention area, where it infiltrates into the ground. This increases infiltration and reduces impervious area and acts as a traffic calming device.

R-Tank Infiltration along Roadways

Roads are constructed with standard curb and gutter. Rather than constructing storm drains with curb inlets, inlets are installed which lead to R-tank infiltration chambers located behind the curb underneath the planter strip.

StormTech Infiltration along Roadways

Roads are constructed with standard curb and gutter. Rather than constructing storm drains with curb inlets, inlets are installed which lead to Storm-Tech infiltration chambers located behind the curb underneath a grassed swale in the planter strip.

Vegetated Swale along Roadway

There are two methods for vegetated swales.

In one method, traditional curb and gutter is constructed and curb cuts are made at regular intervals which open into the roadside swale. Rip rap or cobbles should be placed along the inlets to the swale to reduce velocity and erosion from the high-velocity flow from the gutters. Swales consist of a vegetated mild slope which allows for infiltration and pollutant capture and removal. Multiple studies suggest that swales significantly reduce runoff volumes.

In another method, streets are constructed with a concrete apron flush with the asphalt pavement. Water flows off the roadway over the concrete and sheet flows over a grass filter strip into the bioswale. The bioswale should consist of drought tolerant grasses. In both cases, the swale should be carefully constructed to avoid gullies or rills, which would increase erosion, velocity, and sediment transport, and decrease residence time, pollutant removal, and infiltration rates.