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**Agrément Certificate**

**03/4018**

Product Sheet 6

## WAVIN AQUACELL ATTENUATION AND INFILTRATION SYSTEMS

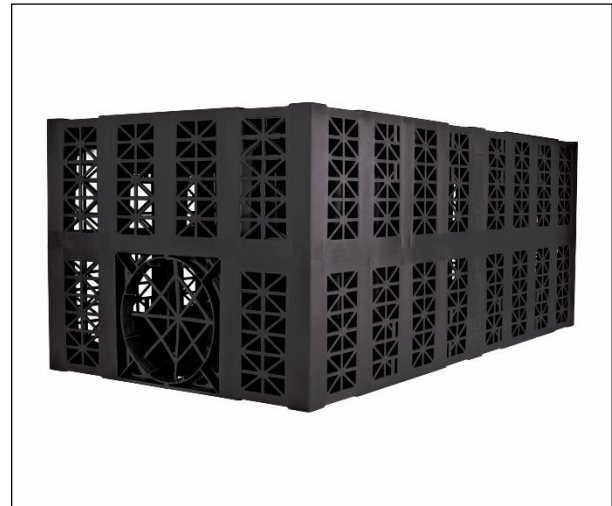
### AQUACELL CORE-R

This Agrément Certificate Product Sheet<sup>(1)</sup> relates to AquaCell Core-R, comprising black polypropylene modular units for use either as below-ground storage tanks 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 this Certificate to assist in the design of a below-ground water management system using the product (see section 6).

**Structural performance** — the product has adequate strength and stiffness to resist short- and long-term loading 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 product will have a design 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 product described herein. This product 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: 2 January 2020

Brian Moore  
Director

*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](http://www.bbacerts.co.uk)  
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Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.*

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## Regulations

In the opinion of the BBA, AquaCell Core-R, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying 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)

<b>Requirement:</b>	<b>H3(3)</b>	<b>Rainwater drainage</b>
Comment:		The product can be used in a construction to satisfy this Requirement. See section 6 of this Certificate.
<b>Regulation:</b>	<b>7</b>	<b>Materials and workmanship (applicable to Wales only)</b>
<b>Regulation:</b>	<b>7(1)</b>	<b>Materials and workmanship (applicable to England only)</b>
Comment:		The product is acceptable. See section 12 and the <i>Installation</i> part of this Certificate.



### The Building (Scotland) Regulations 2004 (as amended)

<b>Regulation:</b>	<b>8(1)(2)</b>	<b>Durability, workmanship and fitness of materials</b>
Comment:		The product can contribute to satisfying this Regulation. See sections 11 and 12 and the <i>Installation</i> part of this Certificate.
<b>Regulation:</b>	<b>9</b>	<b>Building standards applicable to construction</b>
Standard:	3.6	Surface water drainage
Comment:		The product can contribute to a construction satisfying this Standard, with reference to clauses 3.6.1 <sup>(1)(2)</sup> to 3.6.5 <sup>(1)(2)</sup> . See section 6 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The product can contribute to satisfying 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.
<b>Regulation:</b>	<b>12</b>	<b>Building standards applicable to conversions</b>
Comment:		Comments in relation to the product under Regulation 9, Standards 1 to 6 also apply to this Regulation, with reference to clause 0.12.1 <sup>(1)(2)</sup> and Schedule 6 <sup>(1)(2)</sup> .
		(1) Technical Handbook (Domestic).
		(2) Technical Handbook (Non-Domestic).



### The Building Regulations (Northern Ireland) 2012 (as amended)

<b>Regulation:</b>	<b>23(a)(i)(iii)(b)</b>	<b>Fitness of materials and workmanship</b>
Comment:		The product is acceptable. See section 12 and the <i>Installation</i> part of this Certificate.
<b>Regulation:</b>	<b>82</b>	<b>Rainwater drainage</b>
Comment:		The product can be used in a construction to satisfy this Regulation. See section 6 of this Certificate.

## Construction (Design and Management) Regulations 2015

## Construction (Design and Management) Regulations (Northern Ireland) 2016

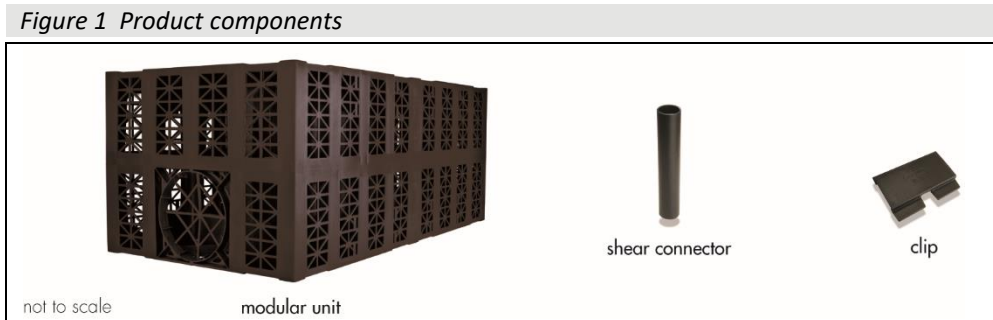
Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

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

## 1 Description

1.1 AquaCell Core-R consists of two moulded halves assembled to make one unit (6LB150), manufactured from recycled black polypropylene, which has been reformulated. The units are then clipped together on site to form tanks of the required dimension.

1.2 Polypropylene shear connectors (6LB102) hold the units together vertically, prior to enclosing the tank in geotextile or geomembrane, and the clips (6LB105) hold the units together horizontally (see Figure 1).



1.3 The overall unit dimensions and characteristics of AquaCell Core-R are shown in Table 1.

*Table 1 Characteristics of modular units*

Characteristic (unit)	Value
Unit dimensions per storage cell (nominal) (mm) (L x W x H)	1000 x 500 x 400
Unit volume per storage cell (nominal) (m <sup>3</sup> )	0.20
Storage volume per storage cell (nominal) (m <sup>3</sup> )	0.19
Porosity (%)	94.7
Weight (nominal) (kg)	11.5

1.4 The modular units have preformed sockets to enable connection to 160 mm diameter pipework. Alternatively, connection to 150 pipework is possible using an adaptor. Connection can also be made, at points other than the preformed sockets, to suitable 150 or 225 mm pipework using a flange adaptor. Adaptors and connecting pipework for use with the product are outside the scope of this Certificate.

1.5 Items used with the units to form AquaCell Core-R, but outside the scope of this Certificate, include:

- pipework and pipe adaptors
- geotextile
- geotextile protection fleece
- geomembrane
- vents and connecting pipework
- silt traps and access chambers
- flow control devices and chambers
- granular material/coarse sand (surround material).

## 2 Manufacture

2.1 The product components are injection-moulded using polypropylene to a defined specification.

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 AquaCell Core-R units are supplied to site in packs of 12 or 15, 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 system 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 should be carefully placed on level ground and should not be stacked on site. Loose individual units should not be stored more than two units high.

3.4 The units contain an inhibitor to resist the effects of ultraviolet light for up to six months. However, prolonged exposure to direct sunlight should be avoided.

3.5 The units should not be stored near fuel bowsers, fuel tanks or other solvents, to avoid potential damage from high chemical concentrations.

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 AquaCell Core-R.

### Design Considerations

#### 4 Use

4.1 The design of AquaCell Core-R must be in accordance with the Certificate holder's design guidelines. Guidance on the application of sustainable drainage systems (SuDS) for new developments using systems such as this can be found in the *Communities and Local Government Planning Policy Statement PPS25*. Additional guidance is also available in the Construction Industry Research and Information Association (CIRIA) Report C753.

4.2 The product is suitable for the management of stormwater run-off from impermeable surfaces and can be used in three main ways:

- infiltration — water is stored within the product during rainfall and allowed to drain away by soaking into the surrounding ground over a period of time after the rain has ceased
- attenuation — water is stored within the product 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
- a combination of infiltration and attenuation.

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 the 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 and structural design.

## 5 Practicability of installation

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

## 6 Hydraulic design

### Infiltration

#### Calculation principles



6.1 There are two approaches, either of which may be adopted: CIRIA Report 156 or BRE Digest 365 : 2016. Further information on the design of SuDS may be obtained from CIRIA Report C753 *The SuDS Manual*.

6.2 When the BRE or CIRIA approach is used, the design volumes and areas for trench or cuboid type installations can be found in Tables 2 and 3 of this Certificate.

*Table 2 Data for use in hydraulic design — one unit wide trench configuration*

Number of units high	Product volume (m <sup>3</sup> ) per metre length of trench	Vertical surface area (m <sup>2</sup> ) (both sides) per metre length of the product	Area beneath product (m <sup>2</sup> ) per metre length of trench
1	0.19	0.79	0.51
2	0.38	1.58	0.51

*Table 3 Data for use in hydraulic design — three-dimensional systems, two units high*

System length (number of units long) (1.2 m side)	2 units wide (0.5 m side)			4 units wide (0.5 m side)			8 units wide (0.5 m side)		
	Volume (m <sup>3</sup> )	Area around sides and ends (m <sup>2</sup> )	Area under base (m <sup>2</sup> )	Volume (m <sup>3</sup> )	Area around sides and ends (m <sup>2</sup> )	Area under base (m <sup>2</sup> )	Volume (m <sup>3</sup> )	Area around sides and ends (m <sup>2</sup> )	Area under base (m <sup>2</sup> )
1	0.80	3.17	1.01	1.59	4.76	2.02	3.19	7.94	4.04
2	1.59	4.75	2.02	3.19	6.34	4.04	6.37	9.52	8.09
4	3.19	7.90	4.04	6.37	9.49	8.09	12.75	12.68	16.18
8	6.37	14.21	8.09	12.75	15.80	16.18	25.49	18.99	32.35
10	7.97	17.37	10.11	15.93	18.96	20.22	31.87	22.14	40.44
100	79.67	159.35	101.10	159.34	160.94	202.20	318.67	164.12	404.40

6.3 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 94.7% of the total volume. As an example, using Table 2, for a typical linear trench 40 m long and two units deep the volume is 0.38 by 40 = 15.2 m<sup>3</sup> and the side area 1.58 by 40 = 63.2 m<sup>2</sup>.

### Attenuation

#### Calculation principles



6.4 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 product 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 94.7% of the total volume of the product.

## Connections



6.5 Connection is made to the units using a preformed socket and adaptor, or a flange adaptor.

6.6 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



6.7 The units are manufactured to allow a connection to be formed by insertion of 160 mm diameter pipes to BS EN 13476-3 : 2018 into the knock-out incorporated in each cell. The capacity of a 160 mm pipe is limited and may be insufficient for the anticipated design flow. The flow may be split amongst a number of 160 mm pipes connected to a manifold to provide increased hydraulic capacity. The product designer should ensure that the pipework connecting the units to the drainage system has sufficient capacity to cope with the design flow.

## Flow control



6.8 When the product is used for attenuation purposes, the outflow from the system must be controlled to comply with the discharge rate consent of the site. The main methods to achieve outflow control are orifice plate, vortex valve or reduced pipe diameter. Comparative features and benefits of these various control flow devices should be considered prior to selection.

## Outflow positioning and head calculations



6.9 The invert level of the outflow pipe should be flush with the bottom of the lowest unit to allow the product to drain. As the product fills, a depth of water develops on the upstream side of the outflow control creating a driving head to push the flow through the control device. For design purposes, the head used in calculations is taken as the difference between the level of the top of the tank and the invert of the outflow device.

## 7 Structural performance

7.1 The structural design of each installation incorporating the product should be carried out by a suitably qualified and experienced engineer.

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

7.3 The product can be placed under landscaped areas, lightly trafficked areas and, under certain circumstances, heavily trafficked areas (see Table 9).

7.4 Care should be taken when the product 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 allowable 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 tank 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 product must be greater than the uplift force caused by the product'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 product below groundwater level.

## Performance characteristics

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

Performance characteristic (unit)	Value
Characteristic compressive strength at the yield ( $\text{kN}\cdot\text{m}^{-2}$ )	
vertical loading on top face	669.3
lateral loading on side face	123.4
Short-term elastic deflection (mm per $\text{kN}\cdot\text{m}^{-2}$ ) (applied load)	
vertical loading on top face	1 per 103.1
lateral loading on side face	1 per 16.6

7.8 The following equations have been established from creep tests with 300 disc, on a single unit. These can be used to estimate the long-term deflection for periods up to 20 years at 20°C (see Table 6). In locations where settlement is not a concern, designs of up to 50 years can be considered.

For loads up to ( $\text{kN}\cdot\text{m}^{-2}$ )	Equations for estimation of long-term deflection (mm)
154.2	Vertical deflection = $0.0873 \ln [\text{time (days)}] + 1.6757$
192.4	Vertical deflection = $0.2281 \ln [\text{time (days)}] + 1.5685$
216.4	Vertical deflection = $0.2397 \ln [\text{time (days)}] + 2.6697$
230.6	Vertical deflection = $0.1023 \ln [\text{time (days)}] + 3.3436$
22.4	Lateral deflection = $0.2027 \ln [\text{time (days)}] + 2.3758$
46.4	Lateral deflection = $0.4588 \ln [\text{time (days)}] + 1.6875$

7.9 The partial load and material factors given in Table 7, as defined in CIRIA Report C680, may be used to attain the ultimate limit state.

Description	Ultimate limit state	Serviceability limit state
Partial load factors		
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 material factor ( $F_m$ )	2.75	1.50

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

7.11 For small-scale applications, such as soakaways for individual house roof drainage, when the product is installed below a garden it should be a minimum of 5 m from the building and inaccessible to motor vehicles. Table 8 indicates the maximum depth and minimum cover applicable to most locations in the UK.

Table 8 Design criteria for use of the product as a soakaway for an individual house<sup>(1)</sup>

Criterion (unit)	Value
Maximum depth to base of units (m)	5.0
Minimum cover depth (m)	0.3

(1) The following assumptions apply:

- soakaway constructed in sandy gravels with a soil unit weight not exceeding  $20 \text{ kg}\cdot\text{m}^{-3}$  and angle of internal friction for surrounding soil not less than  $30^\circ$
- groundwater at least one metre below the base of the units
- soakaway located beneath small gardens or landscaped areas inaccessible to motor vehicles, in accordance with CIRIA Report C680, Table 4.2.

7.12 For installations as detailed in Table 9, the information given 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 9 Minimum cover depths*

Location	Minimum permissible cover (m)
Landscaped areas <sup>(1)</sup>	0.5
Car parks <sup>(2)</sup>	0.7

(1) Landscaped area where drive on mowers are used, drive on mowers in accordance with CIRIA Report C680, Table 4.2.

(2) Car parks: cars or light vehicles up to 12000 kg (GVW) in accordance with CIRIA Report C680, Table 4.2.

Notes:

- calculations based on tanks comprising two layers of the units
- soil unit weight and angle of internal friction of the soil above the product taken as 20 kN·m<sup>-3</sup> and 38°, respectively
- calculations based on there being no groundwater present
- angle of spread for wheel loads taken as 27° from the vertical in car parks with asphaltic surfacing and angle of internal friction of soil in landscaped areas
- no account is taken of accidental loading
- ground surface in vicinity of the product assumed to be level
- formation below the product assumed to have adequate bearing capacity
- partial load and material factors are defined in Table 7.

## 8 Geotextiles and geomembranes

### Infiltration

8.1 The whole product requires a geotextile wrapping when used as an infiltration device to prevent:

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

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

### Attenuation

8.3 The whole product requires a sealed geomembrane wrapping to create an attenuation storage tank and 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, geotextile protection 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 AquaCell Core-R Stormwater Management tank 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 product, 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 wheel loads)
- 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 of the product.

8.8 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 whole product. As a minimum, one 110 mm diameter air vent is required per 7500 m<sup>2</sup> of impermeable catchment area to be drained.

9.2 It is recommended that all air vent installations in storage applications (using a geomembrane) are made using a suitable adhesive or welding to ensure a watertight seal. Venting should be positioned in a non-trafficked area, wherever possible.

## 10 Resistance to chemicals

10.1 An assessment by the BBA indicates that the product components 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 product on brownfield sites should be made only after a suitable site investigation (outside the scope of this Certificate), 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 its maintenance.

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

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

11.4 It is recommended that a silt trap or sediment removal separator be installed upstream of the inlet pipework to the product. A maintenance plan must be in place for regular cleaning of all traps and sumps to ensure correct performance.

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 plate or vortex control valve. This will enable easy removal of any blockage. The orifice plate itself may be protected by a debris screen.

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

## 12 Durability



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

## 13 Reuse and recyclability

The units are made from polypropylene, which is readily recyclable.

## Installation

### 14 General

AquaCell Core-R units should be installed in accordance with the Certificate holder's installation instructions, this Certificate and PD CEN/TR 17179 : 2018. Special attention should be paid to temporary work requirements in excavations.

### 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. Excavation should be carried out in accordance with BS 6031 : 2009, with particular attention paid to safety procedures.

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 50 mm. Jointing with tape is not recommended as the product then becomes reliant on the mechanical properties of the tape to maintain its integrity.

15.5 AquaCell Core-R 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 preformed sockets are in the correct alignment for inlet and outlet pipes. For single-layer applications, clips are used and, for multilayers, 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. Preformed socket positions for pipe connections must be located at the correct position for receiving pipework. Alternatively, flange adaptors are used attached to AquaCell Core-R units with adhesive tape and self-tapping screws (flange adaptors cannot be used at the invert of AquaCell Core-R units into the preformed 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 preformed 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 product 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 product must not exceed 2300 kg per metre width of roll.

15.10 Pavement construction or landscaping over the product is completed.

## Technical Investigations

### 16 Tests

Tests were carried out on the units and the results assessed to determine:

- dimensional and weight accuracy
- impact resistance at 0 and 23°C
- short-term resistance to vertical and horizontal loading
- long-term resistance to vertical and horizontal loading

Material

- resistance to internal pressure to BS EN ISO 1167-1 : 2006 and BS EN ISO 1167-2 : 2006
- melt mass-flow rate in accordance with BS EN ISO 1133-1 : 2011
- oxidation Induction Time to BS EN ISO 11357-6 : 2018.

### 17 Investigations

17.1 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

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

- material properties
- design procedures
- volumetric capacity.

## Bibliography

BRE Digest 365 : 2016 *Soakaway Design*

BS 6031 : 2009 *Code of practice for earthworks*

BS EN 13476-3 : 2018 *Plastics piping systems for non-pressure underground drainage and sewerage — Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) — Specifications for pipes and fittings with smooth internal and profiled external surface and the system, Type B*

BS EN ISO 1133-1 : 2011 *Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics. Standard method*

BS EN ISO 1167-1 : 2006 *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — General method*

BS EN ISO 1167-2 : 2006 *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Preparation of pipe test pieces*

BS EN ISO 11357-6 : 2018 *Plastics — Differential scanning calorimetry (DSC) — Determination of oxidation induction time (isothermal OIT) and oxidation induction temperature (dynamic OIT)*

CIRIA Report 156 *Infiltration drainage — Manual of good practice*

CIRIA Report C680 : 2008 *Structural design of modular geocellular drainage tanks*

CIRIA Report C753 : 2015 *The SuDS manual*

CIRIA Report SP 124 : 1996 *Barriers, liners and cover systems for containment and control of land contamination*

Communities and Local Government Planning Policy Statement PPS25, *Development and Flood Risk*.

PD CEN/TR 17179 : 2018 *Thermoplastics piping and ducting systems — Rainwater infiltration and storage attenuation systems — Practices for underground installation*

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

### 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.