Permeable Pavement as an Option to Reduce Pollutants in Stormwater Runnoff

Stormwater runoff is a concern for both large and small communities across Louisiana. This runoff can contain several pollutants and develops when rain is dropped on the landscape and begins its flow across and through many land-based features both natural and manmade on its way to drains, ditches, creeks, streams and ultimately to our coastal estuaries and the Gulf.

This runoff typically contains substances such as oil and grease, a variety metals, petroleum, sediments, fertilizers and other pollutants that if not filtered by some method, can cause our water bodies to become impaired. One method for mitigating pollutants in stormwater runoff from some low density development sites, which may include both residential and commercial development, is to introduce an alternative, such as permeable pavement.

Permeable pavements serve as alternatives to standard asphalt and concrete, which are completely impervious surfaces. Permeable pavements allow water to infiltrate or pass through them. Several types of permeable pavements are available, including pervious concrete, pervious asphalt, permeable interlocking concrete payers (PICPs), concrete grid pavers and plastic reinforced grass pavement.

These pavements are similar in several ways. They usually contain a gravel storage layer underneath the surface pavement, which often doubles for structural support. Permeable pavements are typically targeted for paved areas with low traffic volumes. Some examples of appropriate uses for permeable pavements include patios, residential parking pads, driveways, fire lanes, overflow parking areas and some daily parking areas. For runoff reduction, permeable pavement on flat slopes tends to work better. Deeper gravel layers under the pavement allow for more storage of rainwater.

Permeable pavements are least expensive and work best when located on sandy soils (such as those on coastal barrier islands, coastal plains and in some northern regions of the state), but they have been used throughout Louisiana. Constructing them over clay soils is possible but more expensive. Clay soils tend to shrink and swell and are rather impermeable. The properties of clay make permeable pavements less stable structurally and limit the rate at which water can infiltrate the paving material. However, when permeable pavements are constructed in watersheds with limited construction, they can function over clay soils, such as many of those coastal Louisiana.

Clay soil permeable pavements are designed differently from their sandy soil counterparts. They tend to be deeper, with a thicker gravel storage layer. They usually have an impermeable liner between the bottom of the gravel storage layer and the existing clay soil on site, and they employ an under drain system to release water slowly to the storm drain network. If sited, designed and installed correctly, permeable pavement can effectively reduce peak runoff rates and consequently reduce local downstream flooding. Permeable pavements also reduce the pollution load to streams and water bodies, the likelihood of soil erosion along streams and waterways, and pavement temperature.

Permeable interlocking concrete pavers and concrete grid pavers consist of concrete blocks with gaps between them filled with a permeable material like pea gravel or sand. The blocks rest on a bedding layer of fine gravel, which overlays a layer of coarse gravel. Pervious concrete and pervious asphalt both allow more air in the mix (air entrainment) and omit finer aggregates (sand) than conventional concrete and asphalt. Each also has a rougher look, slightly resembling a rice cake. The rough look is the result of small waterways connecting the surface of the permeable pavement to the gravel bedding layer underneath.

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All permeable pavements are more expensive to construct than traditional asphalt. Due to peak runoff reduction, however, the system cost (which includes pavement plus other stormwater features like pipes, another structural BMP, or both) may be lower for the permeable pavement system.

How do they work? Unlike traditional surfaces, permeable pavements allow water to pass through their surfaces. After water migrates through the surface, it temporarily collects in the gravel storage layer. Depending upon the rainfall intensity, rainfall volume and existing soil infiltration rate, rainwater either exits the bottom of the permeable pavement (via soil infiltration or drain pipes beneath the pavement) or it builds up inside the pavement until runoff occurs. Intense rainfalls can produce runoff from permeable pavement, particularly on concrete grid paver systems filled with sand. But when water passes through a permeable pavement, many pollutants can be trapped inside of it or removed as the water passes out of the pavement into the surrounding soil.

How well do they work? North Carolina State University researchers have tested several permeable lots in eastern North Carolina. Each reduced annual runoff volume – measured for several years at a few sites – by at least 60 percent. Most of this water infiltrated into shallow groundwater, which helped replicate predevelopment hydrology. This makes permeable pavement an excellent tool for low-impact development. One parking lot, albeit a special case tested in North Carolina for 10 months, never produced any runoff; all rainfall infiltrated the lot. Permeable pavement applications tested for water quality benefits in other parts of NC show that these pavements can reduce concentrations of zinc and copper. There were mixed results for phosphorus and no improvement in nitrogen. In all cases, however, nutrient and pollutant loads entering the storm drain network were decreased because much less water ran off the pavement.

Permeable pavements will function for up to 20 years if they are constructed in areas free of disturbed soil and are regularly maintained. A survey of 48 permeable pavement sites in North Carolina and other Mid-Atlantic states found that permeable pavements built adjacent to active construction zones were far more likely to clog. The study also verified that standard maintenance, such as street sweeping, increased infiltration rates of the permeable pavement tested.

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