Post-Construction Stormwater BMPs

What are post-construction stormwater BMPs and why are they important?

Developed watersheds contain a higher percentage of impervious surfaces (e.g. roads, rooftops, and parking lots) and increased drainage density from the connectivity of stormwater conveyance systems. Instead of infiltrating into the ground, precipitation runs off these surfaces as concentrated flow to nearby streams at a much faster rate, carrying nonpoint source pollutants such as metals, oils, and sediment. Reduced infiltration rates translate into an increase in magnitude of stormwater runoff that can potentially cause flooding downstream. Post-construction stormwater best management practices (BMPs) can be used in commercial settings or other developed areas to mitigate flooding and reduce water quality impacts associated with stormwater runoff. Stormwater BMPs such as infiltration areas, constructed wetlands and vegetated buffers can substantially improve water quality, as can the use of pervious paving techniques. These systems and the benefits they provide in treating stormwater runoff are discussed briefly below.

A high concentration of impervious surfaces (roads, rooftops, parking lots, etc.) can lead to increased flooding if stormwater BMPs are not installed.

Vegetated Swales and Buffer Strips

Bioretention areas like the one shown above are one type of vegetated swale.

Vegetated swales are areas where stormwater accumulates. The movement of water is slowed and allowed to be more readily absorbed into the ground. Most swales are planted with grasses or other low-lying plants that can withstand periodic flooding. Swales are slight depressions that are generally sloped and directed toward areas that can more easily withstand large influxes of water. Buffer strips are usually established between large impervious areas such as roads and receiving water bodies; they treat sheets of water that can accumulate during storm events. Depending on the size and slope of the area and the vegetation they contain, their effectiveness can vary, but they do help to control erosion and sedimentation.

Infiltration trenches and basins

Infiltration trenches and basins store large volumes of water from storm events and slowly release them back into the ground or surface water. In most cases, trenches are the most practical approach, as they can be easily constructed in most places where stormwater accumulates. Building an infiltration trench simply involves digging a trench along the area where water exits an impervious area, and filling it with gravel. The gravel allows the water to be absorbed more slowly and evenly along the ground.

Infiltration basins are much more complicated and are not practical for all sites, but they are extremely efficient at filtering out impurities that accumulate in water as it travels across large impervious surfaces. Basins involve digging a shallow impoundment where stormwater accumulates, allowing the water to gradually be absorbed into the ground. As the water seeps back into the groundwater, the soil it passes through is very effective at filtering out pollutants. While infiltration basins can be an effective tool for managing stormwater, their success is highly dependent on soil type and other site-specific factors. Careful planning and consultation are critical.

Pervious Paving Systems

Paved areas that use pervious materials such as gravel, interlocking pavers, and pervious concrete allow stormwater to be evenly absorbed into the ground. Interlocking pavers where vegetation is permitted to grow between pavers are especially effective at evenly distributing rainwater across the paved surface. Roads and driveways paved with gravel can be effective at absorbing and evenly distributing rainwater, especially in flat areas. Gravel is less stable than asphalt or interlocking pavers, so it is critical that the roads are well maintained and new gravel is laid down periodically. Before constructing a gravel road, careful attention must also be paid to the slope and natural drainage patterns of the site. Interlocking pavers, pervious concrete, and other similar systems commonly have a sub-base layer that can store water and slowly release it to allow infiltration and/or runoff. These systems are also effective pollutant removal devices.

One type of porous paving system (shown above) involves filling a synthetic grid with clean gravel.

Stormwater Wetlands and Ponds

Constructing or maintaining existing ponds and wetlands in areas where stormwater accumulates is a very effective way to manage stormwater. These natural or landscaped areas not only reduce the velocity of the water running off the watershed, they can often mitigate flooding because they reduce the magnitude of the peak flow, thereby reducing the "flashiness" of the watershed. These stormwater devices also filter out impurities that may be present. Nutrient uptake by plants, along with the filtering effect of soils can significantly reduce the amount of nonpoint source pollutants entering the groundwater and nearby streams.

Wetlands are very effective at removing pollutants and reducing flooding. They can also be very attractive.

If ponds or wetlands already exist on the property, they may be useful in treating stormwater runoff. In such cases, water exiting impervious areas may be directed towards these areas, with care taken to ensure that the volume of water entering the pond or wetland can be absorbed without substantial flooding. In order to maintain the long-term viability of the wetland, a healthy biological community should be maintained by controlling invasive species and ensuring that water entering the system is relatively free of chemical pollutants. Some types of wetland systems are sensitive to the natural hydroperiod, or length and frequency of inundation; these systems may not be good candidates for stormwater treatment as their modification in this fashion can result in the modification of the plants and animals that inhabit the area.

Constructing a pond or wetland is more complicated, but if done properly, this can be just as effective a tool as a natural system. The design of a pond or wetland is highly site-specific, and it is important to gain as much information as possible about the soil type of the area. A true constructed wetland must have a connection with the groundwater table or have a confining soil layer. The type of vegetation that is planted will depend on the slope, soil type, and topography of the constructed wetland, along with other physical factors. Careful research and consultation with a professional is highly recommended.

What are the advantages of installing post-construction stormwater BMPs?

In addition to the water quality benefits discussed above, post-construction stormwater BMPs can also be incorporated into a landscape design as an amenity. Many BMPs like vegetated swales, buffer strips, and infiltration trenches are inexpensive and easy to implement given limited space and other constraints. Finally, installation of BMPs provides educational opportunities to increase awareness of water quality improvement strategies and green initiatives.

Are there disadvantages associated with installing post-construction stormwater BMPs?

Post-construction stormwater BMPs are most effectively implemented in the context of a watershed management plan or stormwater master plan. Often, random implementation of stormwater BMPs does not provide significant water quality benefit to justify the cost involved. Routine maintenance is required for proper function of many stormwater BMPs, adding to the total implementation cost.

Internet resources for more information and technical assistance about post-construction stormwater BMPs:

Georgia Stormwater Management Manual
http://www.georgiastormwater.com/

North Carolina Department of Environment and Natural Resources
Business Stormwater and Runoff Pollution
http://www.ncstormwater.org/pages/businesspage.html

North Carolina Division of Water Quality, Stormwater Unit
2007 Stormwater BMP Manual
http://h2o.enr.state.nc.us/su/Manuals_Factsheets.htm

Sample Deed Restrictions for Stormwater BMPs
http://h2o.enr.state.nc.us/su/bmp_forms.htm

North Carolina State University, Stormwater Engineering Group
http://www.bae.ncsu.edu/stormwater/

An Evaluation of Cost and Benefits of Structural Stormwater Best Management Practices in North Carolina
http://www.neuse.ncsu.edu/Stormwater_BMP_Factsheet.pdf