

**REQUIREMENTS AND GUIDANCE
FOR DESIGN, CONSTRUCTION AND MAINTENANCE OF
PERMEABLE PAVEMENTS
FOR COMPLIANCE WITH SB 845**

In a large proportion of the state, some type of stormwater controls are now in place. When permeable pavements are used in those areas to meet a state or local stormwater mandate, Chapter 18 of the Division of Water Quality's Stormwater BMP manual <http://h2o.enr.state.nc.us/su/documents/Ch18-Permpavement.pdf> will determine how those pavements are to be designed, installed and maintained. However, state legislation adopted in July of 2008 (SB 845, Session Law 2008-198), requires that projects in areas of the state not under an existing mandate to control stormwater (as of April 1, 2009) must limit the impervious pavement on those sites. (An alternative stormwater treatment provision is also allowed.) For these special areas, the technical requirements are generally the same but do contain some differences. Most of the differences arise out of the traditionally-limited geographical area where permeable pavements have been allowed in order to receive stormwater credit. (Permeable pavements are allowed anywhere in the state but stormwater credit is only allowed in areas specified in Chapter 18 of the DWQ Stormwater Manual.) The intent of the new legislation was to require maximum impervious parking area limitations for all parts of the state that do not have any existing stormwater controls. Therefore, the soil restrictions that apply in Chapter 18 of the Stormwater Manual are modified for projects across the state that must comply with the new legislation.

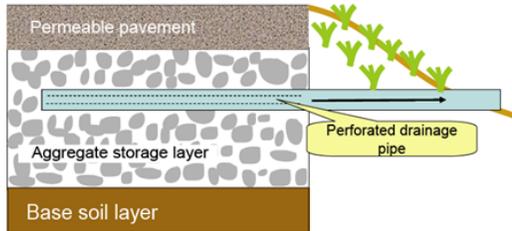
Conditions that may differ from Chapter 18 of the Stormwater Manual

1. When soil permeability rates are less than 0.52 in/hr (sat. k rate), a minimum of 6 in. of open-graded, aggregate base (washed and crushed stone) will be required beneath all permeable pavements. It is important that the aggregate base contain adequately-sized stones, such as the AASTO (American Association of State Highway and Transportation Officials) No. 1, 2, 3 or 57 that will provide voids for water storage.

Permeable pavement installations over soils with permeability rates below 0.52 in/hr will likely need drainage systems in the stone base to prevent saturation of the soil subgrade and minimize heaving related to freeze and thaw conditions. Permeable pavement installation should include an hydraulic analysis to determine the depth of the stone bed and the design of an overflow system. An overflow system would prevent water in the stone bed from rising into the pavement surface during extreme storm events. A weir type overflow system or drain pipes may be used. If drain pipes are installed, they should be elevated from the top of the soil subgrade to enable some or all of a rain event to exfiltrate into the soil subgrade. The elevation of the pipes should be designed to maximize detention time and storage but not to store water to the extent that the

structural stability of the pavement is compromised or that the ability to store upcoming rain events is diminished. (See Figure 1 below.) Research at NCSU-Department of Biological and Agricultural Engineering and has indicated that a

Figure 1
Permeable Pavement System With
Elevated Drainage Outlet



device, such as the upturned underdrain in Figure 2 below can reduce stormwater runoff by creating detention storage and supporting greater infiltration.

Many professionals in the pavement industry have recommended that the storage volume be infiltrated in three days or less. Design software is available that considers the need to install thicker base courses to compensate structurally for wet, soft

subgrade. It should be noted, however, that in order to benefit from nutrient reduction due to detention and flood peak attenuation, collected water should not be released to the storm drain or surface waters in less than two days.

2. In areas with extremely tight soils, such as those where septic tank drain line installations are not allowed, permeable pavements are not recommended. Instead, the use of bioretention cells is recommended as specified in SB 845. (See Requirements and Guidance for Bioretention Cells. It is also advised that soils with a moderate to high shrink-swell ratio should not be covered with permeable pavement. Nevertheless, permeable pavements in clayey soils can be designed as detention basins, holding runoff for several hours or days and releasing it at a rate much less than contributing rainfall.
3. Permeable pavement systems perform adequately at differing surface slopes. Although less than 2% surface slopes are recommended, some pavements perform in an acceptable manner at 2-6% slopes. It is also important that the soil subgrade (the soil below the aggregate storage level) be as close to 0-1% as practicable. If the top of the soil subgrade is sloped greater than 2%, baffled partitions, berms, terracing or other devices (often with downslope, flow restricting drain pipes through them) should be installed to promote infiltration and to reduce the potential for under-pavement, lateral flows. Another design approach for sloped sites is to build the permeable pavement in relatively flat or level sections and drain the base of the higher area or areas via pipes into the base(s) in the lower area(s). This can provide additional pollutant filtering by the bases and allow additional opportunities for some infiltration in tight soils.

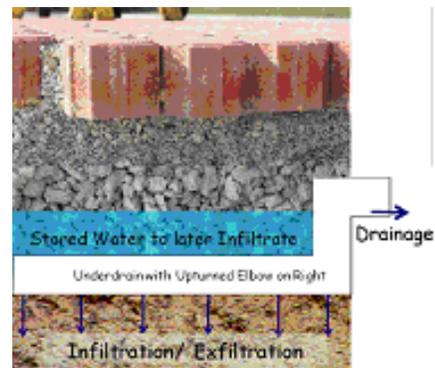
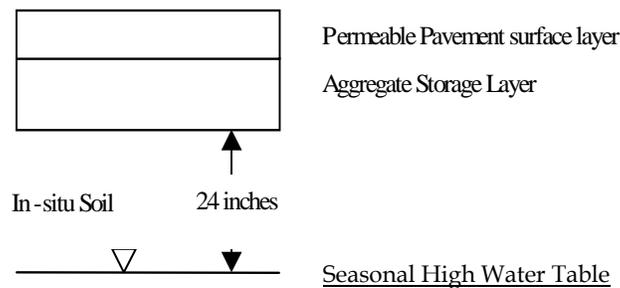


Figure 2 - Upturned elbow
drainage configuration
Photo courtesy of NCSU-BAE

4. Each permeable pavement surface should receive cleaning maintenance at least once per year. If the location is such that greater than average trash and dirt accumulation is expected, more frequent maintenance should be applied. All maintenance sweeping should be done with vacuum-type equipment. Caution should be used with sprayed water systems since spraying on some pavements can result in particles being pushed into the pores in the pavement. Overhanging trees provide an annual deposition of organic debris. Additional cleaning may be necessary to prevent the accumulation of organic matter in the pores. It is recommended that a maintenance agreement for periodic inspection and cleaning for facilities on private, as well as public property be made a part of the local government permitting process.
5. It is strongly recommended that permeable pavement should not be placed where upland land disturbance might occur. Sediment-filled run-on to the permeable pavement from exposed areas can cause the system to fail or perform ineffectively. Construction sequence should insure that the surface installation is planned to be completed after adjacent areas are stabilized with vegetation and that the pavement surface is protected from sediment deposits from adjacent land and vehicles during construction. Such protection can include sediment forebays, upslope sand filters or other sediment catchment devices. Any sediment entering an excavated area prepared to receive the open-graded stone base must have all deposited sediment removed prior to placing the base. Any stone base materials contaminated with sediment must be removed and replaced with clean stone base materials.
6. If development on upland properties will create stormwater runoff onto adjacent permeable pavement, design of adequate retaining or diverting devices such as berms and swales should be incorporated around the pavement's perimeter to prevent sediment from clogging pavement pores.
7. Design of permeable pavement systems must be performed by appropriate professionals who meet who meet all North Carolina occupational licensing requirements for the type of system proposed. Upon completion of construction, the designer for the type of stormwater system installed must certify in writing that the system was inspected during construction and was constructed in conformity with plans and specifications recommended by the Division prior to issuance of the certificate of occupancy.
8. It is important that permeable pavement maintain its ability to infiltrate stormwater during its service life. Prior to approval of a permeable pavement installation, visual documentation should be provided verifying that no sediment has accumulated on the surface, even on perimeter areas. Alternatively, documentation shall be provided from test results using a single or double ring infiltrometer, or similar device, demonstrating that a minimum surface rate of 2 in/hr can be achieved.
9. It is recommended that permeable pavement design provide for an alternate path for stormwater to enter the stone recharge bed, such as a stone-filled border, in the event that the pavement surface becomes plugged or experiences extreme storm events.

Standard design conditions that apply to all permeable pavement installations

1. Where an aggregate base is part of the permeable pavement system, washed, open-graded aggregate must be used. Numbers 1, 2, 3, and 57-sized stone are frequently used. Fine particles from standard “crusher run” also known as aggregate base course or dense-graded base will clog the pores at the bottom of the pavement and will not be allowed.
2. Seasonal high water table must be at least 2 ft. from the bottom of the aggregate base of the permeable pavement. Water tables approaching the permeable pavement system will not allow water to exfiltrate.



3. It is recommended that permeable pavements be installed in areas of low traffic volume (less than 100 cars per day) and with design speeds of 35 MPH or less. Design professionals may support designs subject to higher traffic levels on a case-by-case basis based on the type of pavements installed.
4. During preparation of the subgrade, special care must be made to avoid compaction of soils. Compaction can greatly reduce infiltration of water from the base into the soil subgrade. Information on construction techniques to improve infiltration capabilities for bioretention cells and permeable pavements will be available soon at: <http://www.bae.ncsu.edu/stormwater/pubs.htm>
5. Permeable pavement systems are not allowed in areas, such as vegetative buffers, where impervious surfaces are not permitted.
6. Permeable pavement should not be placed over areas that are known to be contaminated by toxic deposits such as brown fields.