Effective Permeable Pavements





SuDS for Housing Technical

Introduction

Permeable paving is a surface water drainage technique which is promoted by many UK planning departments as an integral component within a sustainable drainage system (SuDS). Currently, some UK planning departments limit new housing developments to a maximum impermeable area. The incorporation of permeable paving into the surface water drainage design can assist developers in meeting these targets.

Offering both 'source control' (where rainwater run-off is managed as close to where it falls as possible) and treatment (cleansing of collected run-off), permeable pavements can also help to meet planning conditions relating to surface water drainage systems. They can be used to infiltrate (soakaway) or attenuate (store temporarily) water at source.

SEL has developed the SEL Source PP range of products to simplify the design and enhance the efficiency of permeable pavements. These products can standardise construction depths, offer enhanced hydrocarbon treatment and optimise the attenuation potential of individual catchments. They also allow permeable pavements to be utilised on sites which are unsuitable for infiltration and sites with gradients. The use of SEL Source PP components can eliminate 'underdrain' pipework allowing the construction of permeable pavements to be placed at the end of the build program, avoiding contamination during the construction phase and allowing contractors to avoid the use of a 'sacrificial' asphalt protection layer.

SEL Source PP products can be utilised with a wide range of permeable surfacings, such as clay, concrete or natural stone pavers, permeable asphalt and resin-bound aggregates.

Solutions are available for both attenuation and infiltration.







The use of SEL Source PP components can:

- Control the flow of water from sub-base layers to provide efficient and managed attenuation.
- Increase the storage capacity of sub-base layers without increasing construction depths
- Allow the use of permeable pavements on developments with gradients.
- Provide efficient distribution of water from downpipes into voided sub-base layers.
- Reduce the risk of silt and debris entering underground networks.
- Reduce the scope of, or eliminate completely, 'underdrain' pipe networks within permeable pavement constructions.
- Eliminate the requirement for 'sacrificial' asphalt layers.
- Simplify and speed up construction.
- Enhance hydrocarbon treatment.





SEL Source PP Components are fully compliant with BS7533-13:2009; 'Pavements constructed with clay, natural stone or concrete pavers; Part 13: Guide for the design of permeable pavements constructed with concrete paving blocks and flags, natural stone slabs and setts and clay pavers; Annex B: Typical physical properties of replacement systems (geo-cellular) units.'

This brochure outlines some typical scenarios. However, the modular SEL Source PP components can be combined to produce a flexible and robust site-specific SuDS design. Please contact our technical department for more details.

SEL Source PP Design Principles:

- Utilise driveways and shared access roads where possible to form micro-catchments of permeable pavement.
- Infiltrate surface water run-off wherever possible.
- If infiltration is not viable, maximise attenuation volumes within the voided subbase for each micro-catchment by optimising flow rates.
- Introduce run-off from downpipes into the voided sub-base of each micro-catchment.
- Standardise voided sub-base thicknesses for all micro-catchments to simplify construction.
- Provide a uniform, flat laying surface to simplify installation of membranes and geotextiles.

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Maximising Storage in Voided Sub-base

SUDS02008 Controflow 500 Series 110Ø Stubs Stepped Invert Rodable

Controllow® Flow Control Chambers have been developed, in association with Robert Bray Associates, to control flows around developments from shallow SuDS features, such as permeable pavements and swales.

The stepped invert version facilitates a simple transition in construction levels, from above to below formation level. This allows for deeper collection pipework to be installed ahead of the individual permeable pavement areas below formation level, away from construction traffic.

Controflow® units for permeable pavements are pre-manufactured to site-specific orifice diameter requirements and arrive on site ready for installation. The units incorporate rodding access and an integral removeable screen to protect the orifice.

SUDS02008 Controflow 500 Series 110Ø stubs stepped invert rodable





The benefits of using an Controflow® stepped invert chamber are:

- Receives flow from above formation and enables a transition in level with ongoing pipework below formation level.
- Orifice can be sized to suit individual micro-catchments to maximise attenuation.
- The orifice is fixed in place to prevent inadvertent removal.
- Removable filter to allow cleaning during routine maintenance schedules.
- Integral rodding access point for maintenance.
- Sump to accommodate the deposition of silt and debris.
- Connects to standard underground push-fit PVCu drainage sockets.

Controflow® chambers allow designers to take advantage of the full storage capacity within the voided sub-base when used to regulate the pass-forward flow from each micro-catchment of permeable pavement.

Across a whole site this can amount to a significant additional storage volume at source and affect the scope of drainage works downstream, potentially downsizing, or eliminating completely, the requirement for additional storage measures to deal with events above the 1 in 30 year storm event, such as geocellular tanks or attenuation ponds.



Maximising Storage in Voided Sub-base

SUDS02005 Controflow 500 Series Universal Level Invert

Controllow® Flow Control Chambers have been developed, in association with Robert Bray Associates, to control flows around developments from shallow SuDS features, such as permeable pavements and swales.

The level invert version allows connection to shallow outfalls e.g. swales and ditches, or other areas of voided sub-base e.g. access roads. This chamber also includes a built-in weir wall, which is removable for easy maintenance.

Controflow® units for permeable pavements are pre-manufactured to site-specific orifice diameter and weir wall height requirements and arrive on site ready for installation. The units incorporate an integral screen to protect the orifice.





The benefits of using an Controflow® level invert chamber are:

- Allows gravity connection to shallow outfalls or permeable construction.
- Orifice can be sized to suit individual micro-catchments to maximise attenuation.
- The orifice is integrated within the weir wall and is protected by a filter screen.
- Weir wall is removable to allow cleaning during routine maintenance schedules.
- · Weir wall height is manufactured to site-specific requirements.
- · Sump to accommodate the deposition of silt and debris.
- Connects to standard underground push-fit PVCu drainage sockets.

Controflow® chambers allow designers to take advantage of the full storage capacity within the voided sub-base when used to regulate the pass-forward flow from each micro-catchment of permeable pavement. Across a whole site this can amount to a significant additional storage volume at source and affect the scope of drainage works downstream, potentially downsizing, or eliminating completely, the requirement for additional storage measures to deal with events above the 1 in 30 year storm event, such as geocellular tanks or attenuation ponds.



TYPICAL BLOCK PAVING CONSTRUCTION

- D ORIFICE DIAMETER (mm)
- E DEPTH OF COVER AND FRAME
 - TO BE USED (mm)

Maximising Storage in Voided Sub-base

SUDS01001 Controllow 300 Series Level Invert Screw Cap

SUDS01001 is a shallow flow control chamber with a removable, unguarded circular orifice (to specified diameter), designed to manage pre-filtered outflows from permeable paving or other open graded sub-base constructions.

Its small size and low cost make it ideal for check dams between permeable paving compartments. The removable cap locks in position with the orifice at invert level. The chamber is suitable for a maximum depth of 600mm from finished ground level, to the orifice plate and is supplied with three 110mm diameter inlet pipe connection stubs to offer a flexible layout. Supplied with a temporary protective site cover (permanent cover and frame not included).





Each chamber has a 200mm deep sump to accommodate the deposition of any suspended solids remaining in the runoff which has passed through RWP Filter Chambers positioned at the base of all the downpipes.

The chamber spigots are sized to fit standard 110mm diameter underground push-fit PVC-u drainage sockets.





SUDS01001 Controflow 300 Series Level Invert Screw Cap - Max & Min Installation Depths

Filter Chambers

Purpose-built high density polyethylene (HDPE) pre-fabricated catchpits are ideal for stormwater drainage systems.

WASP Catchpits are designed to separate silt and other particles, helping to improve the quality of water before it is reintroduced into the environment.

They can be integrated into any drainage system requiring 'in line' silt and debris separation prior to attenuation or infiltration.

WASP Catchpits provide the following benefits:

- Provide a treatment phase, which is especially beneficial where planning conditions seek one treatment phase for runoff.
- Efficient filtration and silt separation.
- Prevents silt and debris entering an attenuation or infiltration system to minimise the risk of system failure.
- Have a 300mm deep collection sump for silt / debris deposition to enable easy removal at regular maintenance intervals.
- No moving parts.
- Spigots sized to suit standard PVCu pushfit pipework.

WASP04301 315mmØ Chamber, 3 x 110mm Ø inlets, 1 x 110mm Ø outlet



The WASP04301 has a diameter of 315mm and an overall nominal height of 1092mm. The polyethylene chamber can be easily reduced on site to suit required invert levels.

Each chamber has 4 number 110mm diameter pipe spigots to suit standard PVC-u push fit drainage pipework. Each spigot can be used to form either an inlet or outlet.

The WASP04301 chamber has a 300mm deep sump to accommodate the deposition of silt and debris in the collected rainwater for later removal under a regular maintenance regime.

WASP04310 315mmØ Chamber, 3 x 110mmØ inlets, 1 x 160mmØ outlet



The WASP04310 has a diameter of 315mm and an overall nominal height of 1092mm. The polyethylene chamber can be easily reduced on site to suit required invert levels.

Each chamber has 3 number 110mm diameter inlet pipe spigots and 1 number 160mm diameter outlet pipe spigot to suit standard PVC-u push fit drainage pipework.

The WASP04310 chamber has a 300mm deep sump to accommodate the deposition of silt and debris in the collected rainwater for later removal under a regular maintenance regime.

WASP04510 500mmØ Distribution Chamber, 5 x 160mmØ inlets, 1 x 160mmØ outlet



The WASP04510 has a diameter of 500mm and an overall nominal height of 1014mm. The polyethylene chamber can be easily reduced on site to suit required invert levels.

Each chamber has 5 x 160mm diameter inlet pipe spigots and 1 x 160mm diameter outlet pipe spigot to suit standard PVC-u push fit drainage pipework. The inlet/outlets can be reduced to 110mm diameter by incorporating level invert reducers as required.

The WASP04510 chamber has a 300mm deep sump to accommodate the deposition of silt and debris in the collected rainwater for later removal under a regular maintenance regime.

Diffusing Water into & out of a Voided Sub-base

PVOD05101 Diffuser Unit 710mm X 710mm X 150mm; 110mm Ø Socket

Diffuser Units comprise pre-assembled Permavoid® units, which are pre-wrapped in a 2mm polypropylene mesh fabric and fitted with an integrated socket to connect to standard 110mm Ø PVCu pipework. Each unit provides efficient diffusion of collected rainwater run-off from downpipes, into and out of the voided sub-base aggregate layers beneath permeable pavements.

Diffuser Units provide the following benefits:

- · High strength allows placement within sub-base.
- · Cover depths as low as 130mm in domestic driveways.
- Large open surface (52% perforated) area allows efficient diffusion of collected run-off into voided sub-base.
- 2mm mesh encapsulation to minimise clogging.
- Connects to standard 110mmØ underground push-fit PVCu drainage.
- 710mm x 710mm x 150mm diffuser will service up to 100m² of roof catchment into minimum 30% voided sub-base.
- 710mm x 710mm x 150mm diffuser will accept flow of up to 3l/s from a minimum 30% voided sub-base.
- Fully compliant with BS7533-13:2009
- · Ready to install with no-site assembly required.



PVOD05101 Diffuser Unit 710mm x 710mm x 150mm with 110mmØ socket



SIDE ELEVATION

PLAN

Diffuser Inlet to Voided Sub-base



Diffuser Outlet from Voided Sub-base

Downpipe Filter Chamber for use within Voided Sub-base

RTNA05002 Raintaina RWP Base Unit Diffuser with Mesh Surround RTNA06001 Raintaina RWP Filter Cover Bronze Aggregate

Raintaina Erosion Pad Filter System is a self-flushing downpipe erosion pad and filter chamber. Downpipes discharge directly onto the permeable cover which effectively prevents detritus, such as leaves, moss and feathers, from entering a permeable pavement. The permeable cover is formed from resin bound gravel and removable for easy maintenance

Raintaina Erosion Pad Filter System provides the following benefits:

- Downpipe discharges directly onto the top of the SEL Raintaina Erosion Pad Filter System.
- Self-flushing; removes leaves, moss, feathers and other debris at ground level potentially avoiding overtopping of gutters.
- Provides a treatment phase, which is especially beneficial where planning conditions seek one treatment phase for roof run-off.
- Efficient filtration and silt separation.
- Prevents silt and debris entering the permeable paving system.
- Units situated under each individual downpipe to minimise the risk of system failure.
- Units positioned within the permeable paving system.
- Suitable for pedestrian areas with filter cover available in a variety of finishes.



Raintaina Erosion Pad RTNA05002 RWP Base Unit Diffuser with mesh surround with RTNA06001 Raintaina RWP Filter Cover Bronze Aggregate





Downpipe Filter Chamber with Pipework Connection

RTNA05001 Raintaina RWP Base Unit RTNA06001 Raintaina RWP Filter Cover Bronze Aggregate

Raintaina RWP Filter System is a self-flushing downpipe filter chamber. Downpipes discharge directly onto the permeable cover which effectively prevents detritus, such as leaves, moss and feathers, from entering a permeable pavement or pipe collection network. The permeable cover is formed from resin bound gravel and removable for easy maintenance.

The SEL Raintaina RWP Filter System provides the following benefits:

- Downpipe discharges directly onto the top of the SEL Raintaina RWP Filter System.
- Self-flushing; removes leaves, moss, feathers and other debris at ground level potentially avoiding overtopping of gutters.
- Provides a treatment phase, which is especially beneficial where planning conditions seek one treatment phase for roof run-off.
- Efficient filtration and silt separation.
- Prevents silt and debris entering the underground drainage system.
- Units situated under each individual downpipe to minimise the risk of system failure.
- · Units for use outside of permeable paving system.
- Suitable for pedestrian areas with filter cover available in a variety of finishes.

RTNA05001 Raintaina RWP Base Unit with RTNA06001 Raintaina RWP Filter Cover Bronze Aggregate



Increasing the Storage Capacity of a Permeable Pavement

PVOD00001 Permavoid Unit; 710mm X 355mm X 150mm

Where it is difficult to achieve the required attenuation volume within the voided sub-base aggregate alone, the addition of Permavoid® within the sub-base construction will enhance the storage capacity of the permeable pavement.

Permavoid® is a pre-formed, geo-cellular sub-base replacement system. As a component within the SEL Source PP range it can be utilised to increase the storage capacity of sub-base layers in both attenuation and infiltration systems, without increasing construction depths.

The use of Permavoid® is especially beneficial in developments with poor underlying ground conditions, such as high water tables, contamination or shallow rock layers and where there are shallow outfall connections (e.g. to adjacent water courses).

When combined with Controflow® Flow Control Chambers Permavoid® can be used to manage storage requirements from individual housing plots, or combined 'local' areas of permeable paving.

The 715kN/m² structural load bearing capacity of the Permavoid® units has been tested in accordance with the following European Standard: BS 7533-13:2009. The system's structural design life expectancy, based upon creep test data (tested according to CIRIA guidelines) is as follows; for lightly loaded areas such as car parks a design life of 50 years is achievable. For areas with prolonged HGV loading a typical design life may only be 25 years, depending on the design of the pavement surfacing and structural layers over the tank.





1m² of permeable paving with 300mm depth of voided sub-base (min. 30% void) could store 90 litres of surface water.



1m² of permeable paving with a 150mm layer of Permavoid and 150mm depth of voided sub-base (min. 30% void) could store 187 litres of surface water without increasing the depth.

PVOD00001 Permavoid Unit; 710mm X 355mm X 150mm

Recommended Minimum Cover Depths

- 130mm cover for Cars Only e.g. parking bays and drives
- 260mm cover for Cars, Vans and Occasional HGV e.g. access roads
- 400mm cover for Cars, Vans and HGV e.g. service and small estate roads

The above recommended cover depths are based on a CBR >5%. Please contact SEL for further advice if required.





How to Achieve Storage Within a Permeable Pavement on a Sloping Site

If a permeable pavement is required on a sloping site and is being utilised for infiltration, then it must be designed to prevent water from infiltrating solely at the lowest point.

If the permeable pavement is being utilised for attenuation then the slope will reduce the available storage in the voided sub-base.

The SEL Checkdam system can provide a solution for both situations.

SEL recommend the creation of terraced areas separated using the SEL Checkdam system.

Developed from our existing range of components to suit podium deck drainage, the SEL Checkdam arrangement comprises the PVOD Flow Control Unit with Permavoid®. These are combined together to construct effective checkdams within permeable pavements on sloping sites.

HD Suds membrane is installed below and to the vertical face of the checkdam leaving a flexible apron which is then heat sealed to the main attenuation liner to form a water tight seal.

PVOD Checkdam Flow Control Chamber 2 40 4 WASP01001 Weld Grade HD Suds membrane WASP02001 WASP02001 Suds HD geotextile Pvod checkdam flow control chamber Suds HD geotextile and collection conduit (minimum 260mm cover for cars, vans and occasional HGV) 710mm wide x 300mm high 0000000 00 0000 \bigcirc 00000 ~~0 \bigcirc -00C 0 \bigcirc 000 Ó 000 000 \bigcirc 00 0 00 0 0 \cap \bigcirc \bigcirc

PVOD05101 Diffuser Unit ———— 710mm x 710mm x 150mm; 110mm Ø socket Section Through Checkdam Flow Control



The Permavoid® units act as a collection conduit and are installed across the full width of the slope. These allow surface water to flow towards a PVOD flow control unit.

The surface water is passed forward through an orifice and dispersed into the on-going voided subbase using a diffuser unit.

The flow rate and centre spacing of the checkdams can be modelled to suit site specific conditions.



,		
WASP01001 Weld Grade HD Suds membrane	Pvod checkdam flow control chamber and collection conduit (minimum 260mm	Pvod checkdam collection conduit (minimum 260mm cover for cars, vans
WASP02001 Suds HD geotextile	cover for cars, vans and occasional HGV)	and occasional HGV)
		Aggregate Industries Sudsagg
	,	0 0 0 0 0 0 0 Pvod checkdam
		Aggregate Industries Sudsagg
PVOD05101 Diffuser Unit 710mm x 710mm x 150mm; 110mm		

PLAN VIEW

Effective encapsulation of a Permeable Pavement for Infiltration

Standard Infiltration



WASP02001 Suds HD Geotextile is a heavy duty, non-woven, needle-punched polypropylene geotextile which is suitable for infiltration (or membrane protection in attenuated areas). When used in a standard infiltration application Suds HD Geotextile is laid to the base and sides of the voided sub-base aggregate and also used as a separation layer between the permeable surfacing bedding layer and voided sub-base.

WASP02001 Suds HD Geotextile provides the following benefits:-

- · Zero breakthrough head.
- · High permeability.
- Good resistance to elongation.
- Excellent protection to WASP01001HD Suds membrane (when used in an attenuation application).

PVOD00501 Permafilter Oil Trapping Geotextile is a non-woven, dimpled, needle-punched geotextile that has been specifically designed to provide enhanced hydrocarbon pollution treatment. In an enhanced infiltration application, Suds HD Geotextile is laid to the base and sides of the voided sub-base aggregate with Permafilter oil trapping geotextile used as a separation layer between the permeable surfacing bedding layer and voided subbase.

PVOD00501 Permafilter Oil Trapping Geotextile provides the following benefits:-

- · Enhanced hydrocarbon pollution treatment.
- Capable of retaining oil contamination ranging from daily car drip losses to catastrophic events.
- Entrapped hydrocarbons are biodegraded by naturally occurring micro-organisms, providing a self-cleansing action.

www.selsource.co.uk

Infiltration with enhanced hydrocarbon treatment



Effective encapsulation of a Permeable Pavement for Attenuation

Standard Attenuation



WASP01001 Weld Grade HD Suds membrane is suitable for lining areas beneath permeable pavements that are being utilised for attenuation. HD Suds Membrane is protected with a layer of Suds HD Geotextile, which is also used as a separation layer between the permeable surfacing bedding layer and voided sub-base.

WASP01001 Weld Grade HD Suds membrane provides the following benefits:

- High resistance to puncture.
- · Fully weldable.
- Good elongation characteristics.
- Range of watertight pipe outlets available.

PVOD00501 Permafilter Oil Trapping Geotextile is a non-woven, dimpled, needle-punched geotextile that has been specifically designed to provide enhanced hydrocarbon pollution treatment. In an enhanced attenuation application, Suds HD Geotextile is laid to the base and sides of the voided sub-base aggregate with Permafilter oil trapping geotextile used as a separation layer between the permeable surfacing bedding layer and voided subbase.

PVOD00501 Permafilter Oil Trapping Geotextile provides the following benefits:-

· Enhanced hydrocarbon pollution treatment.

Attenuation with enhanced hydrocarbon treatment

- Capable of retaining oil contamination ranging from daily car drip losses to catastrophic events.
- Entrapped hydrocarbons are biodegraded by naturally occurring micro-organisms, providing a self-cleansing action.



Raintaina Filter Chamber



RTNA05001 Raintaina RWP Base Unit & RTNA06001 Raintaina RWP Filter Cover Bronze Aggregate

Permafilter Geotextile



Product Code: PVOD00501 Permafilter Oil Trapping Geotextile; 2.4m x 50m Roll

Benefits of SEL Source PP

- It's simple.
- Satisfies the planning requirement for SuDs, source control and treatment.
- · Optimises the storage within voided sub-base.
- Enables use of permeable paving on brownfield sites or sites that are unable to infiltrate.
- Allows connection from roof.
- · Allows use of permeable paving on sloping sites.
- Provides a uniform and flat laying surface for simple, clean, quality assured and cost effective impermeable membrane installation.
- Simplifies and speeds up construction.
- Eliminates 'underdrain' pipework.
- Can be installed towards end of construction which can eliminate contamination during building works, avoiding the need for expensive protection measures e.g. sacrificial asphalt layers.
- · Reduces volume of imported stone.
- · Reduces volume of excavation and muck off site.
- Allows use of small diameter pipe at shallower depths.
- Cost-effective shallow, low flow, flow controls.
- Often eliminates pumping.
- Reduces excavation depths for drainage system.
- Can be used with permeable surfaces and impermeable surfaces.

SEL at Your Service



- SEL can help with your permeable paving design.
- Free design review service.
- · Check catchment areas and levels.
- Calculate attenuation volumes.
- · Optimise depths of voided sub-base required.
- Model the flow control requirements.
- Size the orifice diameters.
- Provide CAD details for incorporation into drawings.
- Undertake CAD layouts.
- Provide 3rd party detailed designs.

This brochure summaries the core products within the SEL Source PP range and will satisfy most schemes. There are other ancillary components and flow control chambers available and in extreme circumstances special one-off solutions would be developed. Please contact SEL to discuss your requirements.

Effective Permeable Pavements

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Technical Services

To support architects, engineers and contractors in designing and installing SEL Source PP systems, our design services department offers computer aided scheme details and advice on installation.

SEL reserves the right to change or modify the design of products and specifications as their policy is one of continued research and improvement.

The information contained in this publication is believed to be correct at the date of publication, but it should be understood that between publications there may be changes in pertinent standards or regulations affecting the accuracy of the information contained therein.

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Other Services

Virtual Curtain Gas Migration Barrier Commercial SuDS Attenuation Tanks Gas Protection SELSports Rooftop Sports MUGA & Sports Pitches Cloud Water Control Modular Paving

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SuDS for Housing Technical