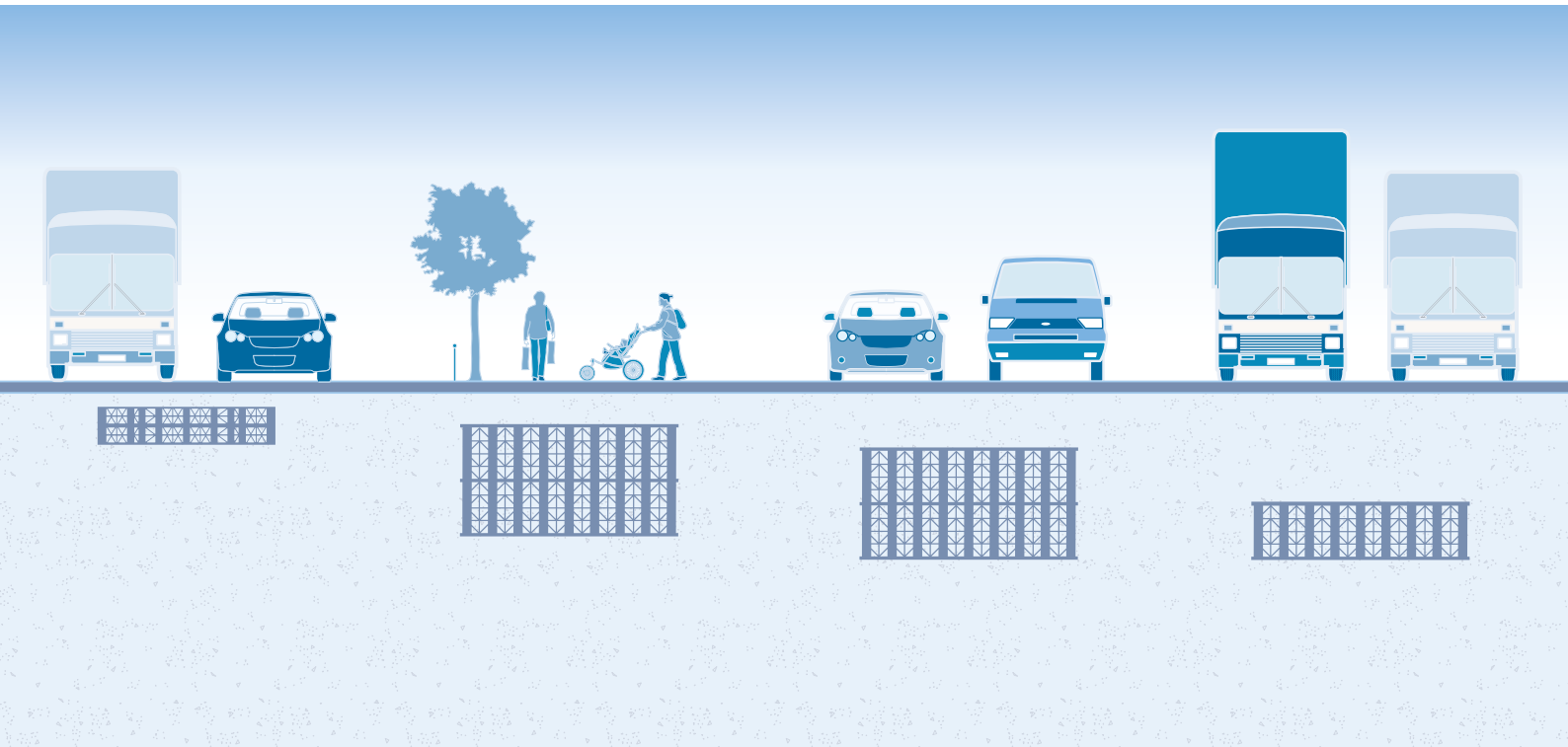


Water Management Solutions



Geocellular Systems

The widest range of geocellular solutions



Because every site is different, Polypipe offers the widest range of geocellular solutions for surface water management and pollution control that are adaptable enough to suit the precise requirements of each individual project, whether used in isolation or combination.

As climate change makes itself felt in increasingly frequent storms and floods, geocellular systems offer a versatile method of creating bespoke solutions that deliver all your objectives for surface water management including attenuation and soakaway systems. By addressing the unique climatic and ground conditions of your site, they allow a value-engineered response to your exact specifications.

Tailored to your project

Every site is different and many have significant challenges to the successful design and construction of an efficient and cost-effective drainage system. It is not unusual to be faced with space constraints, abnormal ground conditions such as contaminated soils on brownfield developments, high water tables or shallow rock dig. Similarly, temporary and permanent loadings associated with the construction process and trafficking of the constructed pavements impact on the design and programming of the drainage system.

Source Control Techniques

With an increasing emphasis being placed on the implementation of source control drainage solutions, which involves the effective management of water volume and water quality as close as possible to where rainfall lands, Polypipe has responded by incorporating Permavoid systems into its existing range of Polystorm geocellular water management solutions.

Whatever your requirements or challenges, whether shallow or deep or a combination of both, Polypipe offers by far the widest range of high strength geocellular products and systems - not to mention the most comprehensive design and technical support services to help you translate your plans into an effective and reliable surface water management solution.

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Legislation and regulations

The Flood and Water Management Act 2010

The Flood and Water Management Act provides for better management of flood risk for people, homes and businesses. It places particular emphasis on the prevention and management of surface water flooding.

Water Framework Directive

The Water Framework Directive is a piece of EU legislation to improve water quality in watercourses and coastal areas. It identifies the treatment of pollution at source as one of the most effective ways of reducing pollution and improving water quality.

Our geocellular solutions can meet that challenge by integrating a number of surface water treatment and water management control systems into your attenuation and soakaway structures.

National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) has replaced PPS 25 Development and Flood Risk, however the policy principles remain the same. The NPPF ensures that developments are not located in flood risk areas if land is available elsewhere. If high-risk areas can't be avoided, it sets out the steps to be taken to protect people and property.



The Growing Importance of SUDS

'Making Space for Water' is an integrated, forward-thinking strategy for managing future flood risk in England, first published in 2004.

Among its many recommendations is the adoption of a 'joined-up' approach to drainage management in high-risk urban areas, and the widespread use of Sustainable Urban Drainage Solutions (SUDS) to control the rate at which rainwater runs off paved areas and into sewer networks and rivers.

Engineered water management solutions provide an effective means of managing flood risk from surface water and because they are often buried below ground, they maximise the amount of land available for amenities.

SUDS

Building regulations

Building Regulations Approved Document H3 requires rainwater to be either stored in a tank or discharged in the following order of preference:

- (a) Soakaway or other infiltration
- (b) Rivers and watercourses
- (c) Direct to sewers

In other words, the traditionally preferred method of rainwater disposal – total discharge to the sewer network – may only be considered where other forms of re-use or drainage are not possible.

CIRIA C697

The SUDS Manual, published by CIRIA 2007 (CIRIA C697) defines that a sustainable urban drainage system should consider certain basic requirements, including:

- Run-off from a developed area should be no greater than the run-off prior to development
- Run-off from a developed area should not result in any down-grading of downstream watercourses or habitat
- Consideration should be given at the development feasibility stage to water resource management and control in the developed area
- Run-off should replicate as far as possible the natural response of the site to rainfall

The Code For Sustainable Homes

The Code for Sustainable Homes provides a points-based sustainability rating across nine key areas.

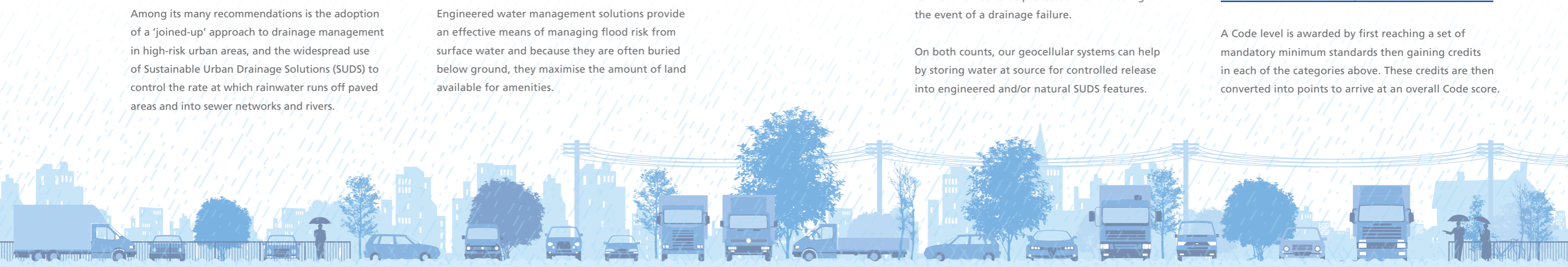
The most significant part of the code for Drainage Engineers is the requirement for run-off rates from a new housing development to be no greater than the rate for the previously undeveloped land, and for new homes to be protected from flooding in the event of a drainage failure.

On both counts, our geocellular systems can help by storing water at source for controlled release into engineered and/or natural SUDS features.

The Code covers 9 areas:

1. Energy & CO ₂ Emissions	6. Pollution
2. Water	7. Health & Wellbeing
3. Materials	
4. Surface Water Run-off	8. Management
5. Waste	9. Ecology

A Code level is awarded by first reaching a set of mandatory minimum standards then gaining credits in each of the categories above. These credits are then converted into points to arrive at an overall Code score.



Geocellular solutions for shallower depths

Polypipe already provides the widest range of geocellular solutions to meet the needs of Drainage Engineers in every application.

Now Permavoid, our latest geocellular system, extends the choice and flexibility of the Polypipe range by providing robust, effective source control through attenuation or soakaway at shallower levels.

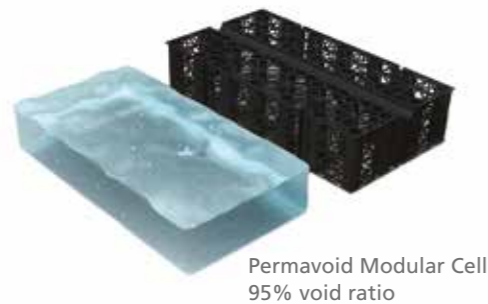
Why a shallower application?

Shallower attenuation or soakaway structures are often necessary because the ground at greater depths presents a construction challenge of one kind or another. This could be the presence of chemicals or contamination left over from previous land use, underground watercourses or an unusually high water table. Some drainage engineers prefer a shallower approach because it does not rely on expensive pumping equipment. Shallower methods also have a reduced environmental impact because they require less excavation and fewer trips to transport infill and rubble to and from the site.



Benefits of the Permavoid System:

- Designed and tested for attenuation or soakaway at shallower depths
- Provides effective source control
- Interlocking raft for rigidity and a high compressive and tensile strength under load
- Can be installed above a high water table
- Allows water to be spread across a wide area
- Suitable for use beneath porous and non-porous surfaces
- Ideal for brownfield or contaminated sites
- Removes the requirement for pumping stations
- Reduction in excavation depth and cost
- No need for trench supports or plant to deliver and remove trench support panels
- Provides treatment to remove silt and hydrocarbon deposits
- Oil interception at source – no need for petrol interceptors
- Can be used in combination with the full range of Polystorm geocellular solutions for deeper applications



Permavoid Modular Cell
95% void ratio



Traditional Aggregate
30% void ratio

Permavoid System – A Comprehensive Source Control Water Management Solution

The Permavoid System comprises of high strength modular cells suitable for sub-base replacement in trafficked pavements, channel and gully components incorporating silt/oil gravity separation features, floating oil treatment devices, special oil treatment geotextiles and shallow flow control devices.



It offers drainage engineers a means of providing integrated source control drainage solutions that can meet the volume control and water treatment demands of current guidance and regulations. The systems can also facilitate better use of conventional landscaped SUDS features such as pervious pavements, swales and shallow basins. To assist designers in developing the most efficient arrangement of the system, Polypipe provides a complimentary design support service that is manned by a team of qualified engineers, experienced in the provision of SUDS solutions.

The Permavoid system comprises of:



Permavoid

Cellular sub-base replacement system that locks together to form an interlocking raft of exceptional high compressive and tensile strength.



Permachannel

A channel drain that combines run-off collection, silt and effluent interception and water treatment functions.



Permavoid Biomat

Comprising of a high strength, low density, oil treating, geosynthetic floating mat.



Permafilter Geotextile

A non-woven geotextile designed for hydrocarbon pollution treatment.



Geomembrane

An impermeable membrane for wrapping around Permavoid structures to form watertight tanks.



Permaties

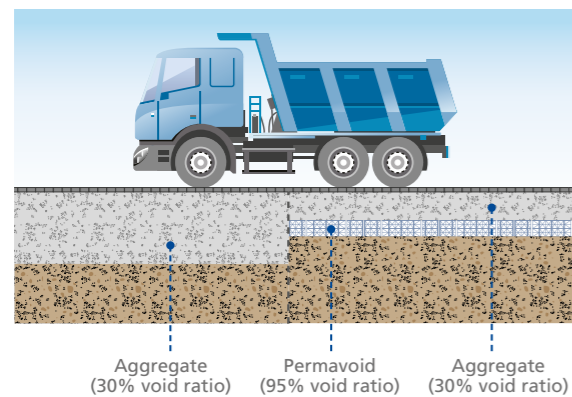
Fully interlocking tapered tie connections to securely link Permavoid cells together in a single structure and to transfer tensile loads.

Geocellular solutions for shallower depths



Permavoid as an aggregate sub-base replacement

Permavoid is designed to be used in place of a traditional aggregate sub-base within trafficked pavements and provides a unique high strength, consistent structural raft with all the associated benefits of highly voided modular geocellular structures.



Permavoid can enhance the attenuation capacity of a pavement and may also enable the reduction of granular thicknesses in hydraulic pavements. The system is suitable beneath asphaltic, block-paved or concrete pavements and for the full range of traffic conditions from HGV to domestic driveways. Because it has a void ratio almost 70% higher than aggregate, Permavoid reduces the depth of your excavations, saving time and substantially cutting the volume of muck-away, thus reducing costs.

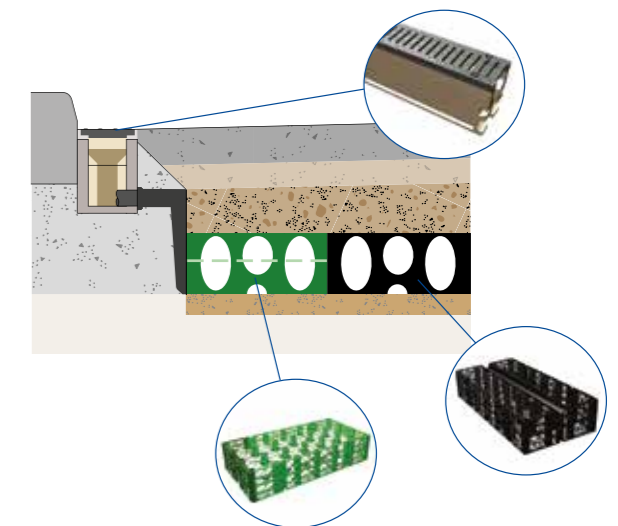


Within pervious pavements

As Permavoid can be installed as a replacement for granular sub-base; the attenuation capacity of pervious pavements can be significantly increased and the thickness of the granular layers may be reduced in many instances. The water treatment efficiency of the pavement can also be significantly enhanced by the introduction of Permafilter oil treatment geotextile at formation level, which is particularly relevant where pavements are designed as infiltration features.

Within impervious pavements

As with pervious pavements Permavoid can be installed as a replacement for granular sub-base to enhance the attenuation capacity and water treatment efficiency of impervious pavements. Invariably, Permachannel is used to collect and treat surface water run-off and to transfer the flows into an adjoining Permavoid layer. The water treatment efficiency of the pavement can be further enhanced by the introduction of Permafilter oil treatment geotextile at formation level, which is particularly relevant where pavements are designed as infiltration.



Geocellular solutions for shallower depths

For pollution management

Increasingly, regulations and design guidance highlights the obligation on developers to mitigate the risk of groundwater pollution emanating from contaminated run-off from pavements.

The most common diffuse pollutants are hydrocarbons and contaminated silts. The Permavoid system offers integrated techniques for the source control treatment of polluted run-off as more effective alternatives to conventional silt-oil separators.



Permafilter Geotextile is a geotextile that has been specifically designed for hydrocarbon pollution treatment and is capable of retaining oil contamination ranging from daily car drip losses up to catastrophic spillages, whilst allowing clean water to pass through the layer. The entrapped hydrocarbons are aerobically bio-degraded and the system is designed to be self-maintaining for the life of the installation. Permafilter can be used to wrap geocellular tanks or to line aggregate layers and can significantly enhance the water treatment aspect of the water management system and is especially beneficial in soakaway applications; particularly in proximity to sensitive aquifers or source protection zones.

Permavoid Biomat comprises a high strength, low density, oil treating geosynthetic layer that floats on water and is designed to intercept and treat potential residual oils that may be present within emulsified surface water. The floating mats are pre-installed within the Permavoid units and can be incorporated where required within the overall geocellular structure. Oils are aerobically bio-degraded and the system is designed to be self-maintaining for the life of the installation. Permavoid Biomat filters can also be incorporated into Polystorm cells to provide treatment for deeper attenuation and soakaway applications.

Permachannel is a combined run-off collection, silt/effluent interception and treatment system. Each channel incorporates a gravity separation device ahead of the outlet to prevent silt and oils from progressing beyond the channel into the rest of the drainage system. Silts are deposited and collected within the channels for removal using normal maintenance techniques and hydrocarbons are bio-degraded aerobically within the channel. When arranged appropriately, Permachannel provides a source control water treatment component that is much more effective and sustainable than conventional silt/oil separators.

Where does Permavoid shallow sub-base replacement particularly help?

With high water tables

High water tables and even perched water at shallow depth require specific design and construction measures to avoid issues such as flotation of attenuation structures and often prevents the use of soakaways. Anti-flotation and temporary dewatering measures are invariably very expensive, but Permavoid can often provide the attenuation or infiltration solution by avoiding groundwater issues.

Avoidance of pumping stations

Shallow Permavoid systems can very often avoid the need for pumping that might otherwise be required with conventional drainage or deep attention tank solutions. Pumped solutions can be costly to install and maintain and considered to be environmentally unsustainable.

In contaminated sites

Redevelopment of brownfield sites is common-place and issues of ground contamination often come hand in hand. The use of Permavoid shallow attenuation or soakaway structures can very often avoid the need to excavate into contaminated soils that invariably incur significant abnormal costs in either on-site remediation or off-site disposal and the numerous associated environmental issues. Thus, the use of Permavoid systems can often avoid substantial costs and reduce overall construction time.

Over hard rock

Excavation of hard rock is usually expensive and slow. However, Permavoid is ideal for use on sites that are underlain by hard rock at shallow depth, as the systems can be incorporated into the pavement construction invariably avoiding any net additional excavation for the drainage system.

On podium decking

On podium decks, key design, construction and cost issues usually involve issues of weight of overlying construction, creation of falls for drainage layers, pipe penetrations through the deck and loss of headroom within the underlying basement due to the need to suspend drainage beneath the overlying deck. Permavoid systems can avoid all of these issues as it can provide an effective drainage and attenuation layer without the need of falls or outlet penetrations through the deck; is lightweight and can accommodate a wide range of finishes including soft landscaping, activity areas and vehicular pavements.

Difficult site access

In narrow, restricted or otherwise limited access sites, Permavoid can be easily manhandled into place without any heavy lifting or off-loading gear. With a 95% void ratio space for maximum water retention, the lightweight cells can be carried and installed by a single construction worker.



Deep Geocellular solutions

The tried and tested Polystorm range is designed to provide attenuation or soakaway at a variety of depths and to accommodate a wide range of traffic loadings, from pedestrianised areas to large HGV parks.

When combined with Permavoid, our latest shallow geocellular system, it creates an even wider choice of options for the management of surface water.



Polystorm Lite

Polystorm Lite

Polystorm Lite has been specifically designed for non-trafficked applications. With a 20 tonne per square metre compressive strength it will, however, take general maintenance vehicles such as grass cutters. Polystorm Lite is typically used in landscaped areas, pedestrianised areas or public open spaces such as playgrounds.



Polystorm

Polystorm

The standard Polystorm cell has a 40 tonnes per square metre compressive strength and is ideally suited for attenuation or soakaway under trafficked and loaded areas such as housing developments, car parks and commercial developments.



Polystorm-R

Polystorm-R

For trafficked and loaded applications with a compressive strength of 61 tonnes per square metre and the added benefit of a higher recycled material content.



Polystorm Xtra

Polystorm Xtra

Designed for use in deeper burial depths and heavily trafficked applications, Polystorm Xtra has a compressive strength of 80 tonnes per square metre, making it suitable for use in very heavily trafficked areas like lorry parks and industrial access roads.

Non-Trafficked

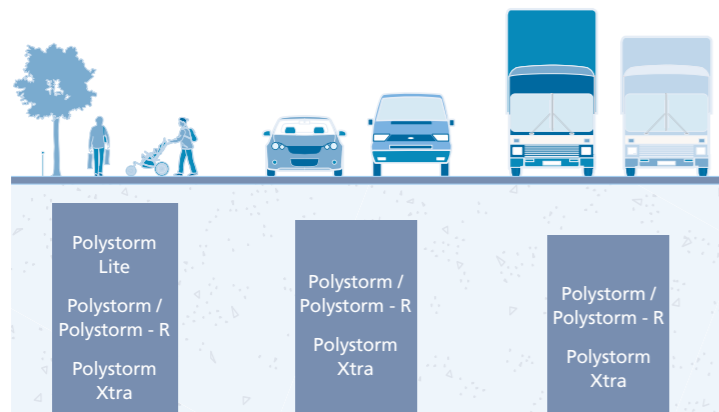
Trafficked

Heavy Trafficked

Polystorm Loads vs Depth

The illustration on the left shows how typical loading and depth combinations can be accommodated by different Polystorm systems. For advice and assistance in designing attenuation or soakaway structures using Polystorm, please see page 14 or contact our technical support team on +44(0)1509 615100.

Note: For illustrative purposes only.



Schemes Requiring Inspection & Maintenance

Where there is a requirement for attenuation or soakaway schemes to be inspected, our Polystorm Access and Inspect solutions provide access for remote CCTV inspection and maintenance activities such as flushing and rodding.

Polystorm Inspect

The Polystorm Inspect cell is complementary to the Polystorm range of modular cell solutions. Its primary purpose is to provide a tunnel along the length of a fully installed Polystorm structure to enable access for inspection and maintenance. Polystorm Inspect is a high strength thermoplastic cell which evenly distributes its load through the Polystorm structure. The tunnel end is left open by default but the unit can be closed off if required by clipping into place the moulded end plate. For purposes of identification the cell features a yellow centre section and end plate.



Polystorm Inspect

Polystorm Access

Polystorm Access provides a 1m x 0.5m shaft within a Polystorm geocellular structure to enable surface access for remote camera inspection and maintenance activities such as flushing and rodding. The system consists of a 500mm diameter shaft which extends from surface level to the top of a Polystorm structure at which point a turret provides an interface between the shaft and the inspection chamber within the Polystorm structure.

At the bottom of the chamber a base unit interlocks with the surrounding layer of Polystorm cells whilst supporting the geomembrane. A 350mm reduced access shaft cap is provided to comply with inspection chamber regulations. Polystorm Access is suitable for use with Polystorm, Polystorm-R, Polystorm Lite and Polystorm Xtra and may be combined with Polystorm Inspect for full length remote inspection and maintenance.



Polystorm Access

Whatever your requirements and whatever the application - from non-trafficked to heavily trafficked areas - there is a Polystorm system within our range to suit your specifications. Combined with our new Permavoid system for shallower applications, it now provides even greater flexibility for surface water management at any depth, than ever before.

Technical considerations

Structural Design Guidelines

When designing plastic geocellular structures for soakaway or attenuation, it is important to ensure the finished system is safe and capable of carrying the loads required of it. Because different Polystorm cells have different load bearing capabilities, it is possible to tailor finished structures according to the forces they are expected to bear. Care must be taken however, to design for both the burial depth and the possibility of occasionally higher loads, such as those exerted by a delivery lorry on a normally lightly trafficked zone, for instance.

Applied loads

- Distributed
- Concentrated
- Traffic
- Backfill
- Stockpiles
- Earth pressure
- Construction traffic
- Cranes
- Uplift
- Depth

Laboratory testing

- Ultimate compressive strength at yield
- Deflection parameters
- Creep



Partial factors of safety

- On material properties
- On loads
- Follow CIRIA guidance

Analysis

- Failure
- Deflection (movement under load)
- Creep
- Flotation



Technical support services

Our Technical Support team provides expert advice on our full range of geocellular systems for surface water management and pollution control.

Taking into account the geology and hydrology of your site, as well as the prevailing climate and rainfall, our qualified engineers will determine the best water management solution for your project, whether that comes in the form of a shallow or deeper geocellular system. We are the only company able to offer such a complete support and design service, thanks to the extent of our geocellular water management solutions range; the widest and most comprehensive in the industry.

Case studies



A3 Hindhead Road Project

Four separate soakaway structures were supplied to manage surface water run-off on the A3 road improvement scheme at Hindhead, Surrey.

The £371 million A3 Hindhead road project, undertaken on behalf of the Highways Agency required an innovative yet heavy duty soakaway solution. Polypipe's water management solutions team worked closely with Balfour Beatty to provide a solution using its Polystorm and Polystorm Xtra cells, which created four separate soakaway structures. Daniel Machnik, Senior Buyer for Balfour Beatty Civil Engineering was impressed with the innovative water management solution provided by Polypipe.

"This project has demonstrated the Polypipe team's design service and technical support capabilities. The adaptability of the Polystorm and Polystorm Xtra cells offered an advantage on this challenging scheme and the installation guidance the team has demonstrated on-site has been of great value."

Polypipe water management solutions team also undertook further design work for £200,000 worth of cable protection products supplied for the project.

To improve the installation times of the cable protection within a tunnel section of the project, Polypipe suggested a large bank of sealed ducts in 94 and 150mm diameter which were installed using its 150mm Ridgidrain pipe with integral sockets. As part of an overall commitment to reducing its impact on the environment, Polypipe also implemented a recycling scheme on-site, collecting off-cuts of pipe for re-use in its manufacturing process.

Polypipe products used:

- Polystorm and Polystorm Xtra
- Ridgidrain pipes and fittings
- Cable Protection products

Case studies

WM Lee Casting Facility

When constructing an extension to the WM Lee Casting Facility in Chesterfield, Beighton Construction required an adaptable SUDS solution which could be installed at a shallow depth to attenuate surface water run-off from a car park and other hard standing areas.

Polypipe supplied over 1,900 of its Polystorm and Polystorm Xtra geocellular cells as a hybrid structure. Installed at a depth of two metres, the cells were covered with 500mm compacted sand and hardcore to support the construction of a new car park. Installing the products at this depth and within the designed footprint of 43 x 7.5 metres was made possible by the inclusion of Polystorm Xtra on top of the Polystorm cells.



The hybrid installation ensures that the required attenuation capacity could be achieved with a cell-depth of one metre, without the need to alter the development footprint or change the cover depth.

- Polypipe products used:**
- Polystorm and Polystorm Xtra

Newcastle City Council

In order to alleviate flooding from the nearby Ouseburn River at a Fawdon housing estate, Newcastle City Council opted to install a Permavoid shallow attenuation system.

As a part of a Defra-funded alleviation scheme, local authority planners and Polypipe engineers developed a Permavoid system to be installed beneath a recreation area lying between the estate and the river. With very little fall between the developed land and the river high water level, a shallower system allowed close control of burial depths for optimum attenuation performance. The Permavoid structure now provides storage until river levels fall and gravity discharge can begin,



while river water is prevented from entering the system by a non-return valve on the outlet. The system also incorporates Permavoid Biomat to trap and digest hydrocarbon pollution from roadways in line with The Water Framework Directive.

- Polypipe products used:**
- Permavoid, Permavoid Biomat

Service and support

Our product knowledge and service teams provide an unrivalled level of technical support for drainage designers and engineers planning attenuation systems in line with legislation and building regulations.

Technical support

Our technical services team includes fully qualified design engineers who provide detailed information on hydraulic sizing, structural calculations, CAD drawings and standard details right through to installation and maintenance guidance. It's their aim to raise the perception of the importance of material suppliers in the supply chain by providing innovative solutions and added value within the industry.

Design

Polypipe provides a full in-house design facility and our team of designers, engineers and drainage specialists provide guidance on the most appropriate solution for any project. Utilising our wide range of products, a bespoke value-engineered solution can be designed to meet the requirements of a project manufactured by our fabrications team and delivered to site as an off-site solution, ready for installation.

Installation guidance

We provide detailed advice for every stage of the installation process, ensuring you receive appropriate guidance on a project from start to finish. Our dedicated team of water management specialists provide invaluable advice and our network of supply and fix teams can provide installation services on-site. At any stage, you can call our helpline for a rapid response to all your enquiries on **+44 (0)1509 615100**.

Commissioning & aftersales

All our attenuation systems are supported by both commissioning and post-installation inspection. Please note that this is an additional service that is available on request.

Literature

Product Literature

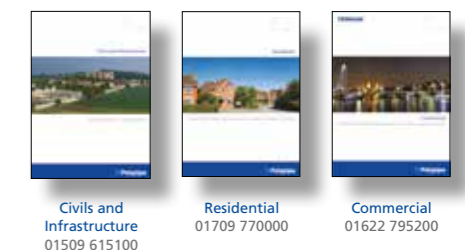


Solutions Literature



Market Sector Literature

Additional market sector literature is available please visit www.polypipe.com or contact the telephone numbers appearing under each brochure.

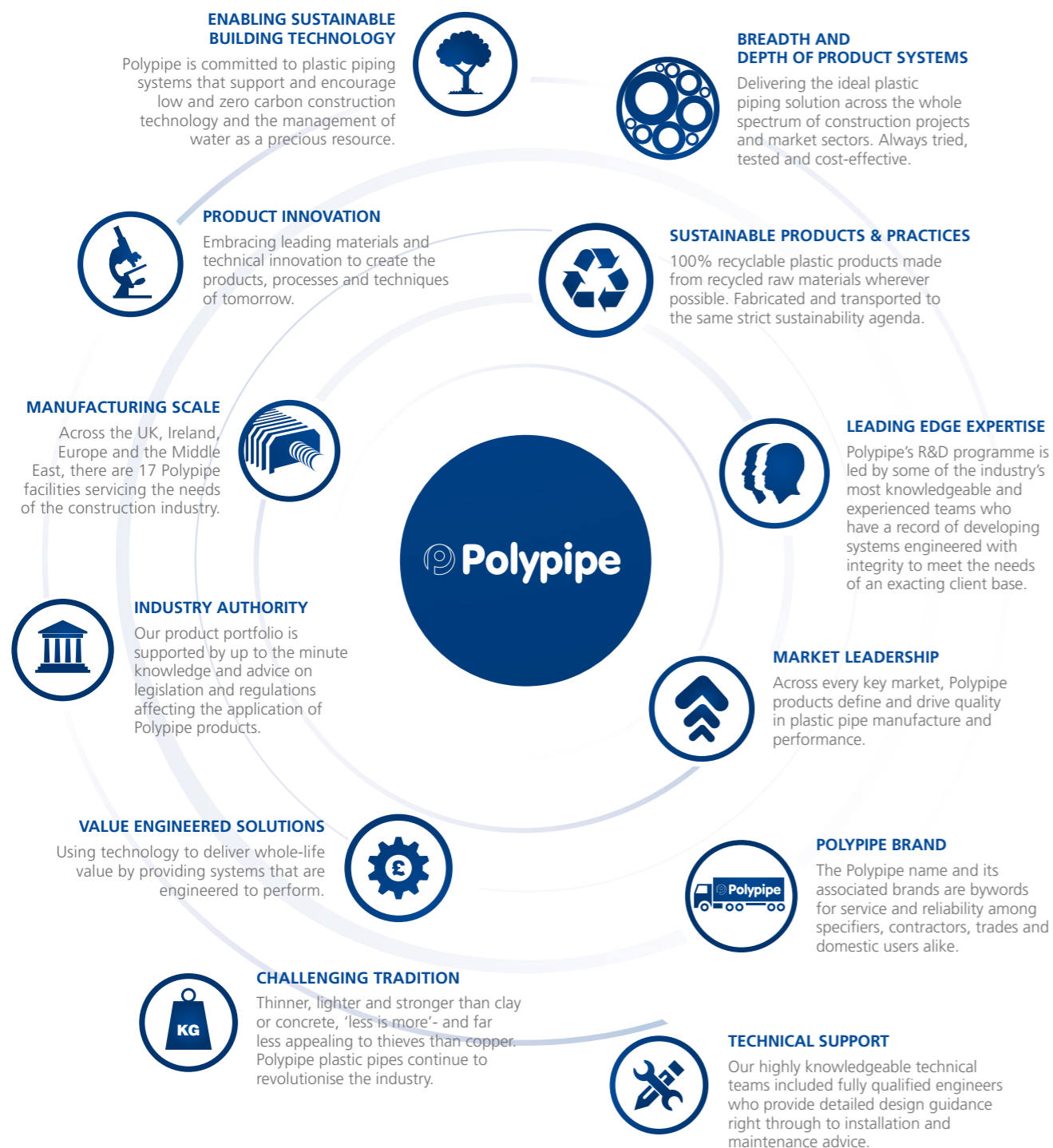


All literature available at: www.toolbox.polypipe.com



Polypipe

We design, develop and manufacture the widest range of plastic piping products, with over 20,000 product lines available. Our primary focus is on developing and supporting pragmatic product systems through specific knowledge and understanding of the residential, commercial, civils and infrastructure market sectors. We ensure that customers can trust our unrivalled expertise to provide value engineered, fit for purpose piping solutions for the growing diversity and complexity of construction and building technology challenges they face.



Polypipe enabling sustainable building technology

Polypipe provides plastic piping systems that enable the effective installation and performance of sustainable building technology, meeting the twin global challenges of carbon reduction and water management.

CARBON EFFICIENT SOLUTIONS 'SUSTAINABLE INDOOR ENVIRONMENTS'

Ever stricter building regulations and ever more environmentally conscious customers are driving the demand for greener building products and technologies. Polypipe fulfils that demand with a full range of systems that enable collection, transmission, emission and control in heating, ventilation and cooling systems.

WATER MANAGEMENT SOLUTIONS 'ROOF TO RIVER'

Offering a comprehensive range of standalone and modular SUDS products, rainwater harvesting and surface water treatment solutions plus legislative and technical support services, Polypipe's water management solutions team address the requirements of every construction and civil engineering project.



Sector Focus

Our product systems respond directly to sector-specific requirements thanks to focused technical and development teams with hands on expertise in the following areas:

COMMERCIAL

Major commercial projects from car parks and high rise office blocks to hospitals, educational premises and shopping centres have all benefited from Polypipe's range of value engineered products and comprehensive service support.

CIVILS AND INFRASTRUCTURE

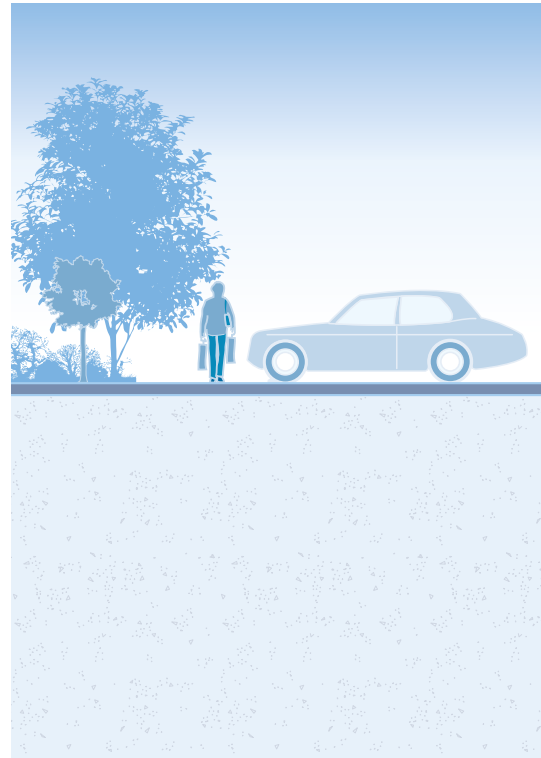
Delivering performance and sustainability, Polypipe's surface water drainage and cable management systems, supported by our in-house fabrications team, offer civils and infrastructure project planners a complete suite of solutions.

RESIDENTIAL

Polypipe offers the broadest range of residential product and service solutions for both new build and RMI applications, as well as innovative solutions in response to legislative and industry targets for more sustainable housing.

All descriptions and illustrations in this publication are intended for guidance only and shall not constitute a 'sale by description'. All dimensions given are nominal and Polypipe may modify and change the information, products and specifications from time to time for a variety of reasons, without prior notice. The information in this publication is provided 'as is' on May 2013. Updates will not be issued automatically. This information is not intended to have any legal effect, whether by way of advice, representation or warranty (express or implied). We accept no liability whatsoever (to the extent permitted by law) if you place any reliance on this publication you must do so at your own risk. All rights reserved. Copyright in this publication belongs to Polypipe and all such copyright may not be used, sold, copied or reproduced in whole or part in any manner in any media to any person without prior consent. Polypipe is a registered trademark of Polypipe. All Polypipe products are protected by Design Right under CDPA 1988. Copyright © 2013 Polypipe. All rights reserved.

Water Management Solutions



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