

Permeable Pavement

Almost every landscape design has to incorporate hard surfaces such as driveways, walkways, and patios. Even these surfaces can be designed to reduce runoff and improve water quality.



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You've probably watched rainfall run down your driveway in rivulets, or collect in puddles on your patio. But that water doesn't have to just flow away.

Permeable pavements include a broad assortment of alternatives to solid concrete or asphalt surfaces. They behave more like nature, allowing more water to soak in rather than leave your property.



Benefits of Permeable Pavement

Reduced winter maintenance and use of winter sanding and salting products.

Surfaces are less prone to icing because it only takes a minor thaw for water to melt and travel to a point where it can soak in. Cutting back on sand and salt prevents these materials from entering the stormwater collection system and ultimately water bodies. Plus you save money on buying salt.

Reduced "urban heat island" effects.

Water soaking into the ground lowers the surface and surrounding area temperatures compared to a regular concrete or asphalt surface. Bonus points for using a light-coloured product, which helps reflect sun and heat. Your feet will thank you.

Permeable Pavement is Best...

When you're already planning to add a concrete or asphalt pad for overflow or RV parking. An open grid lattice or Hollywood driveway will suffice to provide the support you need.

When you need to build up an area where you want a hard surface. You have the opportunity to add a gravel storage layer instead of just solid fill.

When you have icing concerns. A permeable surface will clear faster than a non-permeable one.

Is permeable pavement right for you?



How you think about the applicability of permeable pavements compared to other tools can be swayed by how dry it is where you live and what type of subsoil you have. If you happen to have sandy subsoil, then permeable pavement is an excellent tool, because you don't need to create subsurface storage to achieve runoff volume reduction — runoff will infiltrate without a problem. If you have clay subsoils, then subsurface storage in gravel base layers or some sort of permeable support layer may be necessary to adequately reduce volume. Still, choosing a permeable surface that is installed conventionally without the gravel storage layers is still more beneficial than choosing regular paving. On the other hand, especially in the southern part of the province — where pavement runoff may be viewed as a water source for thirsty landscaping — careful grading of hard surfaces towards planting beds may be a solution with more benefits.

The world of alternatives to regular paving is vast. We'll start with the simplest, least costly alternatives and work our way up.

The most straightforward alternative is to use less paving to begin with. Then there are a number of alternatives that add stability to gravel or grass surfaces and have great storage capacity.

Permeable pavers, pervious concrete and porous asphalt rely on small holes or gaps to channel flows below the surface, and are usually coupled with a gravel base that is designed with additional storage when placed over clay subsoils that drain slowly.



Hollywood Driveways

A driveway with less pavement to begin with is a simple thing to do if you are building new or thinking about replacing what you have now. Add grass, groundcovers, or gravel between two parallel strips of concrete, asphalt, pavers, or other hard surfacing, spaced so a vehicle's wheels can drive on them...and there you have it.

Ribbon driveways (this technique's other name) are in the advanced category because concrete work for driveways is not typically a do-it-yourself job.

Benefits

- Less hard surface equals lower material costs and less runoff.
- Familiar and readily available materials and procedures.
- Adds green space if plants are used.
- Lower maintenance needs than truly permeable materials.

Drawbacks

- Long or curved driveways may be hard to follow or back up on (works well on straight driveways).
- Centre strip may become discoloured, weedy, or die from vehicle leaks, mismatch of vegetation to light conditions, or compaction (if you miss the tracks).





Open Grid Plastic Lattice Pavers

A plastic grid system, sometimes combined with filter fabric, filled with an aggregate or plants of your choice. Water easily passes through while the surface remains stable.

If you are considering paving an area just to get a firmer surface than grass or gravel, consider an open grid plastic lattice product. It gives a firm feel underfoot.



Benefits

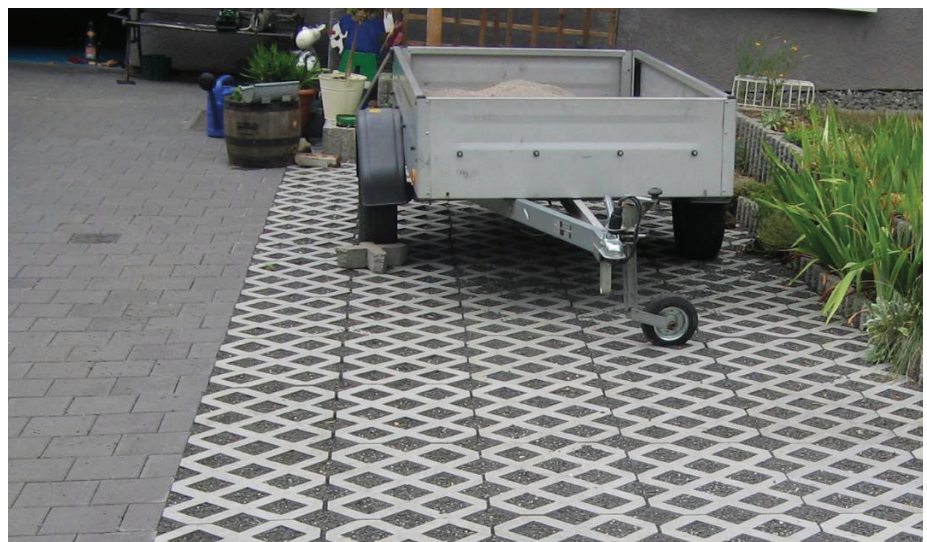
- Lightweight.
- Often made with 100% recycled plastic.
- Some systems are meant to be slightly buried so you don't see the reinforcing aspect at all, making it easy to colour-coordinate with other landscape elements.
- Some are rolled products and some are modular.
- No "ball bearing" slip/skid effect if aggregate is dislodged.

Drawbacks

- Typically a lower weight tolerance than concrete lattice, but can still generally support vehicles.

RIGHT: Here's a hybrid that looks like a concrete lattice. It is actually made out of recycled plastic. A great choice for this surplus parking area.

ABOVE Gravelpave.



CREDIT: Hahn Plastics

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Open-Grid Concrete Lattice Pavers

A concrete grid system with open areas that can be filled with gravel, plants, or other aggregate, providing stability while allowing water to pass through.

Benefits

- Higher weight tolerance than plastic lattice.

Drawbacks

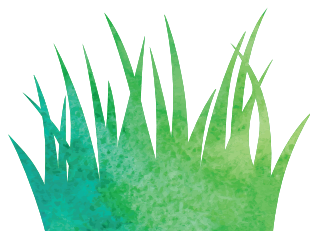
- Typically supplied as 40 by 60 cm or 40 by 80 cm pavers, which can be more challenging to install and keep flat than smaller size pavers.
- Can create “ball bearing” slip/skid effect if aggregate is dislodged.



LEFT: Grasscrete in-situ forming system, courtesy Eagle Lake Landscape Supply.

MIDDLE AND RIGHT: Turfstone with grass and gravel fills, respectively.

Grass or gravel in your open lattice paver?



Open lattice products (plastic and concrete) are promoted as being fillable with either a sandy soil and plant mix or gravel. However, on the prairies, aggressive weeds will easily move in and take over the gaps in a soil-based planted product. They will prove nearly impossible to remove without resorting to chemicals. A gravel-filled lattice product behaves more like a regular gravel surface, with the benefit of added stability. You can use any aggregate you like to achieve a wide variety of looks. If you are determined to have grass, choose species that prefer sandy soil, such as Junegrass (*Koeleria macrantha*).

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Permeable Pavers

Concrete paving blocks are made “permeable” by keeping larger gaps or open spaces between them, and filling those spaces with aggregate (small gravel) so water can readily penetrate the gaps. This effect can be achieved either by using pavers that come with clipped corners or offset tabs that create a gap when installed, or by choosing to set regular pavers with a larger gap than usual. Concrete pavers sold as “permeable” do not typically differ in composition from regular pavers.

The ability of permeable pavement to deliver stormwater benefit is tied to two main factors:

1. The ability of the surface material to store a small amount of water and to filter and break down contaminants, particularly hydrocarbons.
2. The amount of storage provided by the layers of aggregates in the gravel base underneath the surface, which reduces runoff volume and helps reduce nutrient levels, primarily through biological sequestration (capture inside micro-organisms).



Benefits

- Low maintenance.
- Available in a variety of styles and colours, offering familiar aesthetic appeal.
- Installation is similar to regular concrete pavers so professional help is relatively easy to find.
- Pavers have higher strength than regular concrete. They work well for driveways or high-use patios and walkways.
- Can be reconfigured and reused.

Drawbacks

- Some settling may occur and require re-leveling.
- Difficult to remove snow by shovel; requires brushing for best results.
- Expensive.
- Like other concrete products, pavers are energy-intensive to make and have a large carbon footprint.



Emerging Alternatives to Concrete Permeable Pavers

Pavers composed of alternative materials are emerging on the market. These include masonry, rubber, and glass. They may have qualities of both permeable pavers (can be set with a gap) and porous or pervious surfaces, where the aggregate and the binder are open and allow water to infiltrate through them. Like concrete, rubber and glass can be provided as pavers and also as poured-in-place products. For our purposes, we'll focus on concrete pavers in this section, as they're the most readily available.

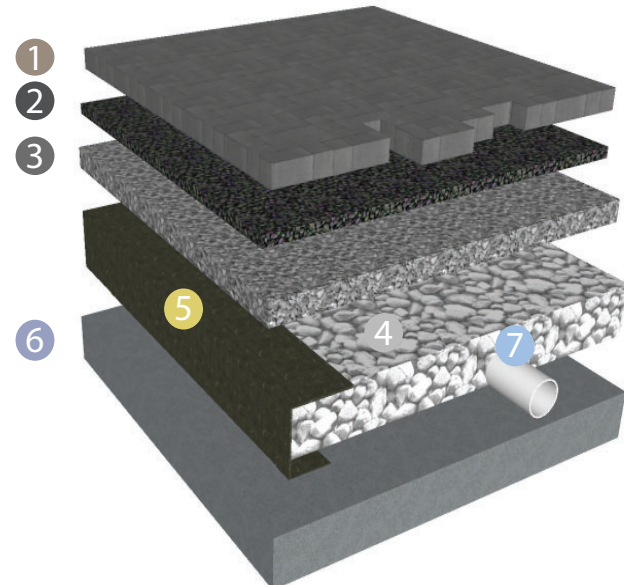
Components

1 Pavers: Pavers have nubs to provide an even gap. Regular pavers can be used with a gap that you choose. **Jointing gravel** goes between the pavers. Small gravel such as gyra rock (7-mm diameter) is often used because it is readily available, but it is often a bit larger than desired. Specialty “grit” is available. Sand provides good infiltration, but is prone to weeds and difficult to vacuum. Choose the largest aggregate possible for the joints so that vacuuming will pick up dust and sediment but leave the larger, heavier jointing material in place. Expect to go over the surface once or twice a year with a Shop Vac to remove sediment. Use a tiger torch or steamer for weeds.

2 Bedding gravel: For permeable installations, bedding and jointing gravel are usually the same material.

3 Finer storage layer: Layers go from finer to coarser to prevent the migration of small particles from the layer above into the layer below. The gravels are prepared with gaps to allow water through while still providing structural support. Your supplier can advise on locally available combinations. In an installation without a storage layer, this would be the final layer composed of well-graded, angular, compactible rock and there would not be an additional storage layer below it.

4 Coarser storage layer: The largest-diameter gravel layer.



5 Geotextile: Placed between the native soil and gravel to prevent fine particles from migrating and clogging storage layers. It may be wrapped further up if the edge treatment is shallower.

6 Native soil: Remaining mineral soil/subsoil layer below the organic layers which are removed to prevent frost heave and provide structural support.

7 Underdrain: Perforated pipe or similar to capture and remove excess water, if needed.

Things to Consider

Choose your battles. A project on the scope of a patio or walkway may be suitable for a do-it-yourself installation, but driveways and areas that are intended to support the weight of vehicles should be professionally designed and installed.

Slope. Installing permeable pavers on slopes greater than 5% is not recommended. Proper slopes for surface drainage are still required so that runoff during heavy rains can drain away from building foundations.

Cost. Permeable pavers can be relatively inexpensive if your subsoil is sandy, as you won't need to add storage layers. This is usually the case with waterfront property and sometimes in river valleys. See the *Trenches and Soakaways* module for how to do a percolation test to find out. If the

subsoil is rich in clay, deep infiltration occurs very slowly. A storage layer under the surface is recommended, which will also contribute to runoff-volume reduction. Consider adding an underdrain to convey overflows. The storage and underdrain add cost over a regular paver installation and, of course, pavers are more expensive to begin with than concrete or asphalt.

Location and use. Permeable pavers are great for low-speed residential applications and low-turnover parking lots (15 km/h). They are not intended to replace regular surfaces on roads or high-turnover lots at shopping malls where wear from tires turning is high. Roadway dirt and winter sanding can clog permeable pavement quickly. This makes it unsuitable for public roadways or busy parking lots.



Pervious Concrete

Regular concrete is basically a combination of Portland cement and aggregate. The aggregate comes in a range of sizes, usually from finer sand to small gravel, depending on the application. With pervious concrete, some of the smaller sizes of aggregate (“fines”) are left out of the mix, creating a network of holes or void spaces. The aggregate in pervious concrete is referred to as open-graded, gap-graded, or without fines. Depending on the final floating technique, the surface can have different appearances but will always have holes in it. A pebbled surface is a common finish.

Benefits

- Long-lasting if installed correctly.
- Fairly conventional appearance.
- Usually lighter coloured, which reduces heat island effect compared to asphalt.
- Flat surface for easier accessibility compared to pavers or lattices.

Drawbacks

- Like conventional concrete, permeable concrete is energy-intensive to make and has a large carbon footprint.
- Difficult to find a qualified installer.
- Expensive to install in small batches.
- Subject to clogging; requires regular sweeping, and vacuuming or pressure washing several times a year.



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Porous Asphalt

Porous asphalt is similar to conventional hot-mix asphalt but, like pervious concrete, it contains fewer fines. Stable, interconnected air pockets allow stormwater to pass through to the underlying aggregate layers.



Benefits

- Long-lasting if installed correctly.
- Fairly conventional appearance.
- Even surface for easier accessibility.
- Low ice buildup in winter.
- Cheaper than pervious concrete.

Drawbacks

- Wears out faster than concrete or pavers.
- Difficult to find a qualified installer.
- Expensive to install in small batches.
- Though less so than pervious concrete, porous asphalt is subject to clogging and requires regular sweeping, and vacuuming or pressure washing several times a year.

Maintenance for Pavers, Pervious Concrete and Porous Asphalt

Regular cleaning is recommended. Vacuuming annually with a shop vac is the first choice. Pressure washing can also work if you don't have a storage layer underneath. Cleaning can be needed more frequently, depending on site conditions and the type of surface.

Weeds. Pull weeds from planted surfaces by hand, without herbicides. On non-vegetated surfaces, steam or another heat source such as a tiger torch are useful alternatives.

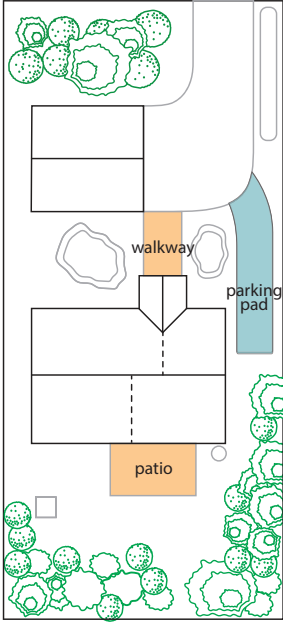
Avoid sediment. Pervious pavements are designed to infiltrate precipitation that falls directly on them, not receive precipitation from adjoining areas, especially if those areas are not well vegetated. Clogging from sediment in run-on may be a problem.

Don't apply sealer coat to a pervious concrete or porous asphalt surface. It will block the pores that water is supposed to pass through.



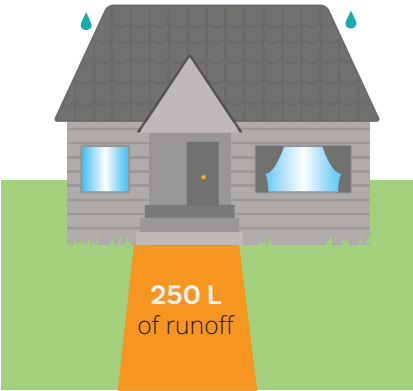
CONSIDER THIS EXAMPLE

EXAMPLE PLAN



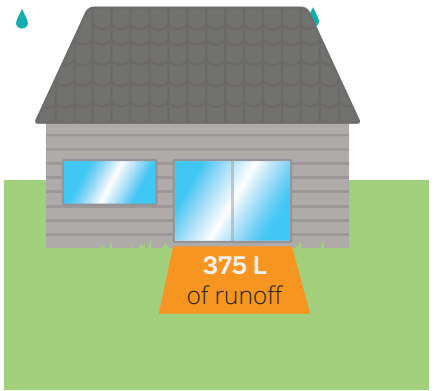
HOW MUCH RUNOFF?

On the front walkway,
a 2.5-cm rain event generates...



250 L
of runoff

On the patio,
a 2.5-cm rain event generates...



375 L
of runoff

IDEAS

Replace the concrete walkway and patio with **permeable pavers** and add an **open grid concrete lattice** secondary parking pad. Usually when you need to have a storage layer for further runoff reduction (in a really tight area with no other options), you pair that with permeable pavers. For supplemental parking, use a lattice or roll-out product. Larger areas? Go for the porous asphalt.

comparisons between installations of 25 m ²		
<p style="font-size: 24px; font-weight: bold; color: #ff9800;">375 L</p> <p style="color: #008080; font-weight: bold;">Porous Asphalt</p>	<p style="font-size: 24px; font-weight: bold; color: #008080;">750 L</p> <p style="color: #008080; font-weight: bold;">Permeable Pavers</p>	<p style="font-size: 24px; font-weight: bold; color: #008080;">750 L</p> <p style="color: #008080; font-weight: bold;">Concrete Lattice - Gravel Fill</p>
 <p style="font-size: 12px;">10cm</p>	 <p style="font-size: 12px;">20cm</p>	
<p style="color: #008080; font-weight: bold; font-size: 18px;">Call the Pros</p> <p style="font-size: 12px;">(difficulty: advanced)</p> <p style="font-size: 24px; color: #4caf50;">\$\$\$\$\$</p>	<p style="color: #008080; font-weight: bold; font-size: 18px;">Call the Pros</p> <p style="font-size: 12px;">(difficulty: advanced)</p> <p style="font-size: 24px; color: #4caf50;">\$\$\$\$\$</p>	<p style="color: #008080; font-weight: bold; font-size: 18px;">Phone a Friend</p> <p style="font-size: 12px;">(difficulty: intermediate)</p> <p style="font-size: 24px; color: #4caf50;">\$\$ - \$\$\$</p>

? **Have you evaluated your site yet?** Our **Evaluate Your Site** section walks through the steps of identifying source flows, calculating runoff volumes, identifying opportunities to reduce runoff, and sizing your solutions.

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Put a fine point on it

Your turn to do the math. As in the rest of this guide, the amount of runoff to retain is calculated based on the 2.5 cm rain event, which is the amount needed to protect our water bodies from excess runoff and pollution.

The table below shows the calculation of storage capacity of gravel base assemblies of varying thicknesses. This type of assembly can be used under a variety of surface treatments presented in this guide.

Storage Volumes of Open-graded Gravel Bases				
Runoff generated from 2.5 cm rain event over these surface areas	Total Volume of Runoff during a 2.5 cm rain event	Stormwater Stored for Different Gravel Thicknesses of the same size as the generating surface area		
		10 cm thick Gravel Base	15 cm thick Gravel Base	20 cm thick Gravel Base
5 m ²	125 L	75 L	112.5 L	150 L
10 m ²	250 L	150 L	225 L	300 L
25 m ²	500 L	300 L	450 L	600 L
50 m ²	1250 L	750 L	1125 L	1500 L
100 m ²	2500 L	1500 L	2250 L	3000 L

The above assumes:

1. the gravel base has 15% storage capacity.
2. the installation has a base of aggregate about 2 cm in diameter, over a 5-cm aggregate sub-base, over subsoil with a slow infiltration rate (clay).

According to these calculations, if the goal is absorption of all stormwater that hits the surface area of the pavement, the gravel base will need to be about 18 cm thick. If it's expected to accommodate flows from additional areas, the gravel depth should increase and cleaning frequency will increase unless its a clean source such as a roof. If you want a gravel base less than 15 cm, then other tools adjacent to the permeable pavement should be considered to make up the difference.

Gravel storage is not the only option. There are structural, modular chambers for use under sidewalks and driveways. A new garage can easily be built with the parking surface structurally supported over a poured-in-place cistern/ base. Soakaways and rainwater harvesting have many potential synergies with surface treatments such as permeable pavements. Refer to the other modules in this guide for more info.

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Products and Suppliers

Unilock
unilock.com

Expocrete
expocrete.com

Brico Services
bricoservices.ca

Home Supply Centres

Eagle Lake Landscape Supply - Hahn Plas-
tics, Grasscrete, pavers
eaglelakelandscape.com

Steam 'n' Weeds
steamweeds.com

Brico Services
[bricoservices.ca products/rainstore-3/](http://bricoservices.ca/products/rainstore-3/)

Permavoid modular structural storage
[https://www.abtdrains.com/products/
environmental-products/permavoid/](https://www.abtdrains.com/products/environmental-products/permavoid/)

DeepRoot modular structural storage
[https://www.deeprooot.com/products/
silva-cell.html](https://www.deeprooot.com/products/silva-cell.html)

Citygreen modular structural storage
[https://citygreen.com/product-category/
soil-structure-systems/](https://citygreen.com/product-category/soil-structure-systems/)

Rainstore3 modular structural storage
<https://www.invisiblestructures.com/>

Brock White Construction Materials - In-
visible Structures grasspave, gravelpave,
turfstone, Rainstore3
brockwhite.com

More Information

Alberta Low Impact Development Partnership
alidp.org

Pigeon Lake Watershed Association
plwa.ca

City of Calgary Technical Guidance Module [http://www.calgary.ca/UEP/Water/Docu-
ments/Water-Documents/ud-bulletin-low-impact-development-permeable-pave-
ment-module.pdf](http://www.calgary.ca/UEP/Water/Documents/Water-Documents/ud-bulletin-low-impact-development-permeable-pavement-module.pdf)

Mutual Materials' Permeable Pavement System Components download
bit.ly/mutualmaterials_components

Expocrete's Permeable Pavers/Stormwater Management Page
expocrete.com/residential/permeable-pavers.php



This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :



Environment
Canada

Environnement
Canada

