

A large, abstract image showing water flowing over a dark, textured surface, possibly a roof or a drainage system. The water is captured in motion, creating a blurred, dynamic effect. The image is framed by a white border that follows the shape of the water flow.

TOPMIX PERMEABLE

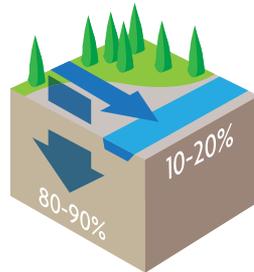
The ultimate concrete solution for surface
and storm water management



The built environment has grown rapidly over the last 50 years, resulting in large areas of land being paved over with impermeable materials. Over the same period of time the number of occasions that the UK experiences three, or more, consecutive days of heavy rainfall has increased by 50%.

With climate change predicted to lead to increasingly warmer and wetter weather conditions, rainfall is likely to continue to rise. As a result, many experts believe the kind of wide-scale flooding seen in 2007 and the winter of 2013/14 will become ever more frequent, unless dramatic action is taken now.

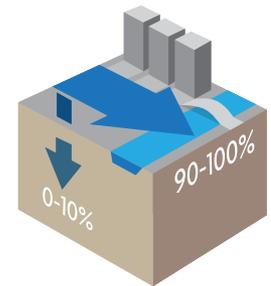
The impact of urbanisation



Forest rainfall



Residential rainfall



Urban rainfall

In towns and cities where there is a lot of hard landscaping and limited green space, only around a tenth of rainwater is absorbed into the ground. This is compared with 80-90% in rural areas.

Topmix Permeable from Lafarge Tarmac

Lafarge Tarmac's Topmix Permeable can play a fundamental role in the majority of Sustainable Urban Drainage Systems (SuDS) designs, providing a practical, long-term answer to surface water flooding that can be implemented quickly and cost effectively.

A new, fast draining concrete pavement solution, it rapidly directs excess water away from streets, parking surfaces, driveways and walkways.

Unlike conventional concrete, it has a high void content of between 20-35%. This allows surface water to drain through into the sub-strata and dissipate naturally, reducing the risk of surface water flooding and watercourse contamination.

Technical Overview

Drainage capacity:	150 to 1,000 litres per minute per square metre
Void content:	20-35%.
Typical compressive strength:	10-20N/mm ²
Flexural strength:	1.5-3N/mm ²
6mm mix:	Final aesthetic finish
10mm mix:	Ground stabilisation underneath blocks

A sealer/hardener may be applied to the surface for aesthetic purposes and to prevent staining.

PROBLEMS WITH TRADITIONAL SURFACE WATER DRAINAGE SYSTEMS

Surface water flooding

The inability of our existing drainage systems to cope with changing weather conditions was brought sharply into focus by the unprecedented floods experienced across Great Britain in 2007 and highlighted again, more recently, by serious flooding in the winter of 2013/14.

The Environment Agency estimated that over two thirds of the 57,000 homes affected by the 2007 floods were not flooded by swollen rivers, but by water running off paving or overflowing from the overloaded drainage systems serving them.

The reason for this is simple. The majority of our existing drainage systems are designed to remove rainwater as quickly as possible from where it falls and direct it into watercourses or drains. This means in cases of prolonged, heavy rainfall the public sewer system quickly reaches its capacity and consequently overflows.

The continued expansion of the urban environment using impermeable materials, coupled with a growing trend for homeowners to replace lawns and gardens with hard landscaping is placing even more pressure on our aging sewage systems. The pressing need to build more homes to meet the demands of our growing population is only likely to make things worse.

Poor water quality

Storm water can easily become contaminated by petrol, diesel, heavy metals, detergents and other pollutants while running down roads and pathways, before entering the drainage system. These are either drained straight into watercourses or have to be removed at treatment plants. This problem is exasperated in areas where combined sewers are in place, and places a significant burden on treatment works.

High maintenance costs

Traditional drainage systems gather small objects, sediment and other pollutants. These are filtered out in gully pots, which need to be maintained and regularly emptied.

Reduced groundwater levels

Directing rainwater directly into watercourses or drains and sewers, results in natural aquifers being bypassed, reducing the level of the water table. This can lead to water shortages and result in natural streams and ponds drying up. A lack of groundwater can also affect the foundations of homes, particularly in areas with clay soils that shrink when they dry out.

Increased risk of contamination

Combined sewers often have overflows, also called combined sewer outlets, through which excess water can drain into watercourses in order to protect properties from flooding. These can spill sewerage into watercourses and therefore must be continuously monitored and licensed by the Environment Agency to ensure they only operate when the system is receiving excess rainfall.



Over two thirds of homes affected by the 2007 floods were flooded by water running off paving or overflowing from overloaded drainage systems.

LEGISLATION AND GUIDANCE

In recent years a range of legislation and guidelines have been published to help address the growing problem of surface water flooding through the implementation of sustainable drainage systems. These include:

The Pitt Review 2008

Following widespread and serious flooding across many parts of the country in 2007, the government commissioned an independent review to be undertaken by Lord Pitt.

As a direct result of this, new guidance was introduced for the surfacing of front gardens in October 2008. This had two very important implications:

- Planning permission to pave a new or existing driveway of any size would not be required if a permeable (or porous) surface is used, or if the rainwater is directed to a lawn or border to drain naturally
- Planning permission will be required to pave an area greater than 5m² with an impermeable surface if it does not provide run-off to a permeable area



“Techniques that control pollution close to the source, such as permeable surfaces or infiltration trenches, can offer a suitable means of treatment for run-off from low risk areas such as roofs, car parks and non-operational areas.”

The Environment Agency's 2006 Pollution Prevention Guidelines (PPG 3)

The Flood and Water Management Act 2010

The Flood and Water Management Act addresses a number of key issues to counter and manage flooding, including four that were aimed specifically at SuDS:

- The requirement for developers to construct sustainable drainage systems for new developments and redevelopments with drainage implications
- Any construction work that has implications for drainage cannot commence until a SuDS plan has been approved at unitary, or county level by a SuDS Approving Body (SAB)
- Local authorities will become responsible for (adopting) the schemes and their maintenance once completed
- The Department for Environment, Food and Rural Affairs (Defra) is responsible for publishing National Standards for sustainable drainage

These points were included in Schedule 3 of the Act, which is currently timetabled to be implemented alongside the introduction of new National Standards by December 2014. The new standards will cover the design, planning approval, construction and maintenance of SuDS, including affordability and exemptions.

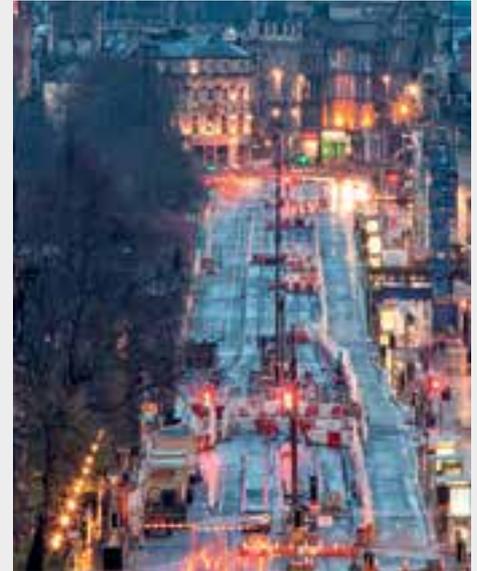
Scottish legislation

Legislation in Scotland is more established than for England and Wales. The Water Environment and Water Services (WEWS) (Scotland) Act made Scottish Water responsible for SuDS and their specifications in 2003.

This was followed by the Flood Risk Management Act 2009 and the Controlled Activities Regulations (CAR) 2011, which made the use of SuDS mandatory for surface water run-off in all new developments (excluding single dwellings).

There are also two sets of guidelines covering the implementation of SuDS. The first, Sewers for Scotland Second Edition, provides guidance on the design and construction of basins and ponds. The second, SuDS for Roads, provides guidance on the types and applicability of SuDS for roads at pre-treatment, source control and site control.

Scottish Water is responsible for the future maintenance and capital replacement of shared public SuDS systems. The Roads Authority and Scottish Water share responsibility for the future maintenance of SuDS incorporated into new road construction.







Permeable pavements are more effective at removing a wider range of pollutants from run-off than oil separators.
CIRIA, 2004

BENEFITS OF SUSTAINABLE URBAN DRAINAGE SYSTEMS (SuDS)

SuDS have a number of very important advantages over traditional surface water systems:

Effective management of water drainage

Being able to control and actively manage the drainage of rainwater from the developed landscape significantly reduces the risk of surface water flooding, protecting both the natural and built environment.

Reduced pressure on existing systems

New systems can be incorporated into the redevelopment of the existing infrastructure, as well as installed in new housing and commercial and industrial developments, easing the pressure on overstretched drainage systems, sewers and water treatment plants.

Improved water quality

SuDS filter surface water as it is drained, improving water quality and reducing the cost of water treatment. Permeable pavements are particularly effective in this area with

pollutants that infiltrate the surface being flushed into the underlying pavement layers where they are filtered and trapped or degrade over time.

Reduced risk of water shortages

Directing rainwater into natural aquifers keeps them recharged, reducing the risk of water shortages during periods of low rainfall.

Better for people and the environment

SuDS can be used to provide a constant supply of fresh water for lakes and pools and to create new water-based amenities, benefiting both local communities and wildlife.

Increased property values

Residential developments that incorporate a SuDS can attract higher values, particularly in areas where there is a high risk of flooding.

TOPMIX PERMEABLE FROM LAFARGE TARMAC DESIGN OPTIONS

There are three typical best practice applications that can be employed in the construction of a pervious paving solution using Lafarge Tarmac's Topmix Permeable.

SYSTEM A – Full infiltration



This system allows all water falling onto the pavement to permeate through the Topmix Permeable surface layer, pass through the lower pavement courses and into the sub-grade. Some water may be retained within the pavement reservoir before permeating into the sub-grade. Full infiltration systems do not discharge any additional water into traditional drainage systems. Geotextiles may be incorporated into the system depending on the nature of the sub-grade.

SYSTEM B – Partial infiltration



This system is viable for locations where the underlying ground offers some level of permeability and infiltration is acceptable. Within the sub-base layer outlet pipes are installed that allow any excess water that cannot penetrate into the existing ground to be drained into other drainage devices such as watercourses, swales or sewers. This system is typically used where the sub-grade is not capable of draining all of the water as a means of reducing the volume of run-off from the site. Geotextiles may be incorporated into the system depending on the nature of the project.

SYSTEM C – Full attenuation



Use of this system is typically adopted where water recycling is desired, in areas where water may be contaminated, or where the sub-grade is impermeable or becomes weak when saturated. The system includes the installation of an impermeable membrane above the sub-grade and the provision of outlet pipes within the sub-base layer. Full attenuation allows water to be captured and harvested for re-use in non-potable applications such as irrigation or flushing toilets. Geotextiles may be incorporated into the system depending on the nature of the project.

Full attenuation allows water to be captured and harvested for use in non-potable applications such as irrigation or flushing toilets.

Typical applications

These three designs can be used for a wide range of practical applications, including:

- Low volume residential roads and parking lots
- Pavements, bike and pedestrian pathways
- Patios
- Tennis courts
- Road shoulders
- Swimming pool decks
- Alleyways
- Driveways
- Greenhouse floors
- Pavement edge drains and gutters
- Hardstanding for sports facilities
- Underneath permeable blocks for ground stabilisation



Factors to consider when using permeable pavements:

- Do not use permeable pavements where there will be very heavy silt loads from the proposed use (e.g. stockpiling sawdust or large recycling centres subject to heavy silt loads)
- It is possible to construct part of an area in impermeable materials that drain onto a permeable pavement. For example, car parking bays are often constructed using permeable paving and the access ways are impermeable construction
- Open graded permeable sub-base below the permeable pavement should not be used by construction traffic, as this will increase the likelihood of clogging
- The design of permeable pavements must take into account the overland flow routes of water when the design capacity is exceeded. Although exceedance will result in flooding of some areas of a site, the flows should be routed to prevent flooding of buildings for events that are well in exceedance of the capacity of the system. Further guidance is provided in CIRIA Report C 635 (CIRIA, 2006)







SURFACE DURABILITY

Freeze-thaw resistance

An effective permeable pavement system will be designed so that the underlying attenuation layer will store the water that passes through it. Because of this, no water should be left sitting within the surface structure. However, if water was ever left to settle within the system (due to changes in future climate etc.), Lafarge Tarmac's Topmix Permeable offers excellent freeze-thaw resistance due to the ability for freezing water to expand in the voids. In addition, Lafarge Tarmac's Topmix Permeable does not contain steel reinforcement so it is not prone to water or chloride attack.

Surface skid resistance

Lafarge Tarmac's Topmix Permeable has comparable skid resistance to low texture asphalt and concrete typically used in the construction of UK footpaths and car parks when tested in wet conditions in compliance with ENGI-961 and HD26/011. It is therefore recommended for low speed applications, typically less than 30 miles per hour. Additional care and consideration should be given for surface material selection in areas of higher slip risk, such as slopes or where heavy braking may occur.

Heavily trafficked areas

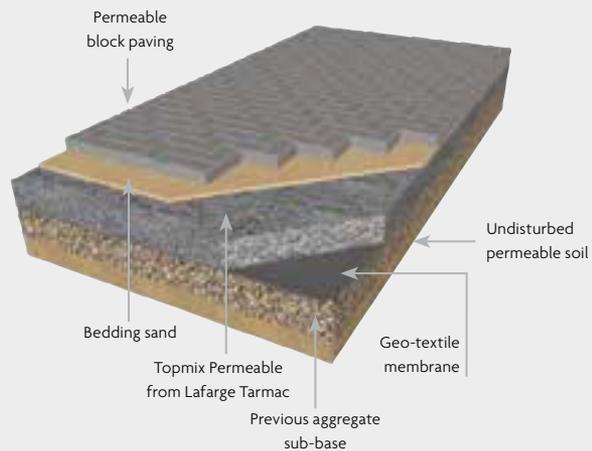
Even though Lafarge Tarmac's Topmix Permeable does not soften in hot weather and is resistant to scuffing when tested in accordance with TRL Report 176 Appendix G, we would still recommend that an impermeable surface is used in areas exposed to frequent tight turning circles and sections carrying very heavy traffic. Designs for these areas would typically incorporate a full SuDS foundation with an impermeable surfacing such as a traditional asphalt or concrete on the top. Run-off may be into the adjoining fully pervious pavement or another drainage channel depending on the site. The pervious foundation across the site acts as a reservoir and water can be dealt with in the same way as a fully pervious pavement.

Examples of applications where this may be appropriate include:

- HGV delivery routes for supermarkets and shops
- Access to car park ticket barriers
- Tight turning areas in industrial yards
- Bus routes

USING LAFARGE TARMAC'S TOPMIX PERMEABLE WITH PERMEABLE BLOCK PAVING

In block paving applications where the underlying soil is poor or the final solution will be subject to heavy loads, remediation works are sometimes required to improve the structural performance of the area. Hydraulically bound course graded aggregate and cement stabilised course graded aggregate are common specifications for this type of application. The minimum permeability rates required for each of these applications can be easily achieved, and exceeded, through the use of Lafarge Tarmac's Topmix Permeable.







DESIGN AND CONSIDERATION

Topmix Permeable from Lafarge Tarmac is a concrete solution that offers improved permeability properties over traditional and historical Topmix Permeables. Combining both the trafficking surface and the drainage solution, simplifies the construction process and reduces both construction and environmental costs.

Performance characteristics

- Void content up to 35%
- Flow rate: Up to 1,000l/m²/min
- Compressive strength: 10-20N/mm²
- Flexural strength: 1.5-3N/mm²

Summary of the system

A typical system consists of a layer of Topmix Permeable from Lafarge Tarmac installed on top of an aggregate sub-base, which is in turn laid onto undisturbed soil or a capping layer. The structure and dimensions of each layer will depend on the application and the design of the system.

Lafarge Tarmac's Topmix Permeable allows rainwater to drain through the wearing surface. During periods of high rainfall the system performs as a reservoir, delaying the discharge of storm water into watercourses or drainage systems. Its ability to store water also acts as a cooling system during periods of rising temperatures when stored water evaporates creating a surface cooling cycle.

Design considerations

The design and implementation of pervious paving solutions are dictated by a number of key characteristics relating to the existing site conditions and post construction performance. A pervious paving solution is required to be tailored to each individual application based on the following design criteria.

Sub-grade permeability

The underlying permeability of the existing sub-grade plays an important role in dictating the viability of a pervious solution, the level of infiltration that can be achieved directly relates to the system that can be employed. Permeability testing should be carried out on-site at paving formation levels in order to enable accurate designs to be created.

Water table level

For an attenuation layer to be incorporated into a pervious paving solution it is imperative that the existing water table is established. A high underlying water table level can have detrimental effects on the available storage within an attenuation layer, as a small rise in table level will reduce the available storage. Increases in the water table level can also negate the pollutant filtering effect of the pavement as the distance to the watercourse is reduced.

Discharge consents

Where new or renovated paving systems are being installed it is necessary to determine if a discharge consent is required, this is dependent on the pavement usage and the likelihood of contaminants being present in the water to be discharged.

Traffic loading

In order for an accurate and cost-effective design to be created it is necessary to determine the general loadings that the pavement will be subjected to. Incorrect specification of loading can result in premature system failure or poor system performance.

Water storage capacity

The capacity of the drainage system needs to be designed in tangent with the structural requirements of the paving solution, with care taken that the greatest substructure design is used to ensure water storage capacity and also structural performance. Storage capacity is required to be designed in line with rainfall return periods – the period of time where the depth of rainfall is only equalled or exceeded once.

Minimize site disturbance

By integrating paving and drainage, less site area is needed to manage storm water, allowing a more compact site development footprint.

MAINTAINING OPTIMUM PERFORMANCE

Topmix Permeable from Lafarge Tarmac is designed to remove a high percentage of Total Suspended Solids (TSS). To ensure the system continues functioning to its optimum efficiency a cleaning schedule should be put in place so that the voids in the concrete do not become blocked.

Maintenance should be undertaken through hydro-pressure with suction cleaning.

The surface can be swept with a road sweeper, however, sweeping should be kept to a minimum and not replace routine hydro cleaning as it can encourage fine particles into the surface.

The frequency of maintenance will depend on the level of contamination and environmental factors such as proximity to trees, run-off from road works, building sites and dirt from car tyres. In general, annual maintenance is advised to maintain optimal permeability.





SUSTAINABILITY



The important role that SuDS have to play in improving the sustainability of the built environment is now recognised by levels of government, throughout the UK and across Europe.

To comply with the European Water Framework directive, and gain certification from respected bodies such as LEED and BREEAM, new developments must have acceptable SuDS in place before planning permission is given.

SuDS can take many forms, from soakaways, swales, retention basins and infiltration galleries used in conjunction with newer permeable pavement solutions such as Lafarge Tarmac's Topmix Permeable.

Advantages of porous pavements over other SuDS

Porous or permeable pavements have many benefits over other systems when it comes to building in an urban environment:

- Provides a direct replacement for more traditional pavements
- Evacuate water faster than conventional drainage
- Provide a smooth, even surface for car parks, driveways and sporting areas
- Can remove pollutants from surface water before it is released into the watercourse or sewage system without the need for additional installations (depending on your application)



The Urban Heat Island (UHI) effect

Materials like asphalt and traditional concrete contribute to the UHI effect – where urban areas are significantly warmer than surrounding rural areas. Due to voids within its structure, Topmix Permeable is less dense than conventional concrete and therefore has a reduced heat storage capacity. Additionally the voids allow stored water to evaporate in warmer weather creating a cooling effect.

The UHI effect is a factor of solar reflectance or albedo, and is the percentage of solar energy reflected by a surface. Typically, this is between 35% and 40% for concrete, which is greater than dark asphalt (between 5% and 10%). The greater the reflectance the less energy absorbed and the smaller the contribution to the UHI effect.

Improved water quality

Permeable pavements are more effective in removing pollution from rainwater run-off than attenuation tanks and can remove a wider range of pollutants than oil separators (CIRIA 2004). Initial larger particles are stopped at the surface reducing penetration to underlying sub-grades. Finer materials, hydrocarbons and heavy metals, whilst able to penetrate the top surface are trapped as they penetrate into the supporting layers. Organic materials, once trapped, breakdown over time reducing the amount and volume of contaminants that reach discharge watercourses. This makes permeable pavements ideal for areas where vehicles are stored or maintained.

Research shows that permeable pavements can remove a high percentage of Total Suspended Solids (such as silt) and hydrocarbons.

When subjected to low level oil drips, such as in car parks, permeable pavements can continue to biodegrade the hydrocarbons indefinitely.

If additional treatment is needed for higher risk areas the use of natural SuDS, such as swales or wetlands, is recommended.

Reuse of construction materials

Concrete readily utilises recycled and secondary materials as constituents through the use of waste materials in the manufacturing of constituent and as replacements in concrete, this makes the concrete industry a net user of waste utilising 47 times more waste than it generates. Concrete is also 100% recyclable.

A product of over 100 years' experience

Lafarge Tarmac has a long and proven history of producing innovative, sustainable products and solutions that deliver consistent and outstanding performance.

As a company we are committed to becoming our customers' preferred choice for sustainable construction solutions, by continuously improving social, economic and environmental standards, and offering quality products and services that contribute positively to the sustainability of the built environment.

Responsible sourcing

All of our production sites and products have been accredited to BES 6001*, the independent third party accreditation scheme that assesses responsible sourcing policies and practices across the supply chain. We have achieved a 'Very Good' rating which demonstrates our proactive responsible management of the environmental, social and economic impacts of our business throughout our supply chain; including the materials we buy, our operations, the way we produce materials and how we transport them to our customers. We also have 5* accreditation in the Achilles BuildingConfidence scheme.

Lafarge Tarmac 2020 Sustainability Strategy

We are making real carbon reductions and are committed to doing so on an ongoing basis. This is reinforced by our 2020 commitments to accelerate the move to a sustainable, low carbon economy. For more information visit www.lafargetarmac.com/sustainability

Environmental and quality management systems

We use management systems certified to ISO 9001, ISO 14001 and OHSAS 18001 across our operations to continuously improve social, economic and environmental performance.

‡ References to BREEAM have been made in line with the 2011 New Construction Technical Guide.

*Our BES 6001 certificate number is BES 559207.

Sustainability benefits of Topmix Permeable from Lafarge Tarmac

- Locally sourced product (average delivery from plant to site 10km)
- Responsibly sourced in line with BES 6001*
- Conforms to BREEAM‡ and LEED standards
- Supports water capture systems for grey water recycling
- Filtration reduces water pollution and reduces the cost of treatment
- Contributes to the natural recharge of groundwater
- Reduces heat build-up and retention, reducing the UHI effect
- Works harder for longer, due to its inherent durability and strength





Summary of features and benefits

Topmix Permeable from Lafarge Tarmac offers a practical, cost-effective, long-lasting, sustainable drainage solution that minimises the risk of surface water flooding and improves water quality. Benefits include:

Storm water management

- Rapid water removal ensures water-free surfaces
- Safer roads and parking areas
- No standing water
- Reduced risk of flash flooding
- High permeability and drainage capacity

Environmental management

- Minimises urban impact on natural water cycle
- Filters petroleum hydrocarbons from dirty road water
- Provides natural groundwater recharge in urban environments
- Reduced pollution in storm water
- More efficient use of land (reduced footprint)
- Reduced heat build-up and retention lowers UHI effect

Reduced costs

- Reduced storm water management costs
- Reduced or zero requirement for piping, catchment basins and infiltration galleries
- Low maintenance surface
- Can form part of a wider cost-effective Sustainable Urban Drainage System (SuDS)
- Minimises the need for run-off retainers, reducing property costs

Full service offering

Lafarge Tarmac are also able to provide a full design, installation and aftercare service if required through our Lafarge Tarmac Construction Solutions business.

This would include the sub-base products to complement Topmix Permeable from Lafarge Tarmac.

Advantages for using in domestic situations

There are a number of advantages of using Topmix Permeable from Lafarge Tarmac in domestic situations such as on driveways:

- No standing water lessens the risk of hydroplaning
- Voids speed up snow and ice thawing
- No planning permission required
- Reduced storm water impact fees

Advantages for using in car parks

The benefits of installing Topmix Permeable from Lafarge Tarmac in car parks are the same as those for domestic applications, with the added advantages of:

- Reduced investment in labour, construction and maintenance of detention ponds, skimmers, pumps and drainage pipes
- Larger areas to be developed at a lower cost



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