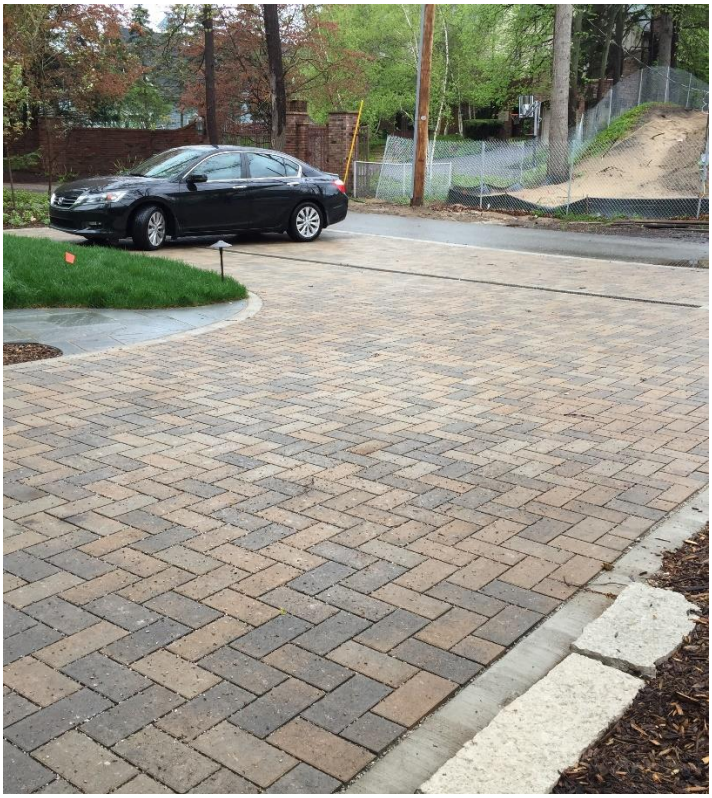
Pervious Pavements



Application

- Local Streets
- Park Lanes
- Service Drives and Alleys
- Bike Lane and Sidewalk

Advantages

- Allows runoff to infiltrate, reducing site imperviousness
- Easily integrated into existing infrastructure
- Filtration of pavement runoff

Limitations

- Higher maintenance than standard pavement
- Not appropriate for high speed, high traffic, or heavy vehicle areas
- Sediment-laden runoff can cause clogging

DESCRIPTION

Permeable pavements are alternatives to conventional impervious surfaces that allow water to pass through them into a subsurface gravel layer that can promote infiltration. The subsurface gravel layer also acts as storage and structural base layer. Types of permeable pavement include poured in place (i.e., porous concrete and porous asphalt), and modular paving systems (i.e., permeable interlocking concrete, grass, and gravel pavers).

Where site conditions allow, the subsurface gravel layer (open-graded base/sub-base) is configured to allow water to infiltrate into the surrounding subsoil. If site conditions do not allow for infiltration, the water is detained in the gravel storage layer and then routed to a stormwater conveyance system through an underdrain. Both conditions provide initial infiltration through the subsurface layers, provides some filtering of pollutants, and decreases peak runoff. Only when the water is allowed to infiltrate does it significantly decrease the runoff volume.

Pour in Place Permeable Pavements

Pour in place permeable pavements are poured where they will ultimately be used and allowed to cure in place. Typically, the pore spaces in the pavement make up about 10% of the total

surface area. Porous asphalt and porous concrete are similar to each other in that the porosity is created by removing the small aggregate or fine particles from the conventional recipe, which leaves stable air pockets (gaps through the material) for water to drain to the subsurface. Porous concrete is rougher than its traditional counterpart and, unlike oil-based asphalt, will not release harmful chemicals into the environment. These types of permeable pavements should only be used in areas of slow and low traffic (e.g., parking lots, low traffic streets, pedestrian areas, etc.).

Modular Paver Systems

Several varieties of paver systems promote infiltration, including (but not limited to) interlocking concrete pavers, grass pavers, and gravel pavers. Interlocking concrete pavers are not porous themselves, rather the mechanism that allows them to interlock creates voids and gaps between the pavers that are filled with a pervious material. Grass and gravel pavers are nearly identical to each other in structure (rigid grid of concrete or durable plastic) but differ in their load-bearing support capacities. The grids are embedded in the soil to support the applied loads, thereby preventing compaction, and reducing rutting and erosion. Grass pavers are generally filled with a mix of sand, gravel, and soil to support vegetation growth (e.g., grass, low-growing groundcovers, etc.), which provides a matrix for microbial growth, which aides in pollutant removal. Grass pavers are good for low-traffic areas, while gravel pavers are good for high-frequency, low-speed traffic areas. Gravel pavers differ from grass pavers in that they are filled with open-graded gravel with no fines and are often underlain with a geotextile fabric to prevent the migration of the gravel into the subbase. Gravel systems typically support greater loads and higher traffic volumes than grass pavers.

CONDITIONS WHERE PRACTICE APPLIES

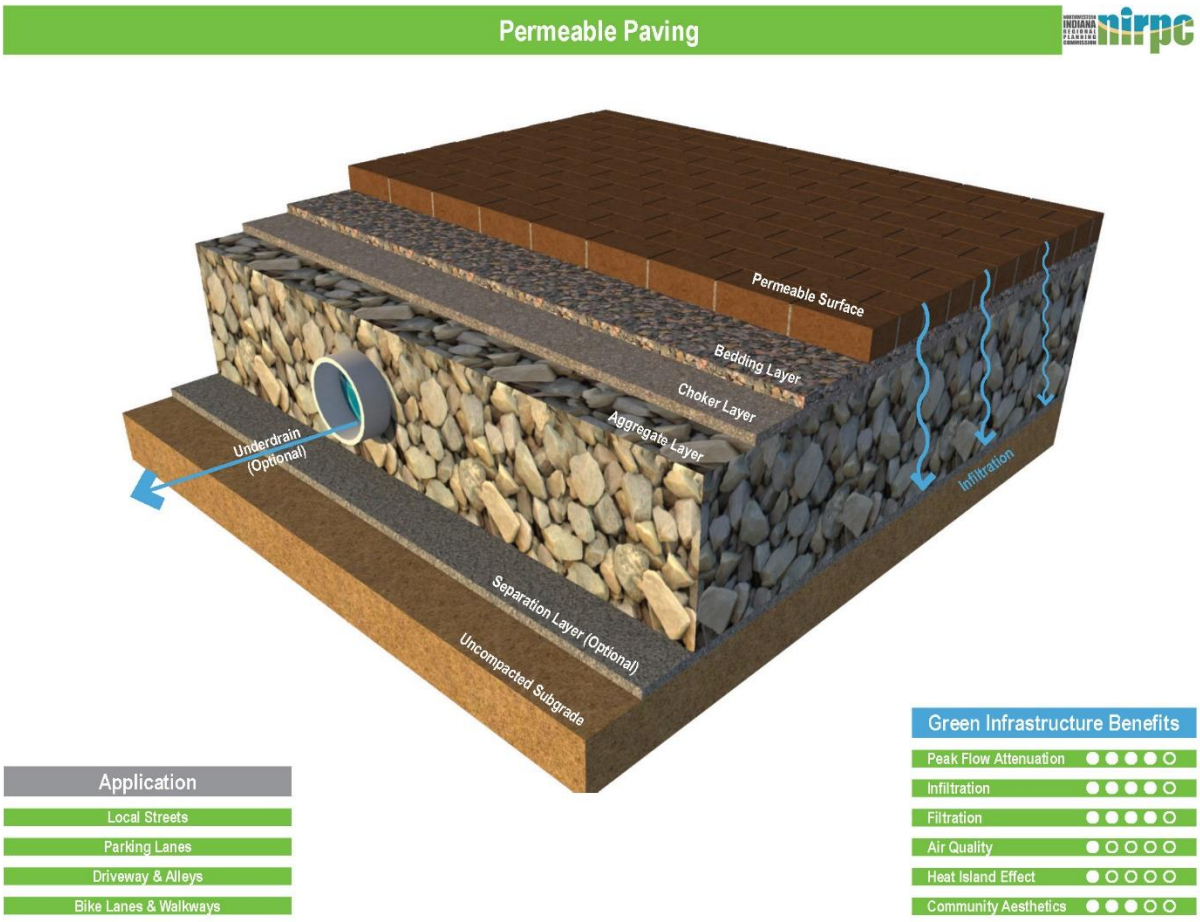
Application

Permeable pavement can be applied as an alternative to traditional impervious surfaces such as low traffic roads (Local Streets), service drives, alleys, parking lanes, bike lanes, and sidewalks. Permeable pavers should be avoided in areas with heavy equipment, heavy vehicle traffic, and locations with high frequency of turning movements.

Site Constraints

Underlying soil conditions should be reviewed for potential contamination, infiltration rates, and seasonal groundwater elevations. Depending on the underlying soils infiltration capacity within the permeable paver footprint, underdrains, in the form of perforated pipes, are recommended for applications with limited infiltration capacity. Underdrains are recommended to prevent excessive saturation of underlying soils, thus reducing load-bearing capacity and surface ponding. Where underlying soils provide some infiltration capacity, the perforated pipe is placed above the bottom of the gravel drainage. This creates a sump storage area to achieve runoff volume losses through infiltration. Permeable pavement should be either

lined or avoided in areas where soils might be contaminated to prevent the migration of contaminants.



Site Suitability Considerations for Permeable Pavement

Tributary Area	< 3 times the area of the permeable pavement surface [1]
Site Slope (%)	< 2 percent
Depth to Seasonally High Groundwater Table	< 2 ft then pavement not recommended
Hydrologic Soil Group	Any [2]

1) Tributary area is the area of the site draining to the porous pavement area. Tributary areas provided here should be used as a general guideline only. Tributary areas can be larger or smaller in some instances.

2) Underdrains may not be required in areas where the infiltration capacity of the underlying soils is not limited (hydrologic soil groups "A" or "B"). Underdrains should be incorporated if the permeable pavement is within 10 feet of a building or has a longitudinal slope of less than 1.5%. If underdrains are provided, the site must have adequate relief between the land surface and the stormwater conveyance system to permit vertical percolation through the gravel drainage layer (open-graded base/sub-base) and underdrain to the stormwater conveyance system.

VARIATIONS AND ENHANCEMENTS

Several variations to the standard permeable pavement design can be used to increase storage capacity or pass more significant flows, including use of a deeper gravel layer, amending native subgrade, and installing perforated riser underdrains. In some cases, roof downspouts may be routed to the permeable pavement to reduce runoff rates and increase volume losses. Additionally, variations in pavement styles and color can be done to match or blend with the surrounding characteristics and add aesthetic value.

SIZING AND DESIGN CONSIDERATIONS

The following are recommended sizing and design considerations. Final permeable pavement designs should be based on site-specific considerations and limitations and designed by a licensed engineer.

- Depending on how and where the permeable pavement will be used, pretreatment of the runoff entering the pavement may be necessary—(e.g., vegetated filter strips, etc.).
- The thickness of the permeable pavement surface course, consisting of either poured in place materials (i.e., porous concrete and porous asphalt) or modular paving materials (i.e., interlocking concrete, grass, and gravel pavers), will vary depending on structural and functional design. The depth of each layer should be determined based on analyses of the hydrology and hydraulics and the structural requirements of the site.
- The bedding material should consist of small-sized aggregate placed below the permeable pavement surface course. This layer provides a level surface for porous concrete and asphalt, and servers and a barrier to prevent the migration of the leveling sand used in porous concrete blocks into the reservoir layer. This layer is typically about 1.5" to 3" inches thick and may be underlain by a geotextile fabric.
- The gravel storage layer must be designed to function as a support layer as well as a reservoir layer (i.e., consideration must be given to the soil conditions and the expected loads). The reservoir layer is typically washed, open-graded without fines.
- Recommended drawdown time of sub-surface storage layer is less than 72 hours. *Intent: Soils must be allowed to dry out periodically in order to restore hydraulic capacity to receive flows from subsequent storms, maintain infiltration rates, maintain adequate subsoil oxygen levels for healthy soil biota, provide proper soil conditions for biodegradation and retention of pollutants, and maintain the structural integrity of underlying soil.*
- If underdrains are provided, they should be made of slotted, polyvinyl chloride (PVC) pipe or corrugated high-density polyethylene (HDPE). The pipe specifics should be determined by a licensed engineer based on analyses of the hydrology and hydraulics and the structural requirements of the site. *Intent: As compared to round-hole perforated pipe, slotted underdrains provide greater intake capacity, clog-resistant drainage, and reduced entrance velocity into the pipe, thereby reducing the chances of solids migration.*

INSPECTION AND MAINTENANCE

Inspection frequencies, specific routine maintenance activities, and major maintenance activities should be considered as part of the design of permeable pavement facilities. Permeable pavement mainly requires vacuuming and the management of adjacent areas to limit soils migration and prevent clogging by fine sediment particles.

Routine Maintenance

At a minimum, routine maintenance activities of the permeable pavement system should include:

- Regularly (e.g., monthly for a few months after initial installation, then quarterly) inspect pavement for ponding water after rain events, this could indicate surface clogging;
- Annually vacuum sweep permeable asphalt, concrete, and concrete block systems to remove fine sediments that can clog the permeable pavement system.
- Inspect pavement for vegetation growth and remove via power washing when present; power washing should occur after vacuuming to minimize the introduction of particles into the deeper pores of the pavement.
- As needed, replace missing gravel in void spaces between pavers; and
- As needed, repair ruts or depressions that form near high traffic areas, such as entrance locations or turn around points. Maintain landscaped areas that may flow onto the pavement to prevent clogging (reseed bare areas).

Major Maintenance

Major maintenance activities for permeable pavement systems should include:

- Use of high-powered vacuum trucks to remove excessive surface clogging of porous asphalt, porous concrete, and concrete block systems. These trucks can be used to remove the joint gravel material between interlocking concrete block systems.