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BBA APPROVAL INSPECTION TESTING CERTIFICATION
TECHNICAL APPROVALS FOR CONSTRUCTION

Agrément Certificate
03/4018
Product Sheet 5

AQUACELL ATTENUATION AND INFILTRATION SYSTEMS

AQUACELL PRIME ATTENUATION AND INFILTRATION SYSTEM

This Agrément Certificate Product Sheet[1] relates to the AquaCell Prime Attenuation and Infiltration System, comprising grey polypropylene modular units used either for below-ground water storage or as a soakaway to manage run-off from impermeable surfaces.

(1) Hereinafter referred to as 'Certificate'.

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 the 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 in 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: 21 March 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.

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Regulations

In the opinion of the BBA, AquaCell Prime Attenuation and Infiltration 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
Requirement:	Regulation 7	Materials and workmanship
Comment:		The units are acceptable. See section 12 and the *Installation* part of this Certificate.

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)(2)	Fitness and durability of materials and workmanship
Comment:		The units satisfy the requirements of this Regulation. See sections 11.1 to 11.6, 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 units are acceptable. See section 12 and the *Installation* part of this Certificate.
Regulation:	82	Rain-water 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 section: 1 *Description* (1.1 and 1.2), 3 *Delivery and site handling* (3.3 and 3.5) and *Installation — Procedure* section of this Certificate.

Additional Information

NHBC Standards 2014

In the opinion of the BBA, the use of the AquaCell Prime Attenuation and Infiltration System, in relation to this Certificate, is not subject to the requirements of these standards.

Technical Specification

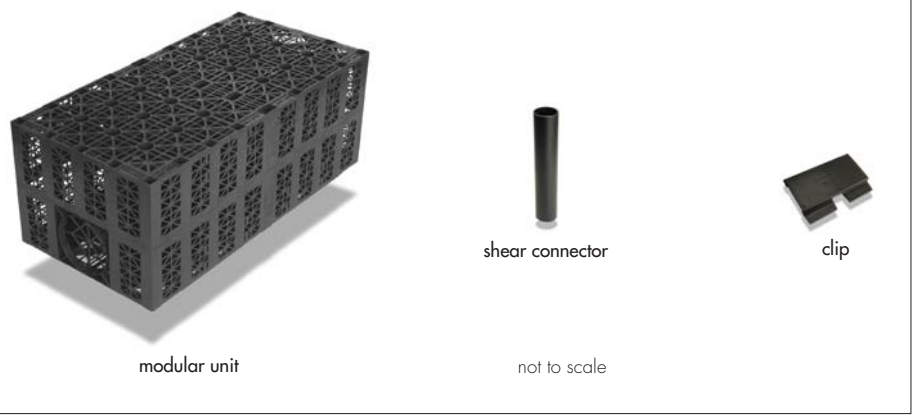
1 Description

1.1 The AquaCell Prime Attenuation and Infiltration System consists of individual, reformulated, recycled grey polypropylene modular units (see Table 1), black polypropylene shear connectors and black polypropylene clips (see Figure 1).

Table 1 Characteristics of modular unit

Characteristic (Unit)	Value
Dimensions (nominal) (l x w x h) (mm)	1000 x 500 x 400
Volume (nominal) (m^3)	0.20
Storage volume (nominal) (m^3)	0.19
Porosity (void ratio) (%)	95

Figure 1 Components



1.2 The polypropylene modular units have pre-formed sockets to enable connection with 160 mm diameter pipework. 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 produced via an injection moulding method.

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 system is supplied to site in packs of 15 units, secured with straps with plastic feet attached to the underside to enable placing and movement by a fork-lift. Each pack of units carries a label bearing the Aquacell type, part number, operator's initials, individual pallet sequential number and date of manufacture.

3.2 Each unit is supplied with two shear connectors and three clips.

3.3 The packs of the units 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 for limited periods. However, prolonged exposure to direct sunlight should be avoided.

3.5 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 that could occur with normal handling. They should be stored away from the possibility of impacts by vehicles and other construction plant.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the AquaCell Prime Attenuation and Infiltration System.

Design Considerations

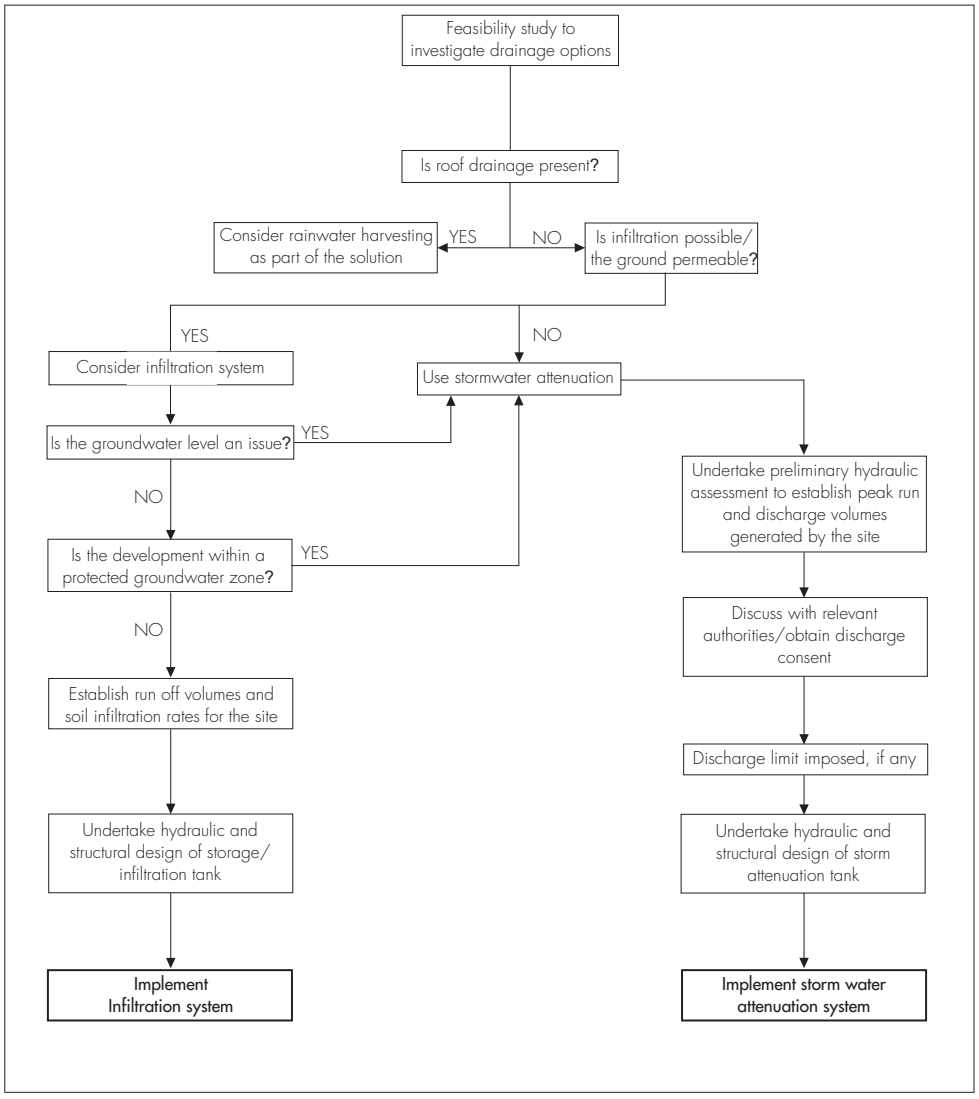
4 Use

4.1 The AquaCell Prime Attenuation and Infiltration System design must be in accordance with the Certificate holder's *AquaCell Systems: Product and Installation Guide WM424*. 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 and Information Association (CIRIA) Report C697.

4.2 The system can be used 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 stored within 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 infiltration and attenuation.

Figure 2 Sustainable drainage system selection and design



4.3 Design of the appropriate system (see Table 2) 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.

Table 2 Design information checklist

Description	Information source
A Existing factors	
Topography	Site survey or inspection
Area of catchment(1)	Site survey
Hydrology of catchment	Site inspection and observations
Soil type(1)	Site investigation
Structural properties of soil — CBR, stiffness	Site investigation and laboratory testing
Infiltration potential of soil	Site investigation
Contamination(1)	Site investigation and desk research
Details of receiving water, watercourse/aquifer	Environment Agency, Scottish Environment Protection or water and sewage company
Environmental sensitivity of site	Environment Agency, Scottish Environment Protection or water and sewage company
Groundwater vulnerability and source protection status	Environment Agency, Scottish Environment Protection or water and sewage company
B Predicted factors	
Development type and land use	Proposed development plans
Traffic loads	Proposed development plans
Rainfall data(1)	Meteorological Office or Wallingford procedure
Discharge design criteria	Environment Agency, Scottish Environment Protection or water and sewage company
Health and safety	Protection Agency or water and sewerage company. All affected parties
C Planned function	
Infiltration	Conclusions from A and B audit/review
Attenuation	Conclusions from A and B audit/review

(1) For individual house soakaways, only the items referenced for this footnote are required.

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 contractor with experience of this type of system.

6 Hydraulic design

Infiltration

Calculation principles

6.1 There are two approaches, either of which may be adopted, ie 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 (ie a single-house development) where detailed site infiltration rate information may not be required nor available (see Table 3). 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 3 Simplified soakaway design for single house development[1]

Number of units	Storage volume (m^3)	Maximum area to be drained (m^2)
1	0.19	19[2]
2	0.38	25[2]
3	0.57	28.5[3]
4	0.76	38[3]
5	0.95	47.5[3]
10	1.90	95[3]

(1) When doubt exists over suitability of ground for infiltration permeability, figures should be derived from 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 BRE or CIRIA approach is used, the design volumes and areas for trench or cuboid type installations can be found in Tables 4 and 5.

Table 4 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	0.19	0.80	0.50
2	0.38	1.60	0.50

Table 5 Data for use in hydraulic design — three-dimensional system, two units high

No of units long (1 m side)	2 wide (0.5 m side)			4 wide (0.5 m side)			8 wide (0.5 m side)		
	Vol (m^3)	Side (m^2)	Base (m^2)	Vol (m^3)	Side (m^2)	Base (m^2)	Vol (m^3)	Side (m^2)	Base (m^2)
1	0.76	3.20	1.00	1.52	4.80	2.00	3.04	8.00	4.00
2	1.52	4.80	2.00	3.04	6.40	4.00	6.08	9.60	8.00
4	3.04	8.00	4.00	6.08	9.60	8.00	12.16	12.80	16.00
8	6.08	14.40	8.00	12.16	16.00	16.00	24.32	19.20	32.00
10	7.60	17.60	10.00	15.20	19.20	20.00	30.40	22.40	40.00
100	76.00	161.60	100.00	152.00	163.20	200.00	304.00	166.40	400.00

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% of the total volume. As an example, using Table 4, for a typical linear, 1 m wide trench, 40 m long and two units deep, the volume is 0.76 by 40 = 30.4 m^3 and the side area 3.2 by 40 = 128 m^2.

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, but 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 Pipe connection is made to the units using a pre-formed socket and adaptor or a flange adaptor. These items are outside the scope of this Certificate. Information can be found in the Certificate holder's *AquaCell Systems: Product and Installation Guide WM424*.

6.7 When connecting pipes to the system, when used for storage applications (in which the system is wrapped with a geomembrane), care must be taken to ensure a watertight seal. It is recommended that all connections into storage applications (using a geomembrane) are made using a flange adaptor. 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 this input pipe is limited and may be insufficient for the anticipated flow load. Therefore, the flow load may be split between a number of 150 mm diameter flow pipes or other connection arrangements used (see Figure 3). The maximum areas that can be drained according to the number of input pipes provided is given in Table 6. The calculations are based on:

- paved surfaces — two-year, three- to five-minute event
- eaves drained roofs — one-year, two-minute event
- internal gutters — 500-year, two-minute event.

Figure 3 Typical inlet connection designs

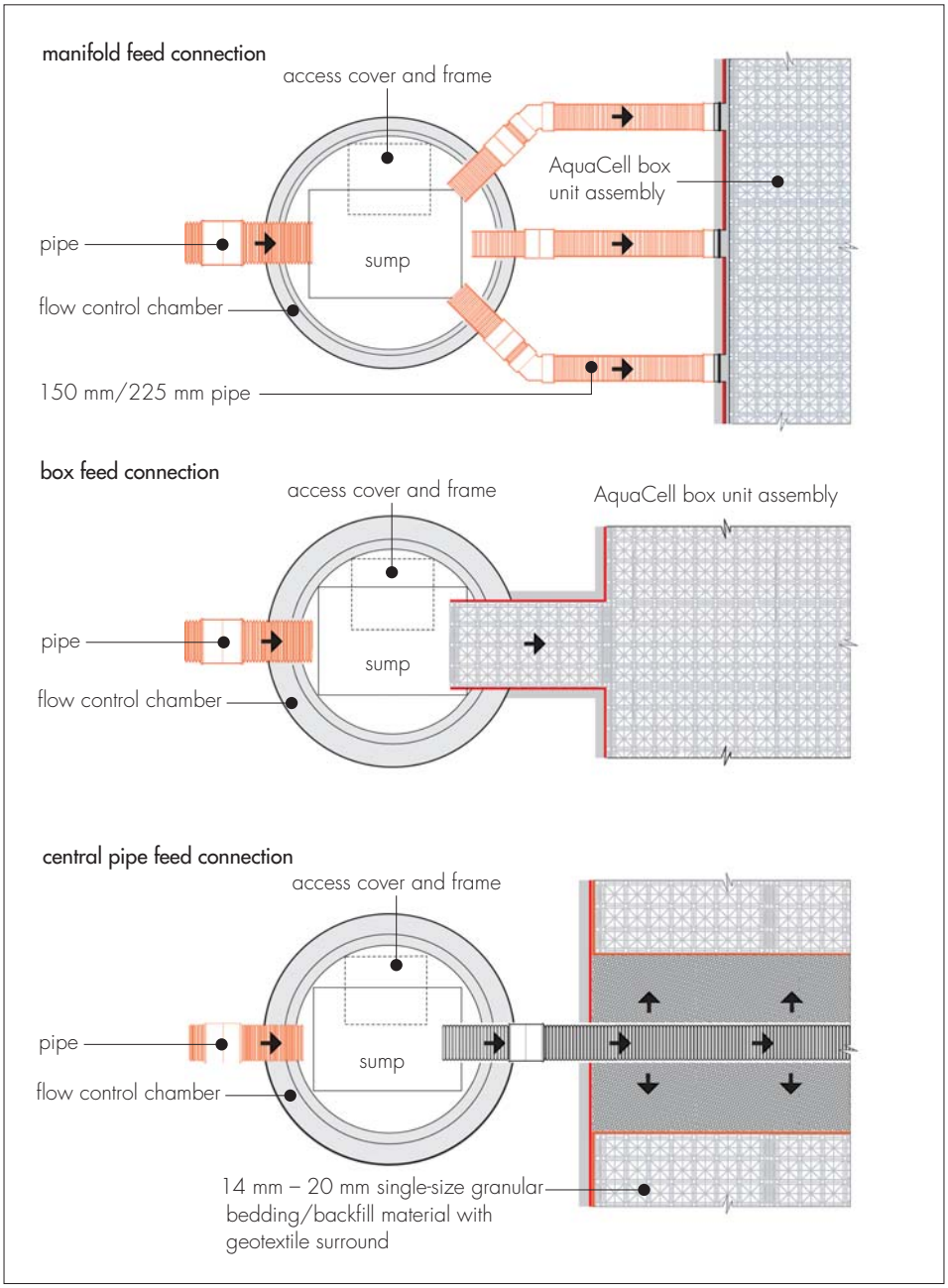


Table 6 Multiple manifolds

Surface type	Drainage area (m^2)					
	Number of inlet pipes					
	1	2	3	4	5	6
Paved area	1110	2220	3330	4440	5550	6660
Roof area[1]	841	1682	2523	3364	4205	5046
Roof area[2]	210	420	630	840	1050	1260

(1) Roofs drained by eaves gutters, close to the attenuation site (within 25 m).

(2) Roofs drained by internal gutters, close to the attenuation site (within 25 m) (especially siphonic roof drainage).

Flow control

6.9 The outflow from the tank must be controlled to comply with the discharge rate consent of the site. There are four main methods to achieve outflow control, ie orifice plate, Garastor, vortex control or small pipe. Comparative features and benefits of these various flow control 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, or lower than, 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 two layers of units, this depth is 0.8 m 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 carried out 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 tanks comprising several layers of units.

7.3 The system can be placed under landscaped or lightly-trafficked 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 7).

Table 7 Short-term performance values

Element	Value
Characteristic compressive strength at the yield point ($kN \cdot m^{-2}$)	
Vertical loading on top face	456
Lateral loading on side face	70
Short-term elastic deflection (mm per $kN \cdot m^{-2}$) (applied load)	
Vertical loading on top face	1 per 64
Lateral loading on side face	1 per 11

7.8 The following equations have been established from creep tests, on a single unit, exceeding 2,000 hours and can be used to estimate the long-term vertical deflection for periods up to 20 years at 20°C (see Table 8). In locations where settlement is not a concern, designs of up to 50 years can be considered:

Table 8 Equations for estimating long-term creep deflection

For loads up to ($kN \cdot m^{-2}$):	Equation for estimation of long-term deflection
92	Deflection = 0.1697 Ln (time (hours)) + 4.6245

7.9 The following partial load and material factors, as defined in CIRIA Report C680, should be used for design (Table 9).

Table 9 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 accordance with CIRIA Report C680 are shown in Tables 10, 11 and 12:

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 10 indicates the maximum depth and minimum cover.

Table 10 Design criteria for use of AquaCell Prime system as soakaway for an individual house(1)

Criterion	Value (m)
Maximum depth to base of units	2.82
Minimum depth of cover required over units to prevent accidental damage	0.30

(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 11 and 12 is 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 11 Maximum installation depths (to base of units)

Typical soil type	Soil weight (kN·m^{-3})	Angle of friction (ϕ)	Maximum installation depth (from invert of structure) (m)			
			No groundwater present		Groundwater present (1 m below ground level)	
			Trafficked area (car park, light access road)(1)	Non-trafficked area (landscaped area)(2)	Trafficked area (car park, light access road)(1)	Non-trafficked area (landscaped area)(2)
Over consolidated stiff clay	20	24°	1.73	1.98	1.60(3)	1.78
Silty sandy clay	19	26°	2.01	2.27	1.75	1.90
Loose sand and gravel	18	30°	2.58	2.86	1.95	2.08
Medium dense sand and gravel	19	34°	2.98	3.24	2.04	2.16
Dense sand and gravel	20	38°	3.45	3.70	2.14	2.24

(1) Trafficked areas taken as car parks and light access roads with vehicles up to 12,000 kg gross vehicle weight (GVW), defined in CIRIA C680, Table 4.2.

(2) Landscaped areas taken as areas where drive on mowers are used, defined in CIRIA C680, Table 4.2.

(3) In this situation, a tank comprising one layer of units is required, to ensure adequate cover depth.

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 is horizontal.
- Shear planes or other weaknesses are not present within the structure of the soil.
- Weight of ground water taken as 10 kN·m^{-3}.
- Accidental loading is not considered.
- Partial load and material factors shall be as defined in Table 9.

Table 12 Minimum cover depths over top of units

Live load conditions	Landscaped area[1]	Light trafficking[2]
		Car park with occasional vehicle mass <12,000 kg GVW
Minimum cover depth required (m)	0.30	0.71

(1) Landscaped areas taken as areas where drive on mowers are used, defined in CIRIA C680, Table 4.2.

(2) Trafficked areas taken as car parks and light access roads with vehicles up to 12,000 kg gross vehicle weight (GVW), defined in CIRIA C680, Table 4.2.

Notes:

- Calculations are based on tanks comprising one layer of units.
- Assumes angle of friction of the surrounding soil of 38° and a soil weight of 20 $kN \cdot m^{-3}$. Groundwater must be at least one metre below base 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 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 9.

8 Geotextiles and geomembranes

General

8.1 In infiltration applications, the geotextile wrapped around the system prevents soil entering the units and stops the soil which surrounds the unit becoming clogged with silt present in run-off. In attenuation/storage applications, the geotextile serves to protect the geomembrane.

Infiltration

8.2 The geotextile should be selected according to specific site conditions. However, typically, a 300 g non-woven material will be suitable for most situations. 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.

Attenuation

8.3 In attenuation/storage applications where infiltration is not possible or permitted, an impermeable geomembrane is wrapped around the system to prevent release of attenuated/stored water into surrounding ground and to prevent inflow of pollutants from contaminated subsoil into the storage reservoir.

Specification of geotextile

8.4 The selection of an appropriate geotextile for a specific infiltration installation should be considered carefully, with particular reference to the surrounding soil properties and required performance. Points to consider are:

- the pore size should be designed and specified to assist infiltration and prevent migration of fine soil particles
- the permeability and breakthrough head should not limit the flow of water in the system, and should be similar to or greater than the surrounding materials
- the material must be able to resist the punching stresses caused by loading on sharp points of contact
- its strength should be sufficient to resist the imposed forces (eg from traffic).

Specification of geomembrane

8.5 The specification and selection of the impermeable geomembrane must be correct for the installation envisaged, 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.

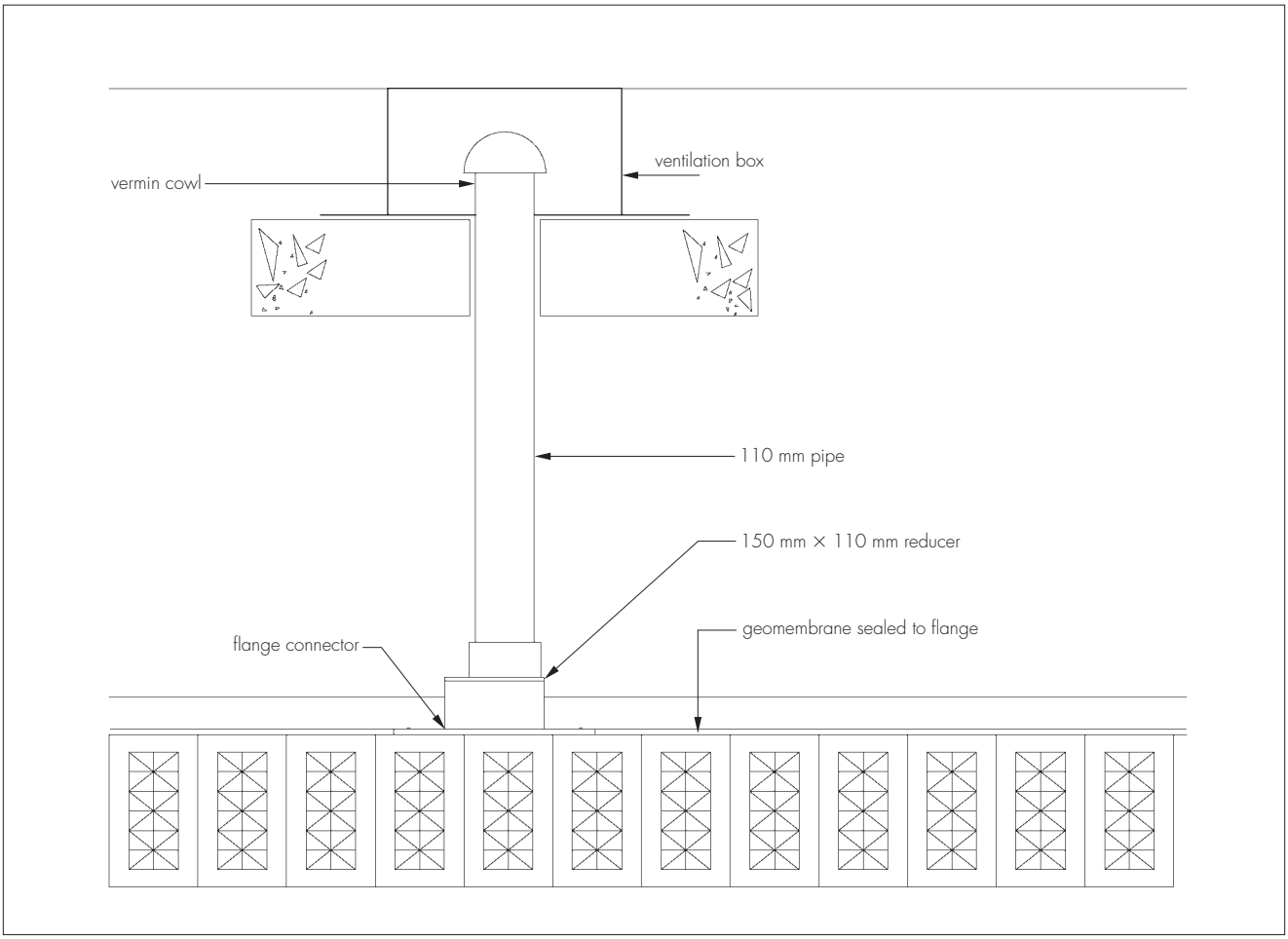
8.6 To ensure total impermeability, joints between adjacent sheets of impermeable geomembranes should be sealed correctly using proprietary welding techniques. The integrity of joints should be demonstrated by non-destructive testing[1].

(1) Advice on seam testing is given in CIRIA Report SP124.

9 Venting

9.1 Adequate venting must be provided to the system. One 110 mm diameter air vent is required per 7500 m^2 of impermeable catchment area to be drained (see Figure 4). Air vent connections and pipework for use with this system are outside the scope of this Certificate.

Figure 4 Typical air vent system



9.2 Typical air vent connectors and pipework can be seen in the Certificate holder's *AquaCell Systems: Product and Installation Guide WM424*. It is recommended that all air vent installations in attenuation/storage applications (using an impermeable geomembrane) are made using a flange adaptor. 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 units 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 at high concentrations. Further information can be obtained from the Certificate holder.

11 Maintenance

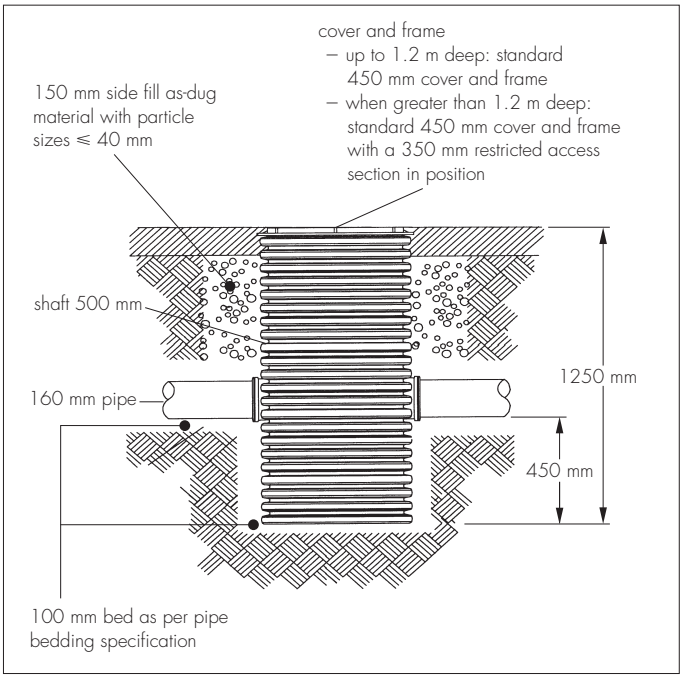
11.1 The owner of the structure is responsible for maintenance. Recommendations for maintenance of SUDS systems are given in CIRIA Report C697.

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

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

11.4 It is recommended that a silt trap is incorporated into the pipework at the inlet to the tank (see Figure 5). There must be a maintenance plan that ensures regular cleaning of the trap to ensure correct performance. Silt traps for use with this system are outside the scope of this Certificate.

Figure 5 Typical silt trap



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 system continues 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 AquaCell Prime Attenuation and Infiltration System, when used in accordance with this Certificate, will have a service life in excess of 50 years.

13 Reuse and recyclability

The units consist of polypropylene material which is readily recyclable.

Installation

14 General

The system should be installed in accordance with the Certificate holder's *AquaCell Systems: Product and Installation Guide WM424*.

15 Procedure

15.1 The hole or trench is excavated to the required depth, dimensions and levels. It must be ensured that the plan area is sufficient to allow plant access around sides to compact backfill material (300 mm minimum). The base must be smooth and level without sharp drops or humps. 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 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, bedding layer of coarse sand is laid on the base and sides of the excavation. If required in attenuation systems, a layer of geotextile is laid to protect the impermeable geomembrane.

15.4 The impermeable geomembrane (or geotextile, if in an infiltration system) is laid over the sand bedding layer and up the sides of the excavation. The impermeable 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 150 mm. Jointing with tape is not recommended as the system then becomes reliant on the mechanical properties of the tape to maintain its integrity.

15.5 The units are installed in accordance with the installation schedule for correct orientation. Wherever possible, continuous vertical joints should be avoided. The units are arranged so that pre-formed sockets are in the correct

alignment for inlet and outlet pipes. For single-layer applications, Wavin clips are used and, for multilayers, Wavin clips and shear connectors are used.

15.6 The geotextile or impermeable geomembrane encapsulation to base, sides and top of installation, including protective geotextile (if required to protect the geomembrane) is completed. Impermeable geomembranes should be welded with double seams. All welds should be tested as required and the membrane inspected for damage.

15.7 Drainage connections are made to the installation using proprietary adaptors. Pre-formed socket positions for pipe connections must be located at the correct position for receiving pipework. Alternatively, flange adaptors are used attached to units with adhesive tape and self-tapping screws (flange adaptors cannot be used at the invert of units into the pre-formed socket). It is recommended that all connections and air vent installations, in attenuation/storage applications, are made with a flange adaptor, using adhesive or double-sided tape to form a seal. Alternatively, drainage connections are sealed into a pre-formed socket using proprietary seals approved by the geomembrane manufacturer.

15.8 The installation is backfilled with Type 1 or 2 sub-base or Class 6P (side fill only) selected granular material in accordance with the *Manual of Contract Documents for Highway Works* (MCHW), Volume 1. The backfill is compacted in 150 mm thick layers.

15.9 A coarse sand protection layer, 100 mm thick, should be placed over the top of the units that have been wrapped. Backfilling is continued with:

- trafficked areas (eg car parks) — Type 1 or 2 sub-base material compacted in 150 mm layers in accordance with the MCHW, Volume 1. Compaction plant over the top of the system 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 the system must not exceed 2300 kg per metre width.

15.10 Pavement construction or landscaping over the system is completed.

Technical Investigations

16 Investigations

16.1 An investigation in relation to data concerning:

- long- and short-term resistance to loading
- volumetric capacity and discharge rate
- material properties
- design procedures.

16.2 The manufacturing process was examined, including the method adopted for quality control, and details obtained on the quality and composition of the material used.

16.3 An assessment of the system was made in relation to material properties and design procedures.

Bibliography

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

BRE Digest 365 *Soakaway Design*

Construction Industry Research and Information Association (CIRIA) Report 156 *Infiltration Drainage — Manual of Good Practice*

Construction Industry Research and Information Association (CIRIA) Report C680 *Structural design of modular geocellular drainage tanks*

Construction Industry Research and Information Association (CIRIA) Report C697 *The SUDS Manual*

Construction Industry Research and Information Association (CIRIA) Report SP124 *Barriers, liners and cover systems for containment and control of land contamination*

Local Government Planning Policy Statement PPS25 *Development and Flood Risk*

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

17 Conditions

17.1 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.

17.2 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.

17.3 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.

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

17.5 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.

17.6 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.

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