Pipelife Nederland BV
Flevolaan 7
1601 MA Enkhuizen
The Netherlands
Tel: 00 31 228 355 555 Fax: 00 31 228 355 666
e-mail: info@pipelife.com
website: www.pipelife.com

BBA APPROVAL INSPECTION TESTING CERTIFICATION
TECHNICAL APPROVALS FOR CONSTRUCTION

Agrément Certificate
13/4985
Product Sheet 1

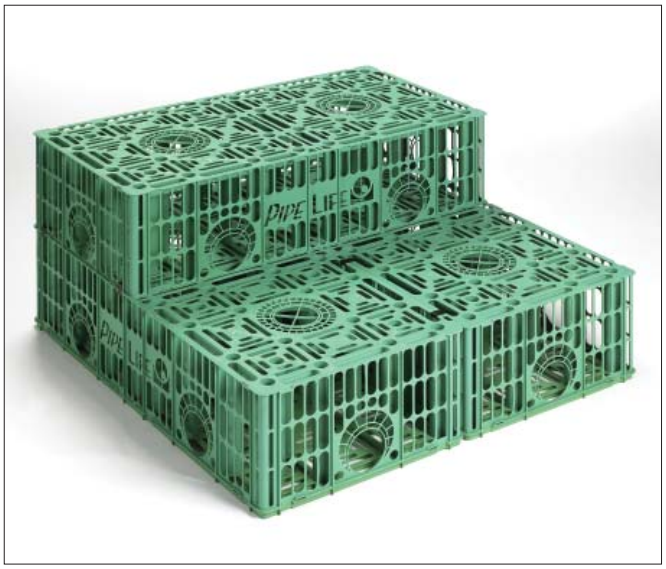
PIPELIFE STORMWATER MANAGEMENT SYSTEMS

STORMBOX STORMWATER MANAGEMENT SYSTEM

This Agrément Certificate Product Sheet(1) relates to Stormbox Stormwater Management System(2), comprising green polypropylene modular units and components for use in below-ground water storage or as a soakaway to manage run-off from impermeable surfaces.

(1) Hereinafter referred to as 'Certificate'.

(2) Pipelife Stormbox is a registered trademark of Pipelife International.



CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Hydraulic design — data is provided in this Certificate to assist in the design of a below-ground stormwater management system (see section 6).

Structural performance — the system has adequate strength and stiffness to resist long- and short-term loads when used in accordance with this Certificate (see section 7).

Maintenance — data is provided to assist planning the maintenance of a completed system installation (see section 11).

Durability — the system will have a service life in excess of 50 years when installed in accordance with this Certificate (see section 12).

The BBA has awarded this Certificate to the company named above for the system described herein. This system has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 29 April 2014

Brian Chamberlain
Head of Approvals — Engineering

Claire Curtis-Thomas
Chief Executive

The BBA is a UKAS accredited certification body — Number 113. The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk

Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.

British Board of Agrément
Bucknalls Lane
Watford
Herts WD25 9BA

tel: 01923 665300
fax: 01923 665301
e-mail: mail@bba.star.co.uk
website: www.bbacerts.co.uk

Regulations

In the opinion of the BBA, Stormbox Stormwater Management System, if installed, used and maintained in accordance with this Certificate, will meet or contribute to meeting the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):

The Building Regulations 2010 (England and Wales) (as amended)

Requirement:	H3(3)	Rainwater drainage
Comment:		The system can be used in a construction to meet this Requirement. See sections 6.1 to 6.10 of this Certificate.
Regulation:	7	Materials and workmanship
Comment:		The system components are acceptable. See section 12 and the *Installation* part of this Certificate.

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)(2)	Durability, workmanship and fitness of materials
Comment:		The system components satisfy the requirements of this Regulation. See sections 11.1 to 11.6 and 12 and the *Installation* part of this Certificate.
Regulation:	9	Building standards applicable to construction
Standard:	3.6(a)	Surface water drainage
Comment:		The units can be used in a construction to satisfy this Standard, with reference to clauses 3.6.1[(1)(2)] to 3.6.5[(1)(2)]. See sections 6.1 to 6.10 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The system can contribute to meeting the relevant Requirements of Regulation 9, Standards 1 to 6, and, therefore, will contribute to a construction meeting a bronze level of sustainability as defined in this Standard.

(1) Technical Handbook (Domestic).
(2) Technical Handbook (Non-Domestic).

The Building Regulations (Northern Ireland) 2012

Regulation:	23 (a)(i)(ii)(b),	Fitness of materials and workmanship
Comment:		The system components are acceptable. See section 12 and the *Installation* part of this Certificate.
Regulation:	82	Rainwater drainage
Comment:		The system can be used in a construction to satisfy this Regulation. See sections 6.1 to 6.10 of this Certificate.

Construction (Design and Management) Regulations 2007

Construction (Design and Management) Regulations (Northern Ireland) 2007

Information in this Certificate may assist the client, CDM co-ordinator, designer and contractors to address their obligations under these Regulations.

See sections: 3 *Delivery and site handling* (3.1, 3.3 and 3.5) and 15 *Procedure* (15.1) of this Certificate.

Additional Information

NHBC Standards 2014

In the opinion of the BBA, the use of the Stormbox Stormwater Management System, in relation to this Certificate, is not subject to the requirements of these standards.

Technical Specification

1 Description

1.1 The Stormbox Stormwater Management System consists of individual green polypropylene modular units (see Figure 1 and Table 1), a ground plate of the same material used on the base of the installation and connecting clips (two per short edge and four per long edge).

Figure 1 Typical Stormbox and ground plate

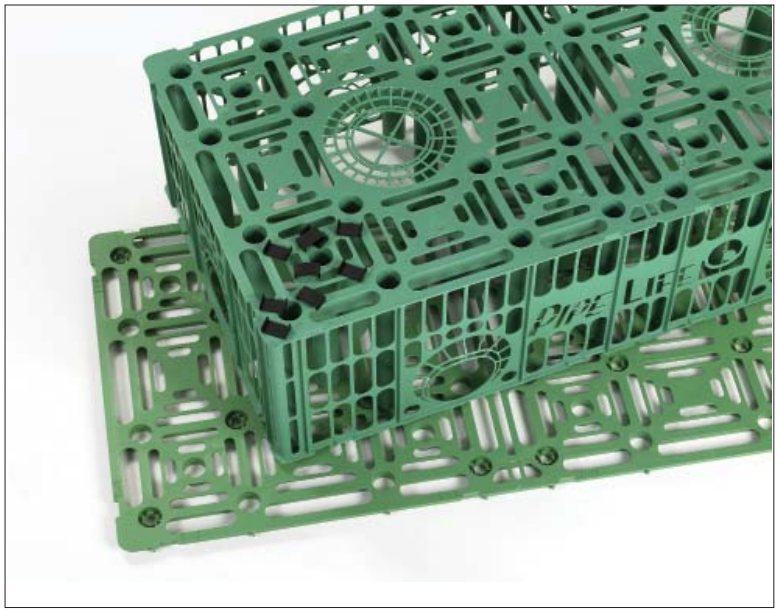


Table 1 Characteristics of modular unit

Characteristic (unit)	Value
Dimensions (nominal) (l x w x h) (mm)	1200 x 600 x 300
Dry weight of unit[1] (kg)	8.38
Volume (nominal) (m^3)	0.216
Storage volume (nominal) (m^3)	0.206
Porosity (void ratio) (%)	95.5

(1) Each ground/bottom plate weighs 1.98 kg and each clip 0.01 kg but are not included in the dry weight of the unit.

1.2 The units have pre-formed sockets to enable connection with 160 mm diameter pipework to BS EN 1401-1 : 2009. Alternatively, connection to 150 mm pipework is possible using an adaptor. Connection can also be made, at points other than the pre-formed sockets, to suitable 150 mm pipework using a flange adaptor. Adaptors and connecting pipework for use with this system are outside the scope of this Certificate.

1.3 Each assembly is wrapped in either a permeable geotextile when used for infiltration or an impermeable geomembrane when used for attenuation. Geotextiles and geomembranes for use with the system are outside the scope of this Certificate. Information on their required specification may be obtained from the Certificate holder.

2 Manufacture

2.1 The units are manufactured to one specification by conventional injection moulding green (RAL 6024) polypropylene.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

3 Delivery and site handling

3.1 The units are supplied to site on pallets (maximum 16 boxes), arranged two by two and stacked eight units high to enable placing and movement by fork-lift truck. The total volume is 3.5 m^3 and the weight, excluding pallet is 136 kg. Each pack carries a label bearing the product name, order number and date of manufacture.

3.2 The connecting clips are supplied separately and sealed in polyethylene bags.

3.3 The packs should be carefully placed on level ground and should not be stacked on site.

3.4 The units contain an inhibitor to resist the effects of ultraviolet light. However, prolonged storage in direct sunlight should be avoided.

3.5 The units should not be stored near fuel bowsers, fuel tanks or areas where solvents may be kept.

3.6 The units are resistant to damage likely to be caused during normal handling, but should be stored in locations where impacts from vehicles and other construction plant will be avoided.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Stormbox Stormwater Management System.

Design Considerations

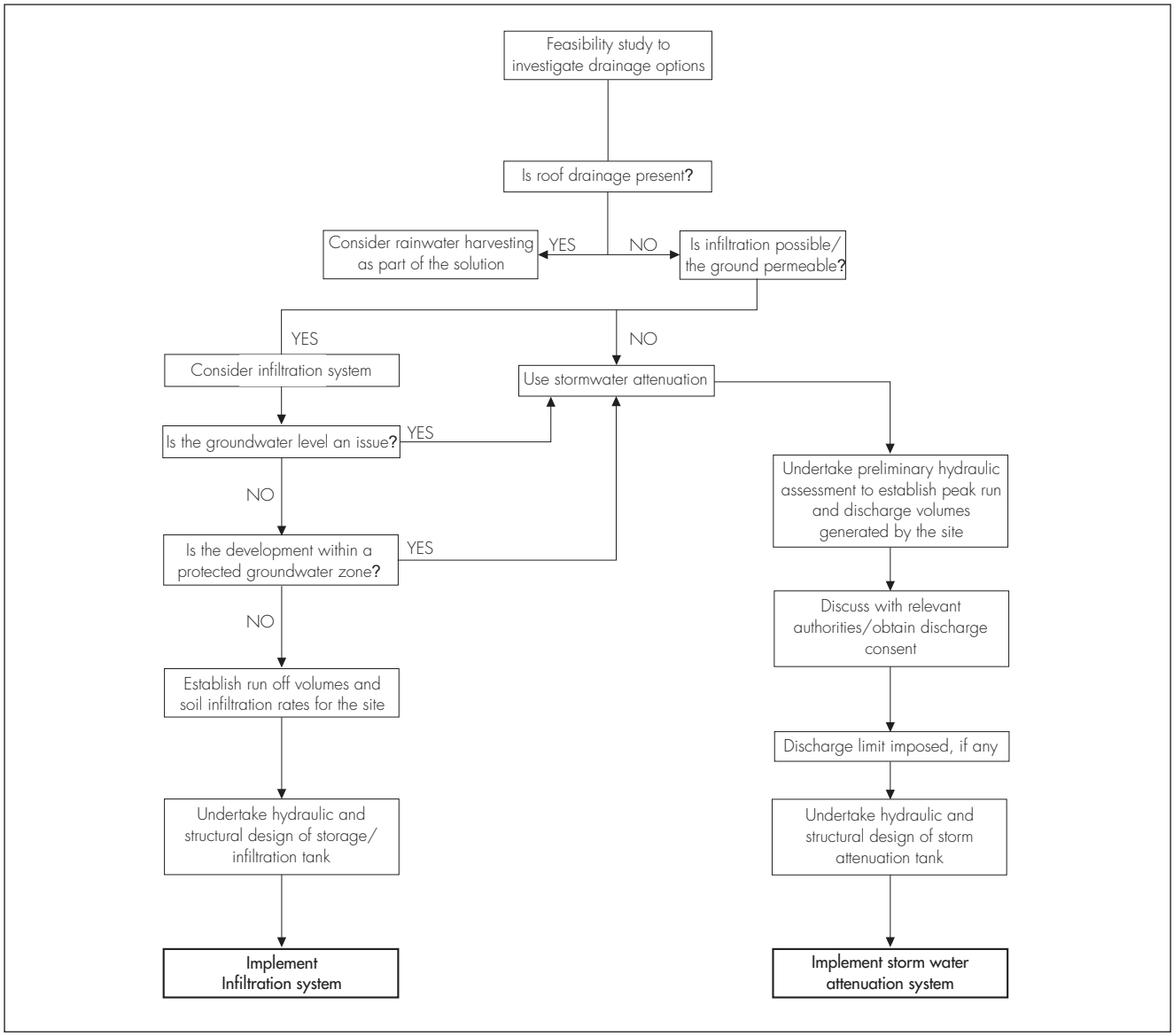
4 General

4.1 Design of the Stormbox Stormwater Management System must be in accordance with the Certificate holder's instructions. Guidance on the application of sustainable drainage systems (SUDS) for new developments can also be found in the Communities and Local Government Planning Policy Statement PPS25 and the Construction Industry Research Information Association (CIRIA) Report C697.

4.2 The system is suitable for the management of stormwater run-off from impermeable surfaces and can be utilised in two main ways (see Figure 2):

- Infiltration — stormwater is collected in the units during rainfall and allowed to drain away by soaking into the surrounding ground over a period of time after rainfall
- Attenuation — stormwater is collected in the units during rainfall and released at a reduced flow rate through a flow control device, into an appropriate outfall. This reduces peak flows in the watercourse, thereby minimising the risk of flooding, or
- Combined — a combination of intiltration and attenuation.

Figure 2 Sustainable drainage system selection and design



4.3 Design of the appropriate system for a specific project must always be preceded by a detailed audit of the proposed site to establish:

- existing factors and considerations applicable to the site
- predicted factors relating to the site's use following the planned development, and the parameters within which the installation is required to function
- the type of function of application suggested by this audit.

4.4 Once the project criteria have been established from the site audit, there are two main parts to the design procedure of individual installations: hydraulic design and structural design.

5 Practicability of installation

The system is designed to be installed by a competent general builder, or a contractor, experienced with this type of product.

6 Hydraulic design

Infiltration

Calculation principles

6.1 There are two approaches, either of which may be adopted: the Construction Industry Research and Information Association (CIRIA) Report 156 or BRE Digest 365. Further information on the design of SUDS may be obtained from CIRIA Report C697.

6.2 A simplified approximate approach can be used on a very small site (eg a single-house development) where detailed site infiltration rate information may not be required nor available (see Table 2). From Approved Document H of the England and Wales Building Regulations, for areas up to 25 m^2, a storage volume equal to the area to be drained multiplied by 10 mm may be used. Beyond this size, design should be carried out in accordance with BS EN 752 : 2008 or BRE Digest 365. It is suggested in BS EN 752 : 2008 that a storage volume equal to 20 mm multiplied by the area to be drained may be used. In Scotland, guidance for the design of single-house soakaways, is given in Mandatory Standard 3.6, clause 3.6.5(1).

(1) Technical Handbook (Domestic).

Table 2 Simplified soakaway design for single-house development(1)

Number of units	Storage volume (m^3)	Maximum area to be drained (m^2)
1	0.10	10
1	0.20	20(2)
2	0.25	25
3	0.60	30(3)
4	0.80	40(3)
8	1.60	80(3)
16	3.20	160

(1) When doubt exists over suitability of ground infiltration, permeability figures should be derived by test (see BRE Digest 365).

(2) In accordance with Approved Document H.

(3) In accordance with BS EN 752 : 2008, clause NA 4.4.8.

6.3 When the CIRIA or BRE approach is used, the design volumes and areas for trench or cuboid type installations can be found from Tables 3 and 4.

Table 3 Data for use in hydraulic design — one unit wide trench configurations

Number of units high	Volume (m^3)	Side area (m^2)	Base area (m^2)
1	0.21	1.1	0.72
2	0.41	2.2	0.72

Table 4 Data for use in hydraulic design — three-dimensional system

No of units high (0.3 m per unit)	One unit long (1.2 m), two units wide (1.2 m) (base area 1.44 m^2)		One-and-a-half units long (1.8 m), three units wide (1.8 m) (base area 3.24 m^2)		Two units long (2.4 m), four units wide (2.4 m) (base area 5.76 m^2)	
	Volume (m^3)	Total side area (m^2)	Volume (m^3)	Total side area (m^2)	Volume (m^3)	Total side area (m^2)
1	0.41	1.44	0.94	2.16	1.65	2.88
2	0.82	2.88	1.88	4.32	3.30	5.76
4	1.65	5.76	3.76	8.64	6.60	11.52
5	2.06	7.20	4.70	10.80	8.25	14.40

6.4 For calculations, the size and volume of the units are given in Table 1. The total areas of the base and sides are required as water is absorbed through the geotextile soil interface. Storage volume is 95.5% of the total volume of the units. As an example, using Table 3, for a typical linear trench 42 m long (35 units) and four units wide, the storage volume is 0.995 x (35 x 4) x 0.21 = 29.25 m^3 and the side area is (42 x 0.3 x 2) + (4 x 0.6 x 0.3 x 2) = 26.64 m^2. Backfilling should be a minimum of 300 mm from the units and retained earth in all vertical sides.

Attenuation

Calculation principles

6.5 The anticipated total run-off volume from the site is estimated. The most commonly-used method for evaluating storm rainfall events in the UK is the Wallingford Procedure by which the total rainfall level of storms over defined time periods ranging from five minutes up to 48 hours is assessed. The allowable discharge rate from the site to an appropriate outfall is established, which will normally be set by the Environment Agency, Scottish Environmental Protection Agency or Planning Authorities. The volume to be stored underground in the system is then determined and the number of units needed to contain this volume is calculated on the basis that the storage volume is equal to 95% of the total volume of the tank.

Connection

6.6 A slotted distribution pipe running through the tank can be used to convey inlet and outlet flow. These items are outside the scope of this Certificate.

6.7 It is recommended that all connections into storage applications (using a geomembrane) are made using a top-hat adaptor. Thermal welding, adhesive or double-sided tape should be used between the geomembrane and flange adaptor to ensure a watertight seal.

Manifold design

6.8 The capacity of the input pipe is limited and may be insufficient for the anticipated flow load. Therefore, the flow load may be split between a number of pipes from the adjacent manhole.

Flow control

6.9 The outflow from the tank must be controlled to comply with the discharge rate consent of the site. There are a number of methods to achieve outflow control. Comparative features and benefits of the various control flow devices should be considered prior to selection. These devices are outside the scope of this Certificate.

Outflow positioning and head calculations

6.10 The invert level of the outflow pipe should be flush with the bottom of the lowest unit to allow the tank to drain. As the tank fills, a depth of water develops on the upstream side of the outflow control. For a tank with six layers of units, this depth is 1.80 m (nominal) when the units are full, creating a driving head to push the flow through the control device. For design purposes, the head used in calculations is taken as that at the centre line of the outflow device.

7 Structural performance

General

7.1 The structural design of each installation incorporating the system should be verified by a suitably qualified and experienced engineer.

7.2 Guidance on the design and installation of systems incorporating the units can be found in CIRIA Report C680. Consideration should be given to the effects of cumulative deflection in systems comprising several layers of units.

7.3 The system can be placed under landscaped or car park areas. For areas where greater loads are anticipated, these applications are outside the scope of this Certificate. Advice should be sought from the Certificate holder.

7.4 Care should be taken when the system is used for infiltration below trafficked areas and close to structures. It is important to ensure that the infiltrating water will not soften the soils or cause loss of fines and settlement.

7.5 The engineer responsible for the design of the installation must confirm that the ground-bearing capacity at the formation level is sufficient for the proposed operational loads. In areas of weak or compressible soils, advice should be sought from a geotechnical engineer.

7.6 When the system is wrapped in an impermeable geomembrane and placed below the groundwater table, flotation may occur. To prevent this, the weight of the soil over the top of the system must be greater than the uplift force caused by the system's buoyancy in the water. This can be achieved with most types of fill if the depth of cover fill is equal to, or greater than, the depth of penetration of the system below groundwater level.

Unit performance characteristics

7.7 Characteristic compressive strength at the yield point and elastic deflection values for the system have been determined from independent, short-term tests (see Table 5).

Table 5 Short-term performance values

Element (unit)	Value
Characteristic compressive strength at yield ($kN \cdot m^{-2}$)	
vertical loading on top face	505
lateral loading on side face	99
Short-term deflection (mm per $kN \cdot m^{-2}$) (applied load)	
vertical loading on top face	1 per 46
lateral loading on side face	1 per 9

7.8 The following equations have been established from creep tests, on a single unit, exceeding 9,000 hours and can be used to estimate the long-term vertical and lateral deflection for periods up to 60 years at 20°C (see Table 6).

Table 6 Equations for estimating long-term creep deflection

For loads up to ($kN \cdot m^{-2}$)	Equation for estimation of long-term deflection
(vertical)	Deflection = 0.5838 Ln [time (hours)] + 2.9725
(lateral)	Deflection = 0.8285 Ln [time (hours)] + 3.2898

7.9 The following partial load and material factors, as defined in CIRIA Report C680, should be used for design (Table 7).

Table 7 Partial factors for loads and materials

Description	Ultimate limit state	Serviceability limit state
Partial factors for loads		
Vertical dead-load (F_{dl})	1.40	1.00
Earth pressure (horizontal) + hydrostatic (horizontal) load (F_{ep}	1.35	1.00
Imposed live-load (F_{ll})	1.60	1.00
Partial safety factors for materials (F_m)	2.75	1.50

7.10 Example maximum installation depths and minimum depths of cover calculated as described in this section and in accordance with CIRIA Report C680 are shown in Tables 8, 9 and 10:

For small-scale applications such as soakaways for individual house roof drainage — the system is located below a garden a minimum of 5 m from the building, inaccessible to motor vehicles. Table 8 indicates the maximum depth and minimum cover.

Table 8 Design criteria for use of Pipelife Stormbox as soakaway for an individual house[1]

Criterion	Value
Maximum depth to base of system (m)	4.15
Minimum depth of cover required over system to prevent accidental damage (m)	0.40

(1) The following assumptions apply:
- soakaway constructed in sandy gravels with a soil weight not exceeding 20 $kg.m^{-3}$ and angle of shearing resistance for surrounding soil not less than 30°
- groundwater at least one metre below the base of the units
- soakaway located beneath small gardens or landscaped areas, no vehicles in accordance with table 4.2 of CIRIA C680.

For installation below landscaped and lightly-trafficked areas — the information given in Tables 9 and 10 are only applicable in temperate climate conditions such as those in the UK. Site specific calculations should be carried out for configurations and prevailing ground conditions other than those shown.

Table 9 Maximum installation depths (to base of system)

Typical soil type	Soil weight ($kN \cdot m^{-3}$)	Angle of friction (ϕ)	Maximum installation depth (from invert of structure) (m)			
			No groundwater present		Groundwater level 1.0 m below ground level (attenuation structure	
			Trafficked (cars only)[1]	Non-trafficked[2]	Trafficked (cars only)[1]	Non-trafficked[2]
Over consolidated stiff clay	20	24°	3.1	3.1	1.8	2.0
Silty sandy clay	19	26°	3.2	3.4	2.0	2.0
Loose sand and gravel	18	30°	3.1	3.3	2.0	2.0
Medium-dense sand and gravel	19	34°	3.6	3.9	2.0	2.0
Dense sand and gravel	20	38°	3.6	3.9	2.0	2.0

(1) Trafficked areas taken as driveways to individual houses and car parks with height barrier to limit vehicle size with vehicles up to 3,000 kg gross vehicle weight (GVW), in accordance with CIRIA C680, Table 4.2.

(2) Non-trafficked areas taken as small gardens or landscaped areas where drive on mowers are used, loading in accordance with CIRIA C680, Table 4.2.

Notes:

- Calculations are based on tanks comprising TWO layers of units.
- The load spread through asphaltic surfaces (for trafficked areas) is assumed to be 27°. The load spread through landscaped areas is taken as ϕ.
- Ground surface in the vicinity is horizontal.
- Shear planes or other weaknesses are not present within the structure of the soil.
- Weight of ground water taken as 10 $kN \cdot m^{-3}$.
- Accidental loading is not considered.
- Formation on which the system is installed assumed to be level and have adequate bearing capacity.
- Partial load and material factors shall be as defined in Table 7.

Table 10 Minimum cover depths over the units

Live load conditions	Landscaped area[1]	Light trafficking[2]	
		Car park with vehicle mass <3000 kg[2]	Car park with occasional vehicle mass <9000 kg[3]
Minimum cover depth required (m)	0.4	0.8	0.8

(1) Landscaped areas taken where drive on mowers are used, loading in accordance with CIRIA C680, Table 4.2.

(2) Trafficked areas taken as driveways to individual houses and car parks with height barrier to limit vehicle size with vehicles up to 3,000 kg gross vehicle weight (GVW), in accordance with CIRIA C680, Table 4.2.

(2) Trafficked areas taken as car parks with vehicles up to 9,000 kg gross vehicle weight (GVW), in accordance with CIRIA C680, Table 4.2.

Notes:

- Calculations are based on tanks comprising ONE layer of units.
- Assumed an angle of friction of the surrounding soil of 38° and a soil weight is 20 $kN \cdot m^{-3}$.
- The load spread through asphaltic surfaces (for trafficked areas) is assumed to be 27°. The load spread through landscaped areas is taken as ϕ.
- Ground surface is horizontal.
- Shear planes or other weaknesses are not present within the structure of the soil.
- Calculations based on there being no groundwater present.
- Accidental loading is not considered.
- Partial load and material factors shall be as defined in Table 7.

8 Geotextiles and geomembranes

Infiltration

8.1 The system requires a geotextile wrapping when used as an infiltration system to:

- allow the water infiltration into adjacent ground
- prevent silt that may be contained in the surface water run-off contaminating the surrounding soil, in addition to reducing its permeability
- prevent surrounding soil from entering the units.

8.2 The selection of an appropriate geotextile requires careful consideration (see section 8.6).

Attenuation

8.3 The system requires a sealed geomembrane wrapping to create an attenuation storage system, to prevent:

- the release of surface water into the surrounding ground
- inflow of groundwater that may overload downstream systems and contain pollutants on contaminated sites.

8.4 Site conditions may also require the use of an additional thick, protective geotextile fleece to prevent puncture or excessive strain in the geomembrane, on which further advice should be sought from the geomembrane manufacturer.

8.5 Selection of an appropriate geomembrane requires careful consideration (see section 8.7).

Specification of geotextile

8.6 The selection of an appropriate geotextile for a specific the Stormbox Stormwater Management System should be considered carefully, particularly with reference to the surrounding soil properties and required performance. Points to consider are:

- pore size — this should be designed and specified to assist infiltration and prevent migration of fine soil particles
- permeability and breakthrough head — the geotextile should not limit flow of water in the system, and should have a similar or greater permeability than the surrounding ground
- puncture resistance — the geotextile must be able to resist piercing by potentially sharp objects, (eg. stones in the soil)
- tensile strength — the geotextile should have sufficient strength to resist any imposed forces (eg. from traffic)
- Specialist advice should be sought if surrounding soil characteristics exhibit a high degree of fines/low infiltration capacity and/or there is risk of damage from ground contaminants.

Specification of geomembrane

8.7 The specification and selection of the impermeable geomembrane must be correct for the proposed installation, to ensure it performs to the level required. It is essential that the specified material:

- withstands the rigours of installation
- resists puncture
- resists multi-axial elongation stress and strains associated with settlement
- resists environmental stress cracking
- resists damage from ground contaminants
- remains intact for the full design life.

8.8 A geomembrane less than 1 mm thick is unlikely to meet these criteria (except in shallow, domestic installations), and is not recommended for use with the system. For further details the Certificate holder's advice should be sought

8.9 All joints must be sealed, using proprietary techniques recommended by the manufacturer. Advice on seam testing procedures is given in CIRIA SP 124 : 1996.

9 Venting

9.1 Adequate venting must be provided to the structure. One 110 mm diameter air vent is required per 7500 m^2 of impermeable catchment area to be drained. Air vent connections and pipework for use with this system are outside the scope of this Certificate.

9.2 Typical air vent connectors and pipework can be seen in the Certificate holder's *Design Manual*. It is recommended that all air vent installations in storage applications (using a geomembrane) are made using a flange adaptor. Thermal welding, adhesive or double-sided tape should be used between the geomembrane and flange adaptor to ensure a watertight seal.

10 Resistance to chemicals

10.1 An assessment by the BBA indicates that the components of the system are suitable for use in contact with the chemicals likely to be found in rainwater.

10.2 An assessment of the suitability for use of the blocks on brownfield sites (outside the scope of this Certificate) should be made only after a suitable site investigation to determine the possibility for chemical attack. Particular care must be taken where acids and organic solvents are present in high concentrations. Further information should be sought from the Certificate holder.

11 Maintenance

11.1 The owner of the structure is responsible for maintenance.

11.2 For soakaways to individual houses, the only necessary maintenance of the system is to keep gullies clear of debris such as leaves.

11.3 For large installations or where the receiving waters are environmentally sensitive, a system of regular inspections should be established to prevent siltation of the system which, if allowed to develop, would reduce effectiveness. They should also be inspected after every major storm event.

11.4 Any silt finding its way into the structure should remain in the slotted distribution pipe, where used, which should be provided with sufficient access to allow flushing as part of a planned maintenance programme; the frequency required will vary between projects.

11.5 For all flow control devices, it is sensible to incorporate access (via a manhole or similar) to the location of the pipe entry, orifice or vortex control. This will enable easy removal of any blockage. The orifice itself may be protected by a debris screen.

11.6 Paved surface areas above an installation should be inspected at the same time to ensure the units continue to provide the required structural support.

12 Durability

The structural properties of polypropylene used in the components of the system will deteriorate with time and should be taken into account at the design stage by the application of suitable safety factors. In the opinion of the BBA, the blocks, the system when used in accordance with this Certificate, will have a life in excess of 50 years.

13 Reuse and recyclability

The units comprises polypropylene that can be recycled. Reuse of the units beyond the 50 year lifetime is not recommended.

Installation

14 General

The Stormbox Stormwater Management System should be installed in accordance with the Certificate holder's *Installation Manual*.

15 Procedure

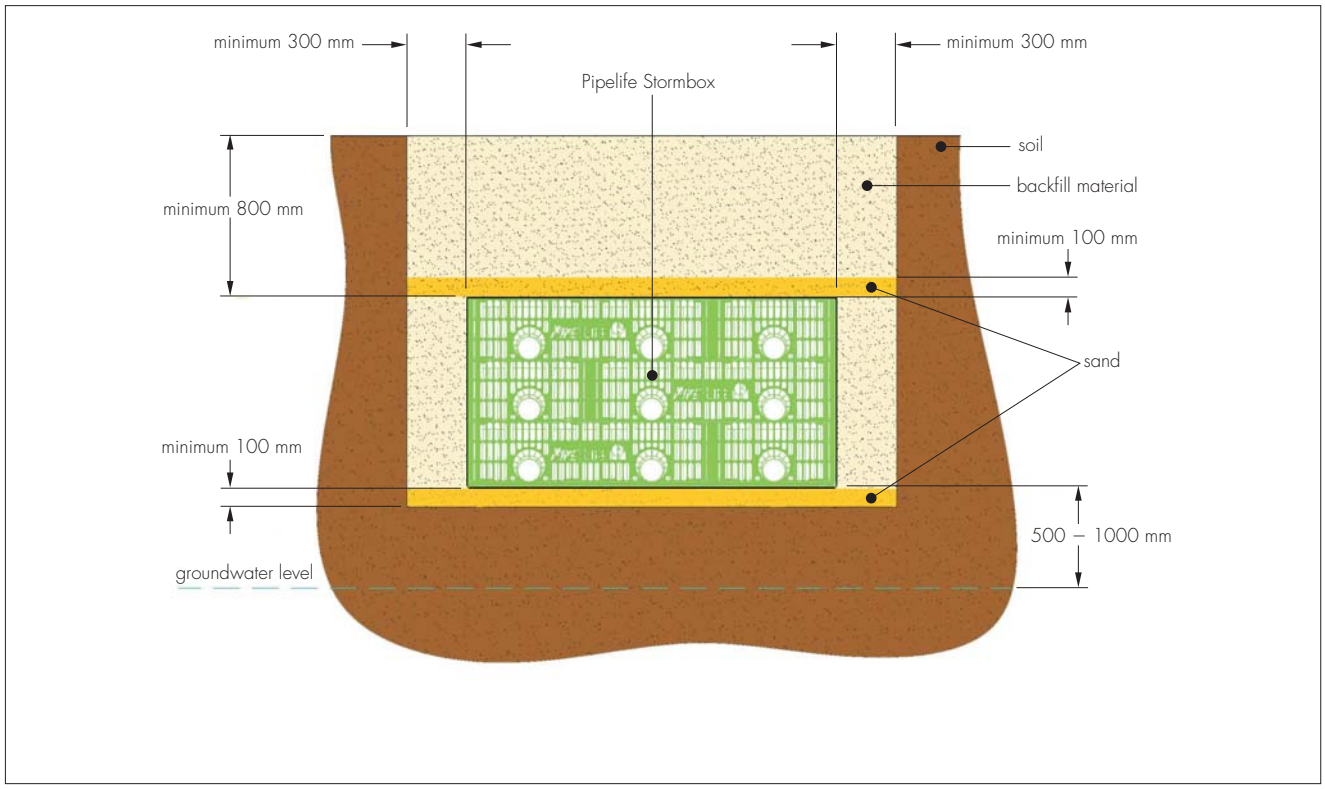
15.1 The ground is excavated to the required depth, dimensions and levels. It must be ensured that the plan area is sufficient to allow compaction plant access around sides to compact backfill material (300 mm minimum, see Figure 3). The base must be smooth and level without any ponds, bulges or soft spots. Any obstacles should be removed and if necessary, refilled with compacted granular fill material. Slopes must be cut to a safe angle or adequately supported and safe access must be provided to allow personnel to enter the excavation.

15.2 The base should be compacted with a single pass of a smooth-wheeled roller with a mass per metre width of roller not less than 2100 kg, a vibratory roller with a mass per metre width of roller not less than 700 kg or a vibrating plate compactor having a mass per square metre of not less than 1400 kg. The base must be inspected for soft spots in the formation — any present must be excavated and replaced with compacted granular fill material.

15.3 A 100 mm thick, blinding layer of coarse sand is laid on the base of the excavation (see Figure 3).

15.4 The geotextile (and geomembrane, if in an attenuation system) is laid over the blinding layer and up the sides of the excavation. When using a geomembrane it must always be protected on both sides by a layer of geotextile. The geomembrane is inspected for damage and all welds are tested as required. Joints between adjacent sheets of impermeable membrane should be sealed correctly using proprietary techniques with a minimum lap of 50 mm. Jointing with tape is not recommended as this places reliance on the mechanical properties of the tape to maintain the integrity of the system.

Figure 3 Typical installation



15.5 Ground plates are laid onto the geotextile and units clicked onto them and connected with clips. The units are installed in accordance with the installation schedule for correct orientation and in a stretcher bond to avoid continuous vertical joints (units can be sawn in half to achieve this, provided the open end is placed inwards, ie not in outer wall) and adjacent layers placed perpendicular to one another. The position of the distribution pipe(s) should be established initially and the units placed around the pipes. The distribution pipe should be bedded and backfilled in accordance with the MCHW, Volume 3, section 1, drawing F2, for filter drain trenches type H or I. The backfill should be compacted in 150 mm layers. A layer of geotextile is placed below the pipe and up the side of the adjacent units overlapping the first layer of units by at least 1 m to prevent the aggregate backfill around the pipe migrating into the tank structure.

15.6 Adjacent units should be placed tightly against one another and connected by clips in each horizontal and vertical joint, with the water distribution holes aligned across each layer.

15.7 The geotextile or geomembrane encapsulation to base, sides and top of installation, including protective geotextile is completed. Geomembranes should be welded with double seams. The geomembrane is inspected for damage and all welds tested as required.

15.8 Drainage connections are made to the installation using proprietary adaptors. It is recommended that all connections and air vent installations, in attenuation applications, are made with a flange adaptor, using thermal welding, adhesive or double-sided tape to form a seal.

15.9 The installation is backfilled with Type 1 or Type 2 sub-base or Class 6P (side fill only) selected granular material in accordance with the MCHW, Volume 1. The backfill is compacted in 300 mm thick layers.

15.10 A protection layer of coarse sand 100 mm thick should be placed over the top of the units that are wrapped in either a geotextile (infiltration system) or a geomembrane with protective geotextile (attenuation system). Backfilling is continued with:

- trafficked areas (eg car parks) — Type 1 or Type 2 sub-base material compacted in 150 mm layers in accordance with the MCHW, Volume 1. Compaction plant must not be allowed over the top of units until a minimum cover of 400 mm has been placed and, in any case, the load must not exceed 2300 kg per metre width
- landscaped and non-trafficked areas — selected as-dug material with size of pieces less than 75 mm compacted to 90% maximum dry density. Compaction plant over the top of system must not exceed a load of 2300 kg per metre width.

15.11 The pavement construction or landscaping is completed over the installation.

Technical Investigations

16 Tests

Tests were carried out on the units to determine the vertical and lateral resistance to short- and long-term loadings.

17 Investigations

17.1 The manufacturing processes were examined, including the method adopted for quality control, and details obtained on the quality and composition of the material used.

17.2 An assessment of the system was made in relation to:

- material properties
- design procedure
- volumetric capacity.

Bibliography

BRE Digest 365 *Soakaway Design*

BS 7533-12 : 2006 *Pavements constructed with clay, natural stone or concrete pavers. Guide to the structural design of trafficked pavements constructed on a bound base using concrete paving flags and natural stone slabs*

BS EN 752 : 2008 *Drain and sewer systems outside buildings*

BS EN 1295-1 : 1997 *Structural design of buried pipelines under various conditions of loading — General requirements*

BS EN 1401-1 : 2009 *Plastic piping systems for non-pressure underground drainage and sewerage — Unplasticized poly(vinyl chloride) (PVC-U) — Specifications for pipes, fittings and the system*

CIRIA Report 156 *Infiltration Drainage — Manual of Good Practice*

CIRIA C680 *Structural design of modular geocellular drainage tanks*

CIRIA C697 *The SUDS Manual*

CIRIA SP124 *Barriers, liners and cover systems for containment and control of land contamination.*

Manual of Contract Documents for Highway Works, Volume 1 *Specification for Highway Works*

Manual of Contract Documents for Highway Works, Volume 3 *Highway Construction Details*

PPS25 *Development and Flood Risk*

18 Conditions

18.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page — no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

18.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

18.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

18.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

18.5 In issuing this Certificate, the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

18.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.

British Board of Agrément
Bucknalls Lane
Watford
Herts WD25 9BA

tel: 01923 665300
fax: 01923 665301
e-mail: mail@bba.star.co.uk
website: www.bbacerts.co.uk