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Agrément Certificate
08/4601
Product Sheet 1

JFC HYDROCHAMBER STORMWATER MANAGEMENT SYSTEM

PRODUCT SCOPE AND SUMMARY OF CERTIFICATE

This Certificate relates to the JFC HydroChamber Stormwater Management System, used for surface water storage or as a soakaway to manage run-off from impermeable surfaces.

AGRÉMENT 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

System design — data is provided in the Certificate to assist in the design of a surface water management system incorporating the JFC HydroChambers (see section 5).

Structural performance — the chambers have adequate strength and stiffness to resist long- and short-term loads when used in accordance with this Certificate (see section 6).

Durability — the chambers will have a service life in excess of 50 years when installed in accordance with this Certificate (see section 11).

The BBA has awarded this Agrément 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: 7 January 2009

Brian Chamberlain
Head of Approvals — Engineering

Greg Cooper
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, the JFC HydroChamber Stormwater Management System, if used in accordance with the provisions of this Certificate, will meet or contribute to meeting the relevant requirements of the following Building Regulations:

The Building Regulations 2000 (as amended) (England and Wales)

Requirement:	H3(3)	Rainwater drainage
Comment:		The units can be used in a construction to meet this Requirement. See sections 5.1 to 5.12 of this Certificate.
Requirement:	Regulation 7	Materials and workmanship
Comment:		The system components are acceptable. See sections 11.1 and 11.2 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 system components are acceptable. See sections 10.1 to 10.8 and 11.1 and 11.2 and the *Installation* part of this Certificate.
Regulation:	9	Building standards — construction
Standard:	3.6(a)	Surface water drainage
Comment:		The system 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 5.1 to 5.12 of this Certificate.
		(1) Technical Handbook (Domestic).
		(2) Technical Handbook (Non-Domestic).

The Building Regulations (Northern Ireland) 2000 (as amended)

Regulation:	B2	Fitness of materials and workmanship
Comment:		The system components are acceptable. See sections 11.1 and 11.2 and the *Installation* part of this Certificate.
Regulation:	B3(2)	Suitability of certain materials
Comment:		The system components are acceptable. See sections 10.1 to 10.8 of this Certificate.
Regulation:	N5	Rain-water drainage
Comment:		The system can be used in a construction to satisfy this Regulation. See section 5.1 to 5.12 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: 2 *Delivery and site handling* (2.3) and 13 *Procedure*. (13.1).

Non-regulatory Information

NHBC Standards 2008

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

Zurich Building Guarantee Technical Manual 2007

In the opinion of the BBA, the use of the JFC HydroChamber Stormwater Management System, in relation to this Certificate, is not subject to the requirements of this Technical Manual.

General

This Certificate relates to the JFC HydroChamber Stormwater Management System, consisting of interlocking polyethylene chambers and end caps.

The chambers are assembled to form an underground structure which can be used for storage of surface water or as a soakaway to form part of a surface water management system.

The system does not cover collection or disposal of the surface water. Information relating to this matter can be obtained from the Certificate holder.

Technical Specification

1 Description

1.1 The JFC HydroChamber Stormwater Management System consists of interlocking chambers and two types of end caps (see Figure 1 and Table 1). Chambers are laid on a bed of crushed stone in rows with a minimum gap of 200 mm between rows. Crushed stone is used to fill these gaps and surround the chambers by at least 150 mm all round. The storage capacity of the installation includes the voids within the crushed stone infill surrounding the chambers.

Figure 1 Components

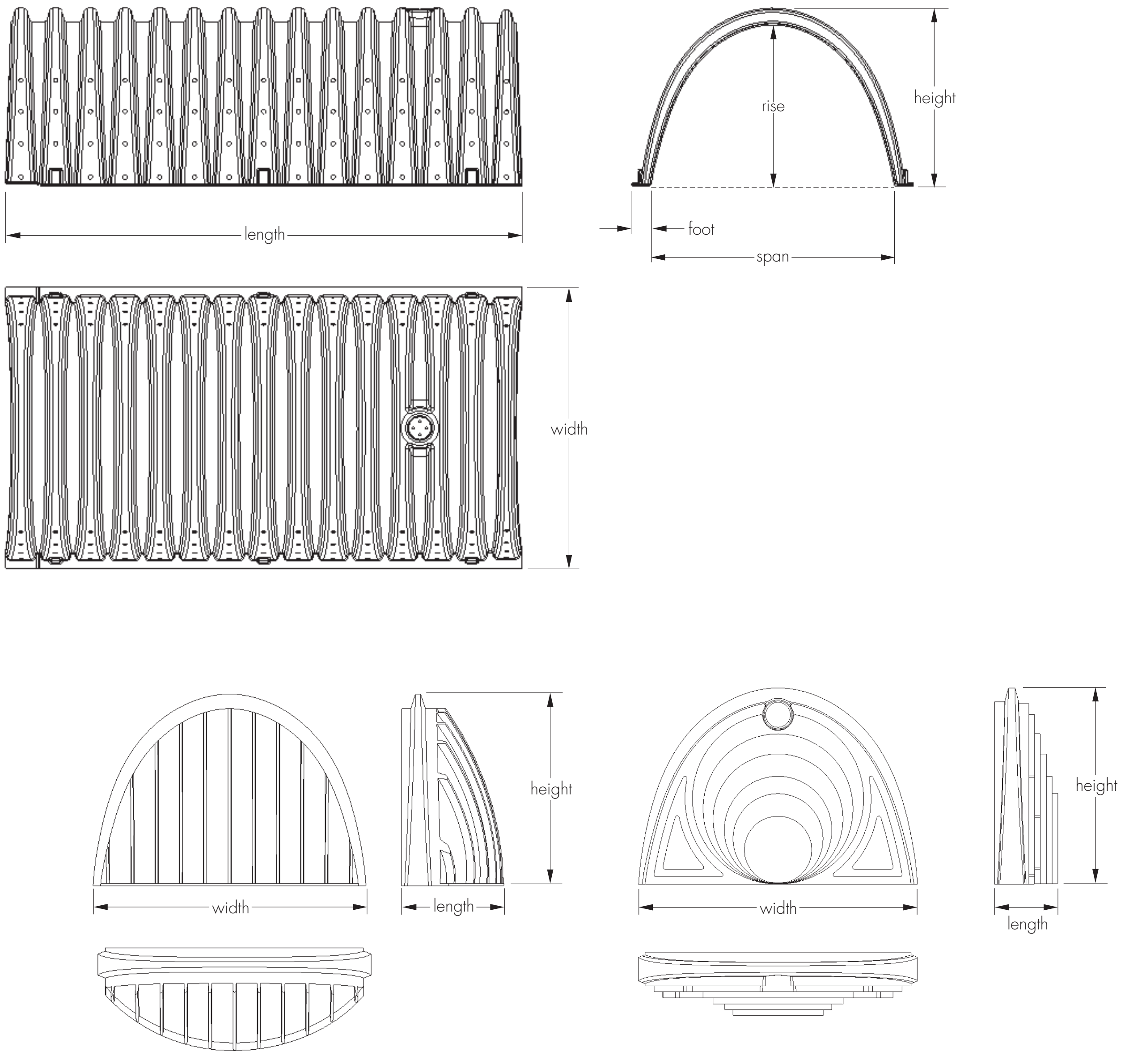


Table 1 Characteristics of HC800 chambers and end caps

Element (unit)	Chamber HC800	End cap HC800-EC01	End cap HC800-EC02
Overall length (mm)	2300	275	415
Installed length (mm)	2175	N/A	N/A
Nominal width (mm)	1265	1115	1130
Nominal height (mm)	800	785	795
Span (mm)	1112	N/A	N/A
Rise (mm)	735	N/A	N/A
Foot width (mm)	76	N/A	N/A
Nominal wall thickness (mm)	5	5	5
Pitch of corrugations (mm)	156	N/A	N/A
Nominal mass (kg)	33	9	9
Nominal storage volume (HydroChamber only) (m^3)	1.4	N/A	N/A
Nominal installed storage volume (m^3)[(1)]	2.1 – 2.8	N/A	N/A

(1) The installed storage volume per chamber will depend on the foundation depth, size of distribution pipe where used and the porosity of the stone (see section 5.3).

1.2 The chambers are vacuum formed from black, high-density polyethylene. The end caps are rotationally moulded from medium-density polyethylene. The material properties are given in Table 2.

Table 2 Material properties

Property	Test method	HC800 Chamber	End caps
Density (kgm^{-3})	ISO 1183-3	960-970	934
Tensile strength (MPa)	ISO 527-2	>1200	650
Flexural modulus (MPa)	ISO 178	>1200	700
Melt flow rate	ISO 1133	0.4 to 0.6 g per 10 min at 190°C and 5 kgs	6 g per 10 min at 190°C and 2.16 kgs
Izod impact resistance	ISO 180/A	19	N/A
50-year creep modulus (MPa)	ISO 899-1[(1)]	135	N/A

(1) Generally in accordance with ISO 899-1 : 2003.

1.3 The infill material is washed, crushed stone to BS EN 13242 : 2002, grade 32/56.

1.4 To maintain a minimum spacing of 200 mm between the outside of the feet of adjacent chambers, a 250 mm spacer may be positioned between the chamber walls. Small diameter plastic pipe may be cut into 250 mm lengths for this purpose.

1.5 The system controls storm water run-off from impermeable surfaces in one of three ways depending on site conditions:

- infiltration system — soakaways to infiltrate storm water back into the ground
- impermeable attenuation system — temporary storage for excess flows and limiting outflow to streams and rivers, or
- permeable attenuation system — excess flow attenuation with a controlled outlet and soakaway provisions for infiltration of a portion of the total flow.

1.6 The chambers and the crushed stone surround are wrapped in a suitable geotextile to prevent migration of fines from surrounding soils for infiltration and permeable attenuation applications. A geomembrane is used to surround the crushed stone for attenuation applications where infiltration is not permitted or possible (see section 7 for additional information on geotextiles and geomembranes). Specifications of the geotextile and geomembrane are project specific and outside the scope of this Certificate. For more information, advice should be sought from the Certificate holder.

1.7 A perforated distribution pipe is normally run through the system between inlet and outlet manholes and connected to a number of adjacent chambers through a manifold[(1)]. The distribution pipe can be inspected and jetted/flushed as required. The distribution pipe should be surrounded by washed, crushed stone to BS EN 13242 : 2002, grade 8/16, sufficient to support the pipe and prevent penetration of larger particles.

(1) JFC Twinwall perforated pipes in various diameters as covered by BBA Certificate 02/H069 are used for this purpose.

1.8 The end cap type EC01 is shaped to allow it to be cut to suit pipes up to 600 mm in diameter. The end cap type EC02 has a domed design with vertical ribs and is used where pipe connections are not required (connection pipework for use with this system is outside the scope of this Certificate).

1.9 Adequate venting must be provided where the chambers are wrapped with a geomembrane (see section 8 for information on venting).

2 Delivery and site handling

2.1 The chambers are delivered on banded bespoke pallets and end caps shrink-wrapped on standard pallets.

2.2 Chambers should be stored:

- on level ground protected from accidental damage, eg by vehicular movements or other site activity
- away from fuel tanks, fuel bowsers or solvents
- protected from direct sunlight if likely to be stored in excess of 12 months.

2.3 Individual chambers may be carried by two persons, normal manual handling precautions should be taken. The mass of the chambers is given in Table 1.

Assessment and Technical Investigation

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

Design Considerations

3 General

3.1 The JFC HydroChamber Stormwater Management System design must be in accordance with the Certificate holder's instructions. Guidance on the application of sustainable drainage systems (SUDS) for new developments, such as the JFC HydroChamber Stormwater Management System, can also be found in the Planning Policy Statement PPS25 *Development and Flood Risk.*

3.2 The system is suitable for the control of storm water run-off from impermeable surfaces. It can be utilised in three main ways:

- infiltration (retention/recharge/soakaway) — water is collected in the units during rainfall and allowed to drain away by soaking into the surrounding ground over a substantial period of time after the rain has stopped
- impermeable attenuation system (detention) — water 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 and, therefore, minimises the risk of flooding
- permeable attenuation system — a combination of above two systems.

3.3 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, including topography; winter water table level; soil type, composition and infiltration rate
- 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.

3.4 Once the project criteria have been established from the site audit, there are two main parts to the design procedure: system design and structural design.

4 Practicability of installation

The units are easily handled and may be installed by operatives with minimal training.

5 System design

Infiltration

Calculation principles

5.1 There are two approaches, either of which may be adopted: the Construction Industry Research and Information Association (CIRIA) Report 156 *Infiltration Drainage — Manual of Good Practice* or BRE Digest 365 *Soakaway* Design[1].

(1) Further information on the design of sustainable urban drainage systems (SUDS) may be obtained from *The SUDS manual* (C697) published by CIRIA.

5.2 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 Technical Handbook (Domestic), Standard 3.6, clause 3.6.5.

5.3 The system storage capacity[1] may be calculated by summation of:

- the number of chambers multipled by 1.4 m^3,
- the internal cross sectional area of any distribution pipe (in m^2) multiplied by the pipe length (in m)
- and the volume of stone (in m^3) multiplied by the porosity (typically 40%).

(1) Typical values have been used for the data given in Table 4.

Table 3 Simplified soakaway design for single-house development[1]

Number of units	Storage volume[2] (m^3)	Max area to be drained (m^2)
1	2.3	115[3]
2	4.6	230[3]
3	6.9	345[3]
4	9.2	460[3]

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

(2) Based on a minimum foundation depth of 300 mm of crushed stone and 150 mm above and 200 mm between chambers assuming a porosity of 40% for the stone.

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

Table 4 Volumetric data for infiltration applications

Volume[1] (m^3m^{-1})	Side area (m^2m^{-1})	Base area (m^2m^{-1})	End-of-chamber area (m^2)
1.06	1.6	1.55	2.60
2.11	1.6	2.80	3.72
3.17	1.6	4.05	4.84
4.23	1.6	5.30	5.96
5.29	1.6	6.55	7.08

(1) Based on a minimum foundation depth of 300 mm of crushed stone and 150 mm above and 200 mm between chambers assuming a porosity of 40% for the stone.

Attenuation

Calculation principles

5.4 The anticipated run-off volume (A) from the site must be 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 are assessed. The depth of water (mm) found can be multiplied by the catchment area to assess the size of attenuation systems and is traditionally based upon a two-hour storm and of a return period appropriate for the catchment. The allowable discharge rate from the site to an appropriate outfall is established but will normally be set by the Environment Agency or Planning Authorities. The outflow volume (B) to be discharged at this rate over the two-hour period is calculated and subtracted from the run-off volume (A–B). This defines the excess volume (C) to be stored in HydroChambers constructed as an underground tank. The number of HydroChambers needed to contain this excess is calculated on the basis that the storage volume of the chambers is in accordance with the values given in Table 4.

5.5 The outlet of detention systems should incorporate a flow control device. The flow control device and the connecting pipework are not covered by the scope of this Certificate.

Connection

5.6 Connection is made between inlet and outlet manholes with a large diameter perforated pipe inside the system. The pipework must be sized to ensure unimpeded flow for a design storm event. The inlet should be free of obstructions and, in some applications, it may be necessary to use multiple inlet pipes in a manifold configuration.

5.7 A silt trap or similar device should be installed upstream of the inlet manhole. An oil separator may also be required where there is a likelihood of contamination or the discharge site is particularly sensitive.

Manifold design

5.8 The distribution pipe may be connected to a manifold, which in turn is connected to a number of chamber rows. The number of connections required depends on the maximum design flow and should be sized accordingly.

Flow control

5.9 The outflow from the tank must be controlled to comply with the discharge rate consent for the site. The main methods to achieve outflow control are by orifice plate, vortex control or small pipe. Comparative features and benefits of these various control flow devices should be considered before selection. However, these devices are outside the scope of this Certificate.

Outflow positioning and head calculations

5.10 The outflow piping design is the same as that for the inlet with one or more large diameter perforated pipes passing through the system to the outlet manhole/manifold.

5.11 The invert level of the outflow pipe should be level or slightly below the bottom of the lined excavation to allow complete drainage. The outflow pipe is sized to convey the peak outflow to the outflow control structure.

5.12 As the chambers fill, a depth of water develops on the upstream side of the outflow control. For design purposes, the head used in calculations is taken from the invert of the outflow device.

6 Structural performance

6.1 JFC HydroChambers may be placed under a wide variety of landscaped or trafficked areas and must be designed to carry all loads that will be applied, including dead and live loads. Minimum and maximum cover depths and other design data is given in Tables 5 and 6.

Table 5 Maximum and minimum cover depths

Application	Cover depth (m)	
	Flexible pavement (eg asphalt)	Rigid pavement (eg reinforced concrete)
Non-trafficked	0.6[1] – 2.4[1][3]	0.6[1] – 2.4[1][3]
Car park and LCV traffic	0.6 – 2.4[2][3]	0.6 – 2.4[2][3]
HGV traffic	0.95 – 2.4[2][3]	0.6 – 2.4[2][3]

(1) The minimum cover may be reduced to a lower level if construction traffic can be eliminated from the area over the installation. The Certificate holder should be contacted for more information.

(2) Minimum cover to underside of pavement for trafficked applications due to traffic from construction equipment installing the pavement layer.

(3) Maximum burial depths assumes a soil density of 2000 kgm^{-3}, for lighter soils deeper burials are possible. The Certificate holder should be contacted for more information.

Table 6 Loading

Characteristic	Short term (vehicle loading)	Long term (earth loading)
Expected service life (years)	>50	>50
Safety factor	3.5	2
Design load	115 kN Max single axle at 600 mm cover	35.3 kNm^{-2}
Test load (kN)		
Case 1 — single axle, single wheel	100	—
Case 2 — double axle, double wheels	260	—
Case 3 — single axle, single wheel	200	—
Case 4 — single point load, 225 mm plate	200	—
Strain limit (%)	3.3	3.3
Modulus for design condition (MPa)	1200	135

6.2 Maximum burial depths given in this Certificate are based on creep testing of the HDPE material. The stated maximum burial depth of 2400 mm is based on a 50-year creep modulus of 135 MPa.

6.3 All safety factors are based on foundation requirements as outlined in Table 7 and backfill requirements as outlined in Figure 2.

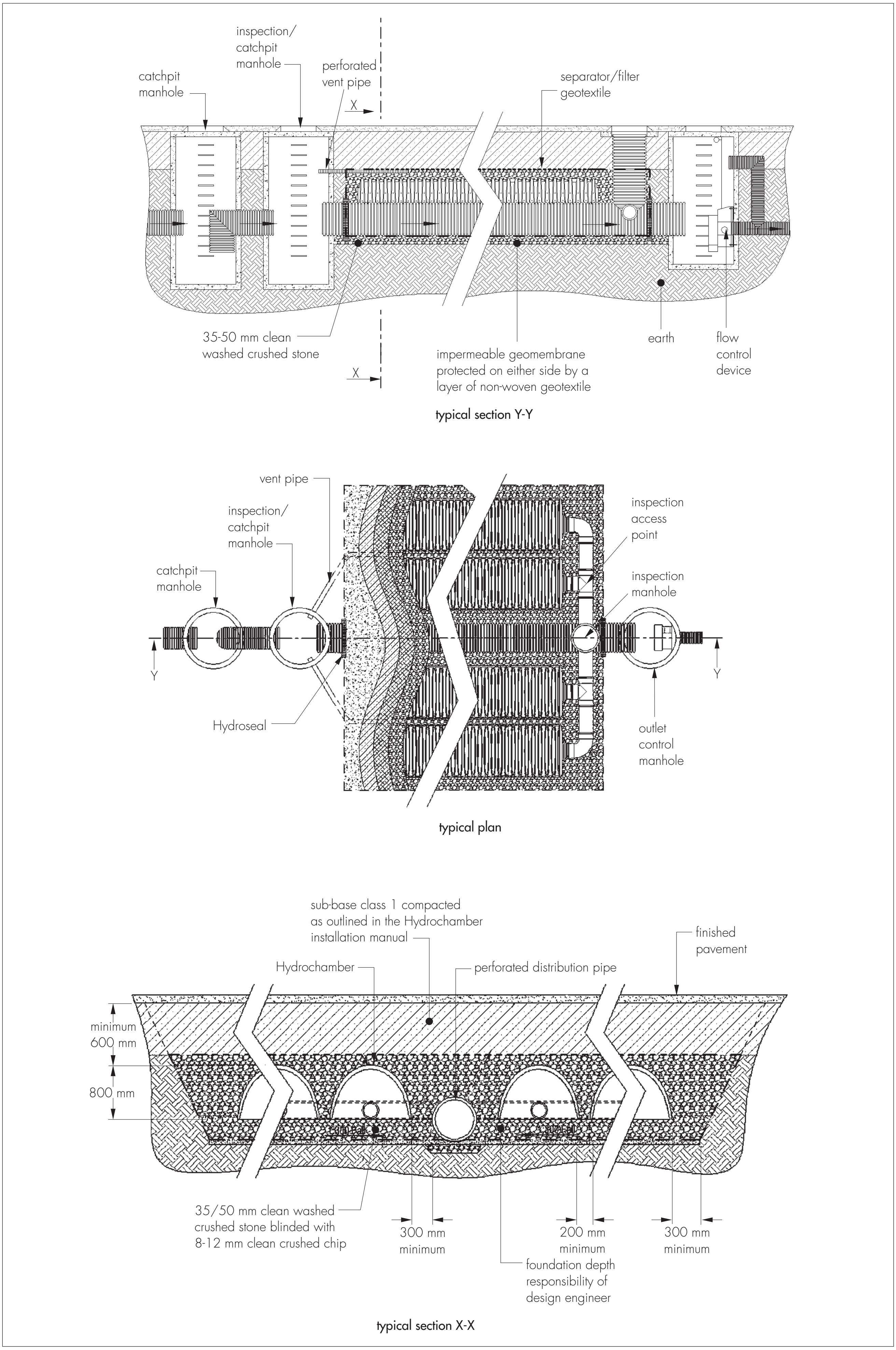
Table 7 Foundation depth for different bearing capacities

Soil type	Condition	CBR value[1][2] (%)	Cover (m)		
			<1.5	1.6 –2.0	2.1 – 2.4
Dead loads (non-trafficked area)					
Sandy clay/boulder clay	firm	2	0.3	0.5	0.6
Sandy clay/boulder clay	stiff	3	0.3	0.3	0.3
Sandy gravel	compacted	15	0.15	0.15	0.15
Dead and live loads (trafficked area)					
Sandy clay/boulder clay	firm	2	0.3	0.6	0.9
Sandy clay/boulder clay	stiff	3	0.3	0.3	0.6
Sandy gravel	compacted	15	0.15	0.3	0.3

(1) CBR value: California Bearing Ratio.

(2) If value is less than 2%, advice should be sought from a Geotechnical Engineer.

Figure 2 Typical installation details



6.4 All foundation and infill stone to 150 mm above the crown of the chambers shall be clean, crushed stone to BS EN 13242 : 2002, grade 32/56.

6.5 The foundation depth recommended depends on the bearing capacity of the underlying soil. Recommendations are given in Table 7.

6.6 For small-scale applications such as soakaways for individual house roof drainage, the system is typically located below a garden at a minimum of 5 m from any building.

6.7 For lightly-loaded applications, the bearing capacity of the underlying soils, typically, should not be exceeded by the JFC HydroChamber System. Therefore, settlement of the underlying soils should be negligible. On weak or compressible soils, the bearing capacity and settlement characteristics should be confirmed by a geotechnical engineer.

7 Geotextiles and geomembranes

7.1 A geotextile is wrapped around the system (see Table 8) in infiltration and permeable attenuation applications to:

- prevent clogging of the soil which surrounds the unit with silt present in run-off
- prevent soil and fines entering the system from surrounding ground.

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

- pore size — 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 materials
- puncture resistance — the geotextile must be able to resist the punching stresses caused by loading on sharp points of contact
- tensile strength — the geotextile should have sufficient strength to resist the imposed forces (eg from traffic).

7.3 A specialist's 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.

7.4 An impermeable membrane or liner is wrapped around the system in impermeable attenuation/storage applications where infiltration is not possible or permitted and functions to:

- prevent release of attenuated/stored water to surrounding ground
- prevent inflow of pollutants from contaminated subsoil into the storage reservoir.

7.5 The specification and selection of the impermeable membrane or liner 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.

Table 8 Typical specification for a polypropylene non-woven geotextile

Properties	Value	Tolerance	Test method
Tensile strength (MD(1), CD(2)) (kNm^{-1})	12	−1.6	BS EN ISO 10319
Elongation (MD, CD) (%)	50	±11.5	BS EN ISO 10319
Static puncture resistance (CBR(3)) (kN)	2	−0.00	BS EN ISO 12236
Dynamic perforation resistance (cone drop) (mm)	24	+5	BS EN 918
Protection efficiency (N)	124	−24.8	BS EN 13719
Water flow normal to plane (lm^{-2})	105	−31.5	BS EN ISO 11058
Water flow capacity in the plane (m^{-2}) (% log q)	1×10^{-7}	−10	BS EN ISO 12958
Characteristic opening size (μm)	110	±33.00	BS EN ISO 12956
Thickness under 2 kPa (mm)	1.3	±0.26	BS EN 964-1
Weight (gm^{-2})	155	±15.50	EN 965
Composition	100% polypropylene non-woven geotextile		

(1) Machine direction.

(2) Cross machine direction.

(3) California Bearing Ratio.

7.6 Two options are recommended by the Certificate holder:

- a geomembrane protected on both sides by a layer of non-woven geotextile (see Tables 9 and 10).
- geosynthetic clay liner (GCL) (see Table 11).

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

(1) Advice on seam testing is given in CIRIA SP124 *Barriers, liners and cover systems for containment and control of land contamination*.

Table 9 Typical specification for a polypropylene geomembrane

Property	Value	Test method
Thickness (mm)	1	—
Density (gcm^{-2})	>0.89	ISO 1183-3
Tolerance average value (%)	±5	DIN 53370
Tensile stress at break (MPa)	>18	ISO 527-1
Elongation at break (%)	>700	ISO 527-1
Tear propagation resistance (Nmm^{-2})	>45	DIN 53515
Piercing resistance (N)	>170	FTMS 101C
Stress crack resistance (h)	2000	ASTM D 1693
Oxidation Induction time (mins)	>100	ASTM D 3895 (200°C)
Water absorption after 7 days (%)	<0.2	BS EN ISO 62
Dimensional changes (%)	±2	DIN 53377

Table 10 Typical specification for non-woven protector geotextile

Properties	Value	Tolerance	Test method
Tensile strength (MD[1], CD[2]) (kNm^{-1})	20/22	−2.6/−2.9	BS EN ISO 10319
Elongation (MD, CD) (%)	45/55	±10.4/12.7	BS EN ISO 10319
Static puncture resistance (CBR[3]) (kN)	3.8	−0.76	BS EN ISO 12236
Dynamic perforation resistance (cone drop) (mm)	9	+1.80	BS EN 918
Protection efficiency (N)	330	−66	WI 189066
Water flow normal to plane (lm^{-2})	80	−24	BS EN ISO 11058
Water flow capacity in the plane (m^{-2})/(% log q)	8×10^{-6}	−10	BS EN ISO 12958
Characteristic opening size (μm)	80	±24	BS EN ISO 12956
Thickness under 2 kPa (mm)	2.2	±0.44	BS EN ISO 9863-1
Weight (gm^{-2})	300	±30	EN 965
Composition	100% polypropylene non-woven geotextile		

(1) Machine direction.

(2) Cross machine direction.

(3) California Bearing Ratio.

Table 11 Typical specification for geosynthetic clay liner (GCL)

Property	Required value	Test frequency	Test method
Index flux ($m^3m^{-2}s^{-1}$)	2×10^{-9}	Weekly	ASTM D 5887
Permeability (ms^{-1})	1×10^{-11}	Weekly	ASTM D 5084
pH	9.8 max	Weekly	BS 1377-2
Bentonite fluid loss (ml)	18 max	5000 m^2	ASTM D 5891
Bentonite mass (kgm^{-2})	4.8	5000 m^2	ASTM D 5261
Grab strength (N)	400	5000 m^2	ASTM D 4632
Grab elongation (%)	20	5000 m^2	ASTM D 4632
Peel strength (N)	65	5000 m^2	ASTM D 4632
Bentonite swell index [$ml(2g)^{-1}$]	24	5000 m^2	ASTM D 5890

8 Venting

8.1 For most chamber applications, venting back through the inlet piping is sufficient. However some applications, where inlet piping may be submerged, require additional vent capacity. A typical detail to achieve additional venting is shown in Figure 2. However, the consulting engineer may specify alternative details.

8.2 It is recommended that one 100 mm perforated vent pipe be used per 400 m^3 of storage volume.

9 Resistance to chemicals

9.1 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.

9.2 An assessment of the suitability for use of JFC HydroChambers on brownfield sites 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 supplied by the Certificate holder.

10 Maintenance

10.1 The owner of the structure is responsible for maintenance.

10.2 The open design of the chambers allows inspection of the inside of the structure provided adequate access is available. Each chamber has a preformed socket that may be cut out to accept a 100 mm pipe to provide an inspection port.

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

10.4 For installations other than that of single dwellings it is recommended a double catchpit manhole arrangement be used as outlined in Figure 2. These catchpits help to prevent sediment and floatable contaminants entering the system and allow for inspection and maintenance of the main distribution pipe.

10.5 Visual inspections may be carried out at inlet and outlet manholes, when entering manholes due attention should be paid to relevant health and safety procedures. Camera inspections may also be carried out at the access point on the distribution pipe, at chamber inspection ports or from the inspection manifold.

10.6 During construction it is recommended to inspect both inlet catchpit manholes monthly, if either catchpit is 50% full both should be de-silted with a vacuum tanker. If a large amount of silt is present, a silt screen may be fitted in the inlet manhole during construction. When construction is finished a full camera inspection is recommended on the main distribution line between inlet and outlet manholes and the system should be jetted or flushed out as required.

10.7 When the construction phase has been completed the intensity of contaminants entering the system greatly reduces. Appropriate maintenance programmes will vary from site to site but a suggested programme is given thus:

- Both inlet catchpit manholes should be inspected at six monthly intervals in the first year
- If either catchpit is 50% full, both should be de-silted with a vacuum tanker
- After the first year, a camera inspection of the main distribution pipe and associated inspection points should be carried out
- If contaminants are found in the line, it should be flushed/jetted and the catchpit manholes de-silted
- After the first year, inspection should be carried out annually or bi-annually depending on activity, and maintenance carried out as deemed appropriate
- Best management practices should be maintained to minimise contaminants entering the stormwater network.

10.8 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 flow control itself may be protected by a debris screen.

11 Durability

11.1 The polyethylene used to manufacture the chambers will not deteriorate significantly over the life of the structure and will remain chemically stable under exposure to contaminants normally found in a storm-water environment and will not be susceptible to environmental stress cracking.

11.2 In common with all thermoplastic structures, the chambers will creep with time. This is taken into account in long-term design by the use of a 50-year modulus for the material to allow for accumulated strain under a dead load. In the opinion of the BBA, the system when used and installed in accordance with this Certificate will have a life in excess of 50 years.

Installation

12 General

The JFC HydroChamber Stormwater Management System should be installed in accordance with the Certificate holder's installation instructions.

13 Procedure

13.1 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 compaction plant access around sides to compact backfill material (300 mm minimum). The subgrade 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: 1981, with particular attention paid to safety procedures.

13.2 The subgrade must be inspected for soft spots in the formation and if any present, they must be excavated and replaced with compacted granular fill material to ensure the bearing capacity in accordance with Table 6 of this Certificate or the structural engineer's requirements.

13.3 The geotextile and/or geomembrane should be placed over the prepared subgrade soils and up the side walls of the excavation. Where a membrane is used, the manufacturers' recommendations for making joints should be followed and care must be taken to prevent damage to the membrane during construction.

13.4 The perforated distribution pipe(s) is installed along the base of the excavation ensuring accurate positioning according to the plans. When installing a sealed system, particular care must be taken to ensure correct sealing of the pipe to the membrane. Accessories to assist in sealing the pipe to the membrane are available from the Certificate holder, but their performance is outside the scope of this Certificate. The Certificate holder should be contacted for further details.

13.5 A layer of clean, crushed, angular, structural aggregate is placed over the entire base of the excavation and mechanically compacted to achieve a flat, level surface. The minimum thickness of this layer will depend on the bearing capacity of the subsoil (see Table 6).

13.6 The aggregate is blinded with a layer of clean crushed stone in accordance with BS EN 13242 : 2002, grade 8/12, to provide a flat level base; the stone is raked to achieve a flat level surface and eliminate voids below the chamber feet.

13.7 The first row of chambers is laid (with the feet of the chambers at least 300 mm from the distribution pipe) with successive chambers overlapping its predecessor by the end corrugation (see Figure 3).

Figure 3 Typical distrubution pipe installation

13.8 End caps are placed into the end corrugation of the last chamber, which may have to be lifted to complete this operation.

13.9 Adjacent rows must be spaced at least 200 mm apart, measured between the feet of the chambers. Spacers may be used between adjacent rows to maintain correct spacing.

13.10 Where required by the design, inlet and outlet connections can be made to individual rows of chambers by cutting holes in end cap (type EC-01) using a reciprocating saw to suit standard pipe sizes up to 600 mm in diameter. Connections to any manifold pipes are made in the same way (see Figure 4).

Figure 4 Typical manifold installation

13.11 Clean, crushed structural aggregate is placed between the adjacent rows and around the perimeter of the chambers. Care must be taken to ensure that the chambers are not displaced and the minimum 200 mm spacing is maintained. The aggregate must cover the crown of the chambers by at least 150 mm.

13.12 The geotextile and/or geomembrane is laid over the top of the aggregate.

13.13 The backfill above the geotextile should be Type 1 or Type 2 sub-base-selected granular material in accordance with *The Manual of Contract Documents for Highway Works,* Volumes 1 and 2. It should be compacted in 150 mm thick layers and carried out to a minimum 95% of the standard proctor density. Compaction plant should not exceed a maximum gross vehicle weight of 3000 kg and a dynamic (vibratory) weight of 10 000 kg as outlined in the HydroChamber installation manual.

13.14 The overall thickness of the backfill above the crown of the chambers must be a minimum of 600 mm to the bottom of the pavement and a maximum of 2400 mm to the top of the pavement. Where it is unpaved and rutting from vehicles may occur, the minimum cover after rutting must be maintained at 600 mm.

13.15 The pavement construction or landscaping is completed over the system.

Technical Investigations

14 Test

Tests were carried out on the system to determine:

- long- and short-term resistance to loading of a full-scale installation
- dimensional accuracy and volumetric capacity.

15 Investigations

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

15.2 A site visit was made to assess the practicability and ease of installation and connection.

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

- material properties
- design procedures.

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15 Conditions

15.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is granted only to the company, firm or person named on the front page — no other company, firm or person may hold or claim any entitlement to this Certificate
- 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.

15.2 References in this Certificate to any Act of Parliament, Statutory Instrument, Directive or Regulation of the European Union, British, European or International Standard, Code of Practice, manufacturers' instructions or similar publication, are references to such publication in the form in which it was current at the date of this Certificate.

15.3 This Certificate will remain valid for an unlimited period provided that the product/system and the manufacture and/or fabrication including all related and relevant 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.

15.4 In granting this Certificate, the BBA is not responsible for:

- 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
- individual installations of the product/system, including the nature, design, methods and workmanship of or related to the installation
- the actual works in which the product/system is installed, used and maintained, including the nature, design, methods and workmanship of such works.

15.5 Any information relating to the manufacture, supply, installation, use and maintenance 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 and maintained. It does not purport in any way to restate the requirements of the Health & Safety at Work etc Act 1974, or of any other statutory, common law or other duty which may exist at the date 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. In granting this Certificate, the BBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the manufacture, supply, installation, use and maintenance of this product/system.

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