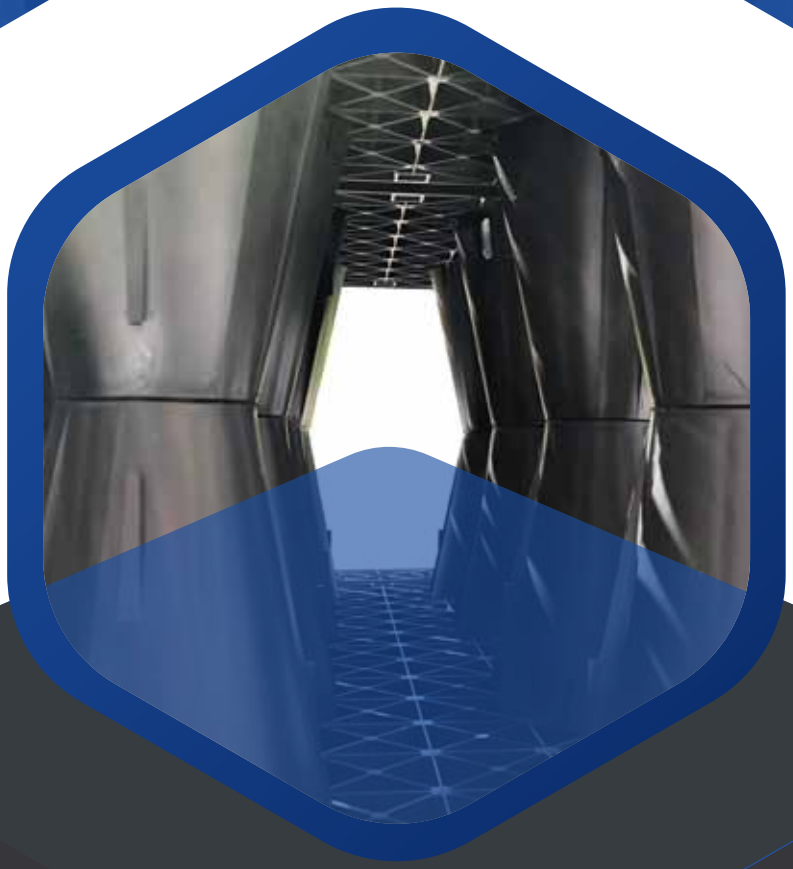
StormMaster
ANTI FLOOD SYSTEM

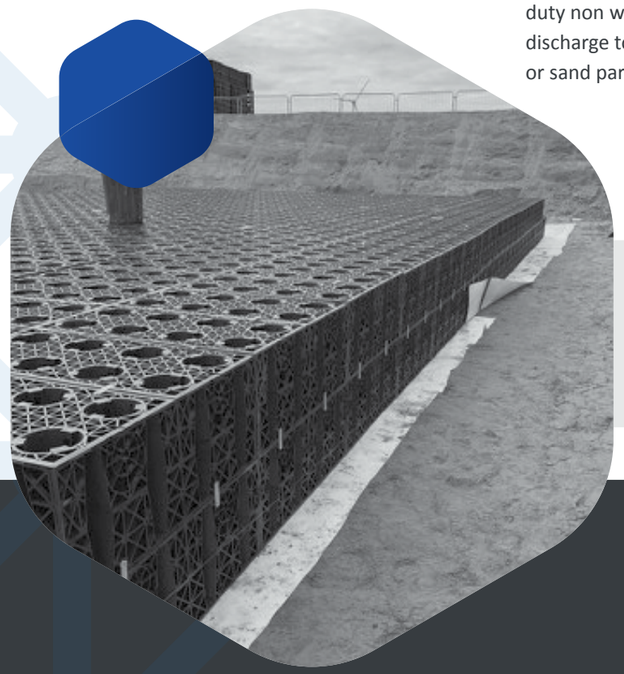


ATTENUATION & INFILTRATION
SOLUTIONS

Attenuation & Infiltration Solutions

Balstreet was founded to offer the **StormMaster** range of specialised infiltration and attenuation crates for surface water management.

We have developed our range over many years and the relationships we have with our manufacturing partners enable us to constantly develop new systems within our core area of expertise which are tested and researched through local universities and international testing laboratories.



Specification without complication

The **StormMaster System** is an extremely strong modular water-permeable polypropylene unit with a large storage capacity of 95.8%.

The StormMaster System has been designed specifically to meet the needs of sustainable construction as advocated by the UK Government and provides the means for rainwater, collected from roofs and pavements, to be infiltrated into the soil. The sewage system is relieved of additional loads and drying out of the sub-surface can be prevented.

These underground storage units are wrapped in a heavy duty non woven, needle punched geotextile to allow water discharge to the subsurface, but prevent any soil or sand particles to go through.

Our solutions reduce overall project costs and offer high environmental benefit with low environmental impact.

Using 100% recycled and recyclable materials.

The Principles of SUDs (Sustainable Urban Drainage)

SUDS or **S**ustainable **U**rban **D**rainage **S**ystems are a sequence of water management practices and/or facilities designed to drain surface water in a manner that will duplicate the natural water cycle and can be physical structures built to receive surface water runoff. They are located as close as possible to where the rainwater falls and provide the options of infiltration and attenuation. Additionally, they treat surface water using the natural processes of sedimentation, filtration, absorption and biological degradation.

Recent research shows that typically up to 80% of sediment, 60% of phosphorous and 80% of nitrogen can be removed from stormwater through infiltration, together with substantial levels of heavy metals and hydrocarbons. This natural treatment provides the ideal opportunity for rainwater conservation and re-use (harvesting) for a variety of non-potable applications e.g. toilet/urinal flushing, irrigation, laundry, process water, vehicle washing, refrigeration, coolant use, etc. It also creates a cleaner output to the sewer or recharging of the groundwater where rainwater harvesting isn't used.

Such source control principles and techniques, also called Best Management Practices (BMPs) are part of planning controls in most areas and are becoming increasingly incorporated within new development projects.

Guidance

- Flood Risk Regulations - in connection with the European Floods Directive.
- Permitted Development Rights.
- Building Regulations (Part H) - Sustainable drainage is the preferred option for dealing with rainwater from a development.
- Surface Water Management Plan (SWMP) - Gives guidance to Local Authorities.
- National Standards for Sustainable Drainage Systems - EA, LA's & House Builders working together.
- Guidance for Pollution Prevention (GPPs) - Replaces the old Pollution Prevention Guideline No.3 - Controlling pollution at its source.
- Local Agenda 21 - furthering the Agenda 21 Process, agreed at the United Nations Conference on Environment and Development (the Rio Earth Summit) held in 1992.

Legislation

- Flood & Water Management Act - Received Royal assent in April 2010.
- NPPF (National Planning Policy Framework) - Revised July 2021 (replaces various Planning Policy Statements such as PPS 25)
- CIRIA C753F - The SUDs Manual - Best Practice Guidance.
- CIRIA C698 - Site handbook for the construction of SUDS.
- Flood and Water Management Act – Management of flood risk by DEFRA.
- Water Framework Directive - Required all signatories to achieve "good status" for all rivers & waterways by 2027.

The four basic principles of SUDs

1. Don't hard pave surfaces unnecessarily - Porous Paving
2. Soakaway where possible or attenuate if necessary - Stormwater Management
3. Re- use if possible - Rainwater Harvesting
4. Improve Water Quality

BREEAM Points

SUDs techniques are a significant contributor to BREEAM points on a development

Product Overview

The **StormMaster** system is an extremely strong 100% recycled plastic water permeable crate with a 95.8% void ratio, allowing rainwater run off to be temporarily stored and then released gradually, either into the soil acting as a soakaway or attenuated for transfer to the sewer system after a rainfall event. The box has a high pressure strength so is suitable for most applications and is easy to expand in all directions to create any size of structure.

The Principle

For soakaways, these underground storage units are wrapped in a non woven, needle punched geotextile to allow water discharge to the sub-surface to re-charge groundwater. For attenuation systems, a sealed geomembrane is wrapped around the tank to create a watertight seal and a protection fleece is then wrapped around to protect the geomem-brane. The StormMaster has a high bearing capacity and can easily be expanded in all directions.

The construction of the storage void is achieved by the use of the StormMaster, a geocellular high-quality synthetic rectangular box with dimensions 1.0m x 1.0m x 0.4m (L x W x H) with a storage capacity of 383 litres (95.8% void ratio). The standard loading capacity of 400 kN/m2 is sufficient for most situations, whether pedestrian or trafficked.

N.B. For HGV applications please contact our tech services.

Design

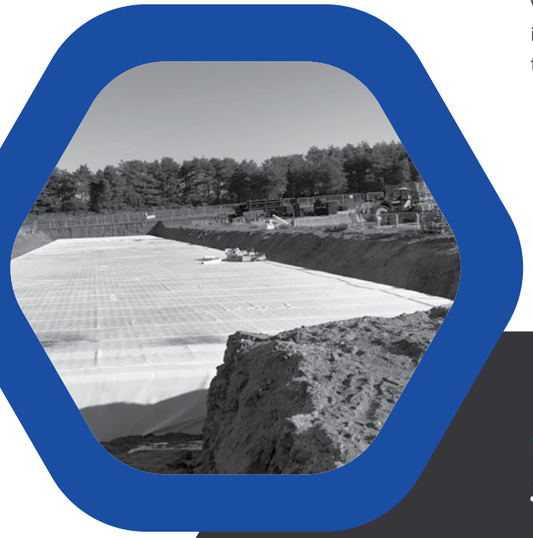
Following detailed assessment of the required volume of stormwater to be stored (see CIRIA C680/737 & BRE 365 for soakaway assessment).

The total number of StormMaster units can be calculated using 2.5/m3 (1,000 litres). Decide on the best configuration for the characteristics of the site in question and create the “box” accordingly using the length and width dimensions.

StormMaster is suitable for landscaped and car park areas as well as heavier duty use. As a guide units require approx 0.5m of cover in landscaped areas and 0.75m cover in vehicular areas with a 75mm sharp sand base.

Application

StormMaster is ideal for the bulk storage of stormwater in both attenuation and infiltration schemes. Buried with 0.5m of cover for non vehicular or 0.75m for vehicular use, standard connection (110 & 160mm) are built in & any diameter can be accommodated. Ideal in amenity areas and even under car parks and roadways, the StormMaster is able to take traffic loading.



*the advantages of the **StormMaster:***

- **Large format - just 2.5 units/m³**
- **Lightweight - 17kg per unit**
- **Choice of diameters for incoming/outgoing connections**
- **Good Bearing Capacity, sufficient for pedestrian & traffic use**
- **Large Storage Capacity (383 litres) with 95.8% voids**
- **Economic and fast to install**
- **Applicable for both high and low groundwater situations**

Crate Loading:

The vertical loading on a crate structure is a combination of both the weight of the backfill and the imposed loads due to traffic (live) and structures (dead loads).

Lateral loads are a factor of the pressure exerted by the depth of installation and the strength of the surrounding soil.

Product Features

Access, Maintenance & Inspection

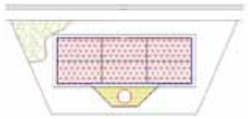
The standard StormMaster crate has two removable cut-outs for inspection/maintenance on each side. Remove the cut-outs on the lateral walls to suit the chosen routes and access to the inspection route is achieved from the upstream silt trap or downstream inspection chamber / manhole.

Two inspection routes in each direction in every crate.

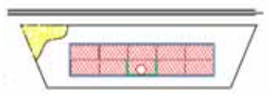
Silt Control

It is good practice to install a silt trap immediately upstream of any crate structure. Alternatively a 225/300mm perforated pipe is installed below the crate structure within the geomembrane seal. N.B. CIRIA does not recommend a perforated pipe within the crate structure itself due to differential settlement. Another alternative is to create a silt channel between the inlet & outlet by a simple “U” shaped geotextile layer to retain silts

Silt Trap/ Catch-pit



Perforated Pipe below structure



Geotextile silt route through structure.

Making Connections

StormMaster crates have two removable cut-outs on each side to allow connections to 110/160mm OD pipework as standard. These can be positioned at both the top or the base of the unit by simply turning the crate upside down. For larger connections a specially made adaptor plate can be used or a manifold system can be utilised.

Vents

Sealed attenuation systems need a 110mm dia vent per 7,500m² of drained area. This is done by flipping the crate to establish a side connection at the top of the crate, or by connecting to the top of the crate by removing the yellow closer & using a flange connector.

110/160 OD knock-out connections at base or top of crates

Top vent facility by removing a yellow closer to suit.

Large Structures

When dealing with large structures there is no necessity to have side plates right across the structure, we can therefore supply a side-less crate for this purpose, with the full crates forming an outer ring around the structure.

Begin with a row of full crates, install the next row as half height open crates (1m x 0.5m), use the yellow clips to clip the bases together. The bases are then flipped to provide tops and are clipped in place at 90 degrees to the bases with 4 yellow connectors (or 2 yellow & 2 red for multi-layer systems). The structure is finished with full crates around all sides.

Open crates for large structures

Clipped together before tops are clicked into place.

Guidance from CIRIA C680 on Minimum Cover (table 4.7)

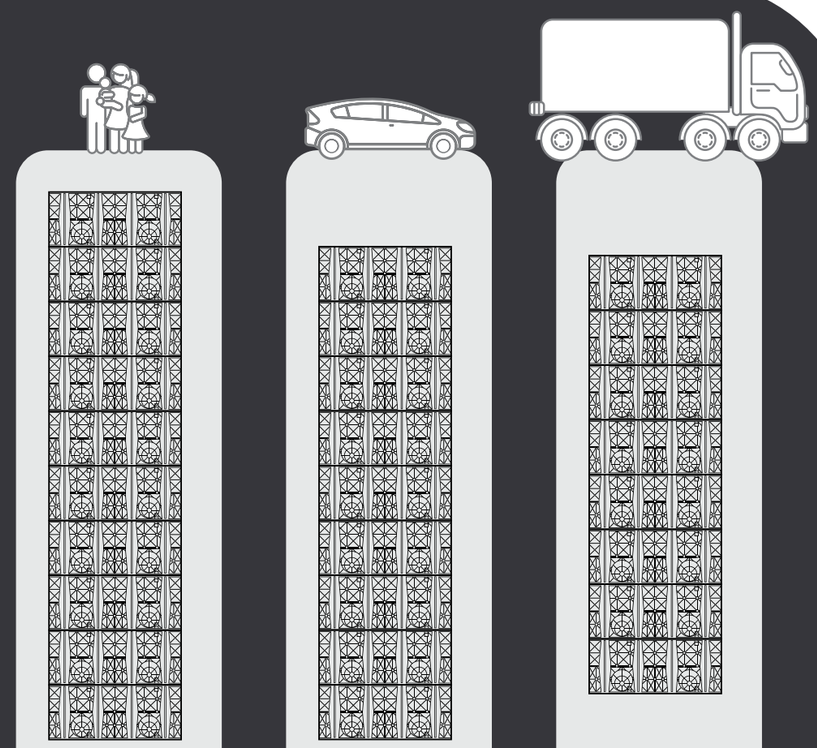
Type of Use	Loading	Cover
Landscape	Pedestrian	0.3m - 0.5m
Car Park	**> 3T GVW**	**0.6m**
Car Park	**> 9T GVW**	**0.75m**
HGV	**> 44T GVW**	**1.2m**

*** CIRIA recommend an assessment of the risk of damage due to gardening operations etc.**

Guidance on Maximum Depth

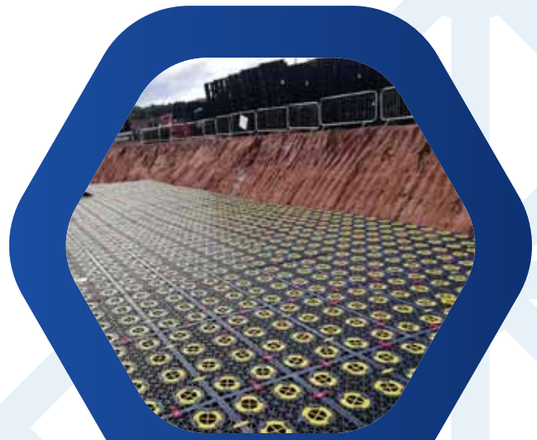
Maximum Depth of Installation to base with varying soils (no groundwater within 1m of base)

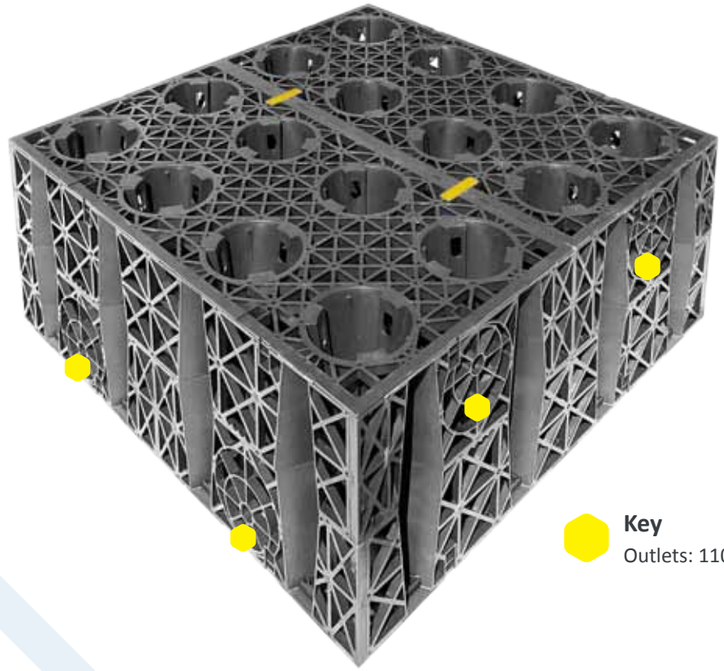
Soil Type	Shear Angle	Pedestrian	Car Parks	Heavy Use
Stiff over consolidated clay	**24°**	**2.8m**	**2.8m**	**2.5m**
Silty sandy clay, consolidated	**26°**	**3.0m**	**3.0m**	**2.8m**
Loose sand & gravel	**30°**	**3.9m**	**3.9m**	**3.3m**
Medium dense sand/gravel	**34°**	**4.2m**	**4.2m**	**3.9m**
Dense sand & gravel	**38°**	**4.5m**	**4.5m**	**4.5m**



Landscape

Not every scheme requires the extreme load bearing capabilities of our standard Heavy Duty crate. For these situations we have developed the Landscape crate - a lighter weight crate with all the features of the standard crate.





Key
Outlets: 110 / 160mm

Landscape 20T Crate

Our 100% recycled Landscape crate is designed for use in landscaped and pedestrian areas, or indeed any non-loaded situations. It has a bearing load of 20t/m².

Yellow Clips Unit to unit connections.

Red Clips For layer to layer connections, allow 2 per crate to replace the yellow clips.

Yellow Closers For the top finishing layer, clip 16 per crate into place to finish structure.

a lighter weight crate with all the features of the standard crate.

Features:

Product Code	**SM04-12**
Plan Dimensions	**1m x 1m**
Colour	**Grey**
Height	**0.4m**
Weight	**16.8kg**
Volume	**383 ltrs**
Void Ratio	**95.80%**
Vertical Strength	**200kN/m²**
Lateral Strength	**80kN/m²**
Short Term Defl. (Vert)	**35kN/m² per mm**
Short Term Defl. (Lat)	**5kN/m² per mm**
Creep (Vertical)	**0.279 Ln + 0.485**
Creep (Lateral)	**1.019 Ln + 3.86**
Max Burial Depth*	**2.4m**
Suitability	**Landscape/Garden**

* Depends on angle of shear

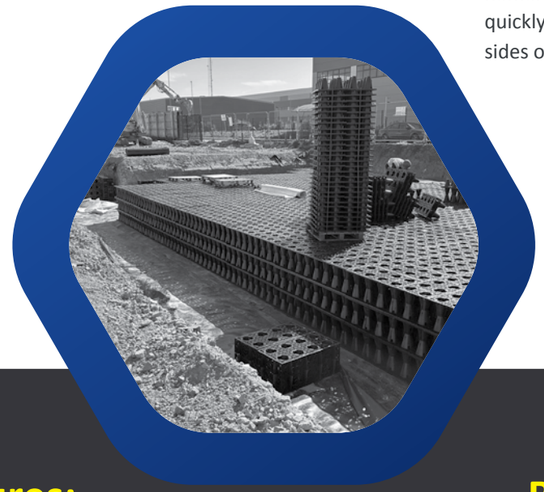
Benefits:

- **Prevents extreme peak flows to main drainage and water purification systems**
- **Rainwater is “cleaned” by geotextile surround**
- **Decreases flooding during heavy rain falls**
- **Promotes the balance in the groundwater position**
- **Decreases environmental problems caused by development**
- **Flexible - can easily be expanded in all directions**
- **Enables rapid construction of large storage capacities (95.8% void ratio)**
- **Economic to install (we offer a full commercial installation service)**
- **Choice of many diameters for incoming pipes**
- **Applicable for both high and low groundwater situations**

General Duty

Our General Duty crate is suitable for most situations subject to vehicular use from car parks right up to major roads. With only 2.5 crates to a m^3 it is fast to install and the use of the unique inners and outers allow the water to flow in three dimensions without restriction whilst still maintaining the strength of the closed system. The open structure allows multiple routes for maintenance and inspection.

On larger tanks the StormMaster General Duty 40T will be supplied as inner and outer crates - these inner crates allow the water to flow freely throughout the structure and allow silt & inspection routes (if required) to be created through the structure for inspection & jetting. The outer crates are installed on two sides of the structure before infilling with the open crates with cones facing upwards, the open crates can then be turned through 90 degrees and simply clipped onto the male/female sockets created before the yellow clips between the units are tapped home. This enables large structures to be created very quickly and does away with the need for side plates as all sides of the structure are created using the closed crates.



Key
Outlets: 110 / 160mm

General Duty
Inner Open Crate

Features:

	Outer Closed Crate	Inner Open Crate
Product Code	**SM04-10**	**SM04-11**
Plan Dimensions	**1m x 1m**	**1m x 0.5**
Colour	**Black**	**Black**
Height	**0.4m**	**0.22m**
Weight	**16.8kg**	**6.8kg**
Volume	**383 ltrs**	**n/a**
Void Ratio	**95.80%**	**96.50%**
Vertical Strength	**400kN/m²**	**400kN/m²**
Lateral Strength	**90kN/m²**	**90kN/m²**
Short Term Defl. (Vert)	**45kN/m² per mm**	**45kN/m² per mm**
Short Term Defl. (Lat)	**7kN/m² per mm**	**7kN/m² per mm**
Creep (Vertical)	**0.279 Ln + 0.485**	**0.279 Ln + 0.485**
Creep (Lateral)	**1.019 Ln + 3.86**	**1.019 Ln + 3.86**
Max Burial Depth*	**4.5m**	**4.5m**
Suitability	**General**	**General**

* Depends on angle of shear

Benefits:

- **Prevents extreme peak flows to main drainage and water purification systems**
- **Rainwater is “cleaned” by geotextile surround**
- **Decreases flooding during heavy rain falls**
- **Promotes the balance in the groundwater position**
- **Decreases environmental problems caused by development**
- **Flexible - can easily be expanded in all directions**
- **Enables rapid construction of large storage capacities (95.8% void ratio)**
- **Economic to install (we offer a full commercial installation service)**
- **Choice of many diameters for incoming pipes**
- **Applicable for both high and low groundwater situations**

Yellow Clips Unit to unit connections.

Red Clips For layer to layer connections, allow 2 per crate to replace the yellow clips.

Yellow Closers For the top finishing layer, clip 16 per crate into place to finish structure.

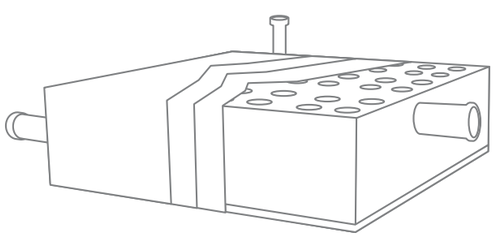
General Duty
Outer Closed 40T Crate

Our 100% recycled General Duty crate is ideally suited for vehicular loads such as housing, commercial & infrastructure projects. It has a bearing load of 40t/m².

Stormwater Management

The management of Stormwater has become increasingly important in recent years, with climate change creating unexpected rainfall events resulting in localised flooding. Stormwater is the runoff from rooftops and roadways and other “sealed” surfaces and by its very nature it washes the area over which it travels picking up pollutants such as debris and hydrocarbons on its way. These pollutants have to be dealt with but also the volume of water has to be managed.

This management can take many forms; either by infiltration into the ground using soakaways or by attenuation (the temporary storage of the water until the storm has passed). Both these methods reduce the impact of storms on the UK’s beleaguered sewer system and help reduce flood risk dramatically adding to the sustainability of building schemes.

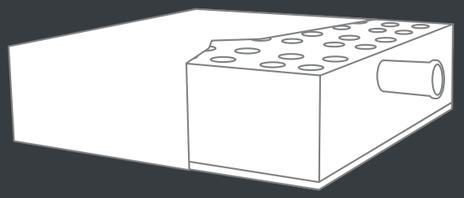


Attenuation Systems

Attenuation means to temporarily store stormwater for a period of time, normally until the worst of the storm has passed, the water is then released to the sewer network.

This process uses a “sealed” storage box (attenuation tank) created from our the StormMaster system with both a geotextile and geomembrane surround as part of a SUDs scheme.

The stormwater is collected by normal road gullies and routed to the sewer in the usual way, but is passed through a “control manhole” that only allows a controlled volume of flow through to the mains. The water then backs up in the manhole and is fed into the temporary attenuation storage system and over a period of time this stored water continues to exit the system through the control manhole at a regular rate thus preventing flooding downstream. These systems tend to be commercial rather than private schemes and are a common method of a SUDs scheme.



Infiltration Systems (Soakaways)

Where the surrounding ground is insufficiently permeable to allow the volume of water to infiltrate away naturally, the insertion of a soakaway structure as part of a SUDs scheme (StormMaster with a permeable geotextile surround) will help this process dramatically by providing an underground void for temporary storage of the stormwater whilst it infiltrates into the surrounding soil.

Installation

Features & components of StormMaster

StormMaster comes as two strengths of crate: 400kN/m² (40T) & 200kN/m² (20T) dependant on anticipated use. The units can also be supplied fully assembled, or for larger projects as both assembled & open.

A full crate ready assembled with sides, knockouts etc. This is supplied for smaller projects to enable simple installation. For larger projects, this crate forms the outer ring of any structure enabling both inspection/maintenance routes to be created and incoming / outgoing connections to be made.

An inner crate is also supplied for larger projects that is supplied without sides to allow unfettered access to water entering the system which forms the inner volume within the full crate perimeter.

Systems are supplied with unit to unit yellow connectors (4 per unit) and layer to layer red connectors (2 per unit) that also act as unit to unit connectors where required.

A yellow closer unit is supplied to cap the top layer of crates prior to covering with geotextile and/or geomembrane to create a flat top surface (16 per unit) for the top layer only.

StormMaster units are designed to include three purpose designed inspection & maintenance routes within every unit running in both directions. Because of these routes can be created running the width or length of the structure at virtually any position this aids versatility in design.

Design procedure

1. Decide system application: Determine whether its porous paving & whether its attenuation of infiltration.
2. Decide on the location and quantity of storage systems: Locate the best site position to minimise excavation and pipe runs (normally at low point in site).
3. Decide the surfacing above the storage structure: Parking or leisure area etc. (this will decide the loading on the units).
4. Calculate required capacity: This is based on storm intensity, duration, porosity of soil, EA restrictions etc.
5. Calculate quantity of StormMaster units: (2.5 per m³)
6. Based on the layer depth of StormMaster of 400mm calculate the dimensions of the tank to suit local site conditions.
7. Decide on silt trap positions and inflow locations: Water entering any storage device is best passed through a silt trap prior to storage. For infiltration systems this can be the geotextile barrier.
8. Decide on outflow locations (if required-attenuation systems): This would normally be at the base of the unit for attenuation systems and should be of a size required to suit the outflow requirements.
9. Select StormMaster liner: If a permeable infiltration system is required choose a single layer a suitable non-woven needle punched geotextile. If an attenuated system is required a Geomembrane would envelope the units with a protective fleece around it.
10. Decide position of maintenance access: Although systems of this type require virtually no maintenance, it is advisable to provide for visual inspection to all types of system.
11. For attenuated systems decide on position of vent: This can be a simple 100mm dia pipe per 7,500m² of drained area.

Pre-installation notes

For **attenuation** systems: Position the inflow and outflow connections level with the base of the StormMaster structure

For **infiltration** systems: Position the inflow connection at the top of the StormMaster structure.

Installation Instructions

1. Excavate to the required length, width and depth and level the base. Ensure area is enough to allow plant access around sides to compact the backfill material (500mm minimum). Ensure base is smooth and level with no sharp protrusions. Cut back slopes to a safe angle or adequately support and allow safe access for site personnel.

2. Inspect the base for soft spots and if any are present, excavate and replace with compacted granular fill material.

3. Lay 75mm sharp sand bedding layer to the base of the excavation and level off. Lay the geotextile protection fleece (non woven, needle punched), ensuring a minimum 150mm overlap. This is required for both attenuation and infiltration structures.

4. Lay the geomembrane (if attenuation) over the geotextile and sand bedding layer and up the sides of the excavation. Examine the geomembrane for damage and test all welds if apparent.

5. Install the StormMaster units (1.0m x1.0m x 0.4m) within the void in accordance with the installation instructions supplied. Arrange the units so that the outlet positions are in correct alignment with the inlet and outlet pipes. In multi layer installations use the shear connectors provided to secure the units against accidental displacement around the edges of the structure.

6. Complete the geotextile and/or geomembrane encapsulation to the sides and top of the installation, ensuring 150mm minimum overlap for the protection fleece. Geomembrane should be welded with double seams and inspected for damage, testing the welds as required.

7. Make drainage connections using proprietary adaptors. Ensure that the pre-formed socket positions are located correctly to receive the pipe-work. Alternatively for infiltration systems use flange adaptors and attach them to the StormMaster units with self tapping screws.
For attenuated systems, it is recommended that all connections and air vent installations are installed using sealed drainage connections into a preformed socket with proprietary seals.

8. Backfill the installation sides with Type 1 or 2 sub base, compacting in 150mm layers, in accordance with Specification for Highway Works.

9. Place a 75mm sharp sand protection layer if required over the top of units and continue to backfill over units as follows:

For trafficked areas (car parks etc):
Type 1 or 2 sub base material compacted in 150mm layers in accordance with the Specification for Highway Works. Compaction equipment on top of the system not to exceed 2,300kg per metre width.

For landscaped and non-trafficked areas:
Selected “as dug” material with a unit size no more than 75mm compacted to 90% maximum dry density. Compaction equipment on top of the system not to exceed 2,300kg per metre width.

For a professional installation:

We have partnered with various highly experienced installers and as such we normally able to offer a supply and install service with gas sealed joints and a guaranteed installation. Please ask for details.

Specification Clause

To assist in the specification of the StormMaster stormwater retention system we would suggest the following clause: The Stormwater retention system shall be StormMaster as supplied by Balstreet Ltd., Units shall be manufactured from 100% recycled plastic and be 400mm deep and have a plan area of 1.0mm x 1.0m with a void ratio not less than 95.8%. Standard units shall have a vertical loading capability of not less than 400kN/m^2 and a lateral loading capability of not less than 90kN/m^2.

Sectors

Supermarkets

Parking

Housing Development

Warehousing / Logistics

Airports / Travel Infrastructure

Civil Engineer/Architect

As a Civil Engineer or Architect you are focused on the performance of the products you recommend, as well as their aesthetics. You need to ensure you specify the most effective scheme for your project.

If you are currently working on a scheme which uses SUDs solutions, StormMaster is here to help:

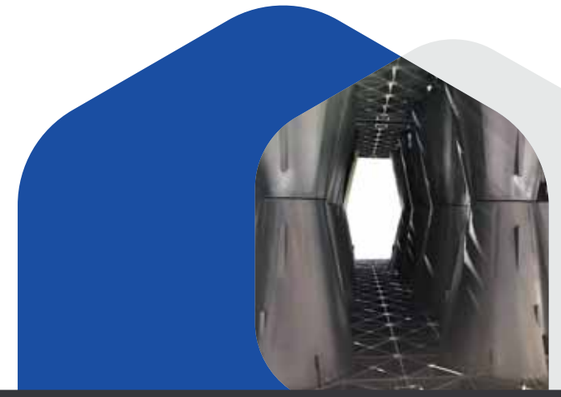
- Continuous Professional Development (CPDs)
- **BREEAM Points** - Don't forget that using our products in your designs will provide you with additional BREEAM points

House Builder

As a House Builder considering a SUDs solution you are focused on cost, ease of installation, product availability and compliance with the specification.

Contractor

As a contractor considering a SUDs solution you are focused on cost, professional installation, product availability and compliance with the specification. We provide a full installation service for our StormMaster system using approved partners.



Contact Us

Our sales team can support you with:

- **Design Assistance** - If you have not used a SUDs solution before, you may need advice on which product is suitable for your customer's specific project and how to include it in your design. Just contact us for assistance.
- **Site Visit** - StormMaster can send a representative to your customers site to advise on the suitability of our products in their specific application. Click here to book a site visit.
- **Free Samples** - If you would like to examine any of our products up close, you can request a free sample
- We provide a full installation service for our StormMaster system using approved partners.
- **Installation Guidelines** - StormMaster products are quick and easy to install, often saving your customers time and money when compared to alternative solutions. We have **downloadable pdf installation guides** available online for all our products, as well as short video demonstrations.

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