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Stormwater Management for Homeowners Fact Sheet 3: Permeable Pavement

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This fact sheet is part of a series. Please refer to definitions in the glossary at the end of this fact sheet. Glossary terms are italicized on first mention in the text.

Introduction

When rain falls on *pervious surfaces*, like soil, mulch, and vegetative groundcovers, it soaks in through a process called *infiltration*. The water can be used by plants or it can recharge underground water storage areas called *aquifers*.

When rain falls on *impervious surfaces*, like roads, driveways, and rooftops, it does not infiltrate. Instead, water quickly collects and flows off these surfaces to the nearest stream, river, pond, lake, reservoir, bay, sound, or ocean. Water that moves in this way is called *runoff* or *stormwater*. It carries *pollutants* with it, including fertilizer, pesticides, fluids from cars, *sediment* from bare soil areas, bacteria from pet waste, plant debris like leaves and grass clippings, and trash like plastic bottles and cigarette butts. The more area covered in impervious surfaces, the greater the amount of pollution and volume of runoff, which increases the likelihood of flooding, stream *erosion*, harm to wildlife and the environment, and degradation of water quality.

Stormwater best management practices, or *BMPs* for short, are tools for managing runoff. They reduce the speed and volume of runoff and clean up the pollutants in it. Homeowners can use different practices, like *rooftop redirection, rain barrels, permeable pavement, grass swales, rain gardens*, and *buffers*, in their landscapes to manage runoff at the source. This prevents large volumes of polluted runoff from going into storm drains that flow directly into nearby water bodies. Some additional benefits of BMPs include improved drainage, a healthier and more attractive landscape, increased property value, wildlife food and habitat, improved water quality, and a cleaner environment.

What Is Permeable Pavement?

Permeable pavement (also known as pervious or porous pavement) is like typical pavement that people walk, drive, and park on, but it also manages stormwater. It can be used in new developments, or it can replace impervious pavements for sidewalks, patios, driveways, and parking areas in existing developments.

Permeable pavement is made from different materials, including plastic, rubber, and asphalt, but concrete is most common. Instead of running off, stormwater flows through deliberately created spaces in the pavement surface to a storage area underneath where it is held temporarily. This process slows down, collects, filters, and infiltrates the stormwater on-site. Permeable paving effectively removes sediments and nutrients, which are the top two pollutants in Virginia's waters. It also helps reduce erosion and flooding and improve water quality.

How Does It Work?

While the specific design may vary, all permeable pavements have a similar structure consisting of layers, including a permeable surface layer, underlying gravel or stone reservoir layers, and a filter or fabric layer (see figure 1). The depth and the materials used are determined by the amount of stormwater (based on the amount of impervious surface), the type and amount of traffic (pedestrian or vehicular), and the surrounding soil type.

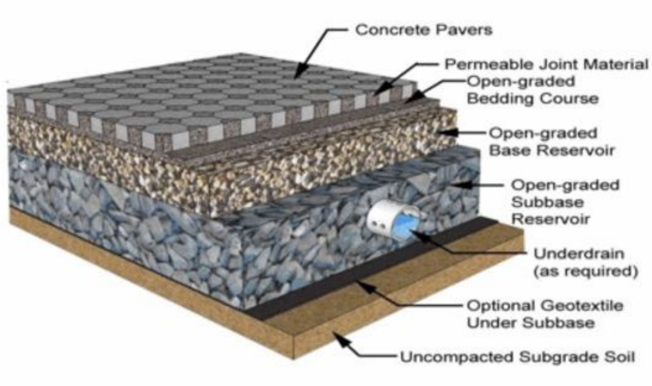

Figure 1. Profile of a typical permeable pavement. Source: Interlocking Concrete Pavement Institute. "Permeable Interlocking Concrete Pavements Manual: Selection, Design, Construction, Maintenance," 3rd ed.

Stormwater moves through open spaces in the pavement itself or through joints between pieces of the pavement. The collected runoff is stored temporarily in the reservoir until it infiltrates into the surrounding soil. Sandy soils infiltrate more quickly than clay soils.

An underdrain may be required if there is a large volume of stormwater or if the collected water doesn't infiltrate into the surrounding soil quickly enough. Underdrains carry excess water from the reservoir to an existing storm drain pipe.

A variety of permeable pavement types is available, including plastic or concrete grids, *porous asphalt* and concrete, and interlocking concrete pavers (see figure 2). Grids usually have large spaces that are filled with soil and plants or pea gravel, with an additional 4 to 12 inches of larger stones underneath. They are typically used for lower traffic areas.

Porous asphalt and concrete consist of a solid-looking surface with small and medium spaces on top of a layer of pea gravel on top of 12 to 24 inches of larger stones.

Permeable *interlocking pavers* have joints or spaces between each paver that are filled with pea gravel or a specialty small gravel to allow water through. The pavers sit on top of layers of gravel and larger stones that create the runoff storage reservoir. Permeable pavement typically collects and filters stormwater that falls on the actual pavement surface area, but it can also treat runoff from nearby impervious areas like rooftops.

Permeable paving is not a good management practice to use on steep slopes, in high-speed vehicle traffic areas, where the surrounding soils do not infiltrate quickly, or where the *water table* is high (the distance between the bottom layer of the permeable pavement system and the seasonal high level of the water table should be greater than 2 feet). It is strongly recommended that a trained and/or certified professional be consulted when designing and installing permeable pavement.

2A

2B

2C

2D

Figure 2. Examples of permeable paving: 2A, grid; 2B, asphalt and concrete; 2C, pavers with gravel; and 2D, grass.

Cost

Permeable pavement is an expensive stormwater management practice when compared to other practices.

The cost depends on factors such as the cost of the materials, the use and size of the area covered by the pavement, the amount of stormwater that is being collected and filtered, whether an engineer or professional is hired to design the pavement, the cost to prepare the site, the cost of labor to install the pavement, and long-term maintenance costs. Consulting an engineer or permeable pavement professional is highly recommended so the pavement can be designed and installed to best meet the needs of the property and the users. When mistakes are made, they are costly to fix, the pavement doesn't function properly, and there could be harmful environmental impacts.

While an estimate of the average cost of permeable pavement is $4.00 to $50.00 per square foot depending on the specific type used (2017 cost estimates from the Low Impact Development Center and the Center for Neighborhood Technology, Green Values), remember that many other associated costs could make the final amount much higher.

Some cities and counties offer incentive programs that encourage residential stormwater management practices. The incentives could include rebates, utility bill credits, or cost sharing for installation. Homeowners should contact their local stormwater, public works, or soil and water conservation office to find out about these programs.

Maintenance

Permeable pavement has very specific maintenance needs. It generally lasts 20 to 30 years or more if maintained. If it is not maintained, it will not function properly, which can lead to costly repairs, flooding, and other environmental problems. Permeable pavement that handles high volumes of stormwater or pedestrian or vehicle traffic needs more frequent maintenance. *Pervious concrete*, porous asphalt, and interlocking pavers need more maintenance than grids do. The goal is to keep the spaces in the pavement from clogging. This is done with special vacuum machines, and the cost should be included in the budget.

Routine maintenance (weekly or monthly):

- Check pavement for clogging. Make sure water is flowing through the surface layer during storm events.
- Make sure there is no debris building up on the pavement surface. Debris includes sediment, mulch, leaves, branches, and trash. Have cans to collect trash and sweep or use a blower weekly to remove any debris. Do not power wash. Do not store mulch or soil piles on top of permeable pavement.
- Manage the surrounding landscape areas to reduce debris. Cover bare ground to prevent erosion. Do not blow grass clippings onto the pavement. Prevent mulch from washing out of the beds. Do not have plants that drop a lot of leaves, flowers, or fruit next to the pavement.
- Set up a vacuuming schedule based on the amount of debris and pavement use.
- Inspect the pavement for wear and damage from vehicular traffic. Repair damage in a timely manner.
- Avoid sealing pervious concrete or porous asphalt, which is often done to renew the surface. This will close the spaces and cause the pavement to fail.
- Replace plants, sand, or gravel in grid or interlocking pavers as needed.
- Do not use salt or sand to melt ice or snow because this could clog the spaces.
- Do not use snow plows to scrape ice or snow off the pavement. This could seriously damage the layers. Ice and snow generally melt off of permeable pavement quicker than off of impervious surfaces.

Resources

Alliance for the Chesapeake Bay, "Reduce Your Stormwater: Pervious Pavers" – https://stormwater.allianceforthebay.org/take-action/installations/pervious-pavers

Center for Neighborhood Technology (CNT), Green Values – http://greenvalues.cnt.org

Chesapeake Bay Program, "How-To's and Tips" – www.chesapeakebay.net/action/howtotips

Chesapeake Conservation Landscaping Council, "The Eight Essential Elements of Conservation Landscaping" – www.ChesapeakeLandscape.org

Chesapeake Stormwater Network, "Homeowner BMP Guide" – https://chesapeakestormwater.net/homeowner-bmp-guide/

Interlocking Concrete Pavement Institute – https://www.icpi.org/

Low Impact Development Center – https://lowimpactdevelopment.org/

Virginia Cooperative Extension, "Best Management Practice" fact sheet series on urban stormwater management practices, 426-119 – 426-134, by D. Sample – http://pubs.ext.vt.edu/

Virginia Cooperative Extension, "Stormwater Management for Homeowners" fact sheet series, HORT-293P–

HORT-298P, by L. Fox – http://pubs.ext.vt.edu/

Virginia Department of Environmental Quality, "Stormwater Design Specification No. 7: Permeable Pavement" – https://swbmpvwrrc.wp.prod.es.cloud.vt.edu/wp-content/uploads/2018/07/BMP_Spec_No_7_PERMEABLE_PAVEMENT.pdf

Glossary

Aquifer – A natural underground storage area for water.

BMP (best management practice) – An action or device meant to manage runoff.

Buffer – An area of vegetation next to the water's edge that protects water quality by slowing runoff, filtering pollutants and sediment, providing infiltration, and stabilizing shorelines. Buffers also add plant diversity to the landscape and provide wildlife with food, habitat, and movement corridors.

Erosion – The loss of soil on property, often due to water flow.

Grass swale – A graded, linear, shallow, open channel covered with plants, usually grass; used to slow down, spread out, and filter stormwater.

Impervious surface – A surface that does not allow water to flow through it.

Infiltration – The process by which water enters the soil or other materials.

Interlocking concrete pavers – Small pieces of concrete designed to attach to other similar pieces to form an area of continuous pavement, typically with narrow spaces between them to allow water to infiltrate.

Permeable pavement – Also known as pervious or porous pavement. Pavement with a top layer that allows water to infiltrate due to spaces in the paving material or spaces between the pavers.

Pervious surface – A surface that allows water to flow through it.

Pervious concrete – A permeable pavement material consisting of concrete in which the fine materials are left out of the mix, creating spaces that allow water to pass through.

Pollutants – Materials that have a negative impact on human or environmental health.

Porous asphalt – A permeable pavement material that uses asphalt with the smaller aggregates left out, allowing water to pass through it.

Rain barrel – A small collection tank installed at the end of a downspout to collect and temporarily store rainwater runoff from a roof for later use.

Rain garden – A planted shallow depression that temporarily holds runoff from impervious areas until it evaporates, is absorbed by plants, or infiltrates into the ground.

Reservoir – In permeable pavement, it is the underground gravel layer where excess stormwater is stored.

Rooftop redirection (disconnection) – A stormwater management practice that moves the runoff collected from rooftops through gutters and downspouts into the landscape where it can spread out, slow down, and infiltrate instead of moving the runoff directly into a storm drain system.

Runoff – Water that runs off impervious surfaces during rain events, often associated with urban areas. Runoff can also occur from pervious surfaces if the precipitation rate is greater than the infiltration rate. Also called "stormwater."

Sediment – Soil, rock, or biological material particles formed by weathering, decomposition, and erosion.

Stormwater – Water that runs off impervious surfaces during rain events, often associated with urban areas. Also called "runoff."

Underdrain – A pipe with holes in the bottom of a best management practice that collects water that does not infiltrate into the surrounding soil and carries it from the reservoir to an existing storm drain pipe.

Water table – The depth at which soils are fully saturated with water.

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