ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	British Precast Concrete Federation
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-BPC-20170091-CCD1-EN
Issue date	11/07/2017
Valid to	10/07/2022

UK Manufactured DN600 Concrete Pipe with Class B Bedding

Produced by members of the Concrete Pipeline Systems Association (CPSA) a product group of the British Precast Concrete Federation

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mpa British Precast

General Information

British Precast Concrete Federation	DN600 Concrete Pipe
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the Declaration** British Precast Concrete Federation The Old Rectory 8 MainStreet,Glenfield Leicester, LE3 8DG
Declaration number EPD-BPC-20170091-CCD1-EN	**Declared product / Declared unit** 1m length DN600 unreinforced precast concrete pipe with an average gross density excluding bedding material of 2350 kg/m^3. The declared unit includes class B bedding for the 1m length.
This Declaration is based on the Product Category Rules: Pre-cast concrete components, 07.2014 (PCR tested and approved by the SVR)	**Scope:** This is an association declaration which uses manufacturing data from member companies of the Concrete Pipeline Systems Association (CPSA) for a mass weighted average 1m length of DN600 precast concrete pipe with class B bedding. It is based on data covering a period of 12 months (From January to December 2014). All data were collected from UK factories. The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
Issue date 11/07/2017	**Verification** The CEN Norm /EN 15804/ serves as the core PCR Independent verification of the declaration according to /ISO 14025/ ☐ internally ☒ externally
Valid to 10/07/2022	
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	
Dr. Burkhart Lehmann (Managing Director IBU)	Mr Carl-Otto Neven (Independent verifier appointed by SVR)

Product

Product description / Product definition
The product covered in this EPD is a generic 1m length of precast DN600 concrete pipe with class B bedding. Precast concrete pipes are made of cement, aggregates, water and (if needed) admixtures. Reinforcing steel is also present in some precast concrete pipes but not the size studied in this EPD. The pipes covered by this EPD have been manufactured using a cast moulding process in a specialist factory vibration system setting. The instant strip moulds are normally fabricated from steel plates, with fixings such that the mould casings can be easily removed. Once cast the pipes are either steam cured or stored in a warm humid environment to cure, sometimes electrically controlled. Primary data for the production of precast concrete pipes were collected from members of the Concrete Pipeline Systems Association (CPSA). These data were used to generate a mass weighted average of production for the EPD.

For the placing on the market of the product in the EU/EFTA (with the exception of Switzerland) Regulation (EU) No. 305/2011 / CPR / applies. The product needs a Declaration of Performance taking into consideration BS EN 1916:2002 Concrete pipes and fittings, unreinforced, steel fibre and reinforced / BS 5911-1:2002+A2:2010 Concrete pipes and ancillary concrete products and the CE marking. For the application and use the respective national provisions apply.

Application
Precast concrete pipes are used in a variety of applications including storm water drainage and foul sewer systems.

Technical Data
Concrete is specified in accordance with /BS8500 / EN 206
Precast concrete pipes are manufactured to BS EN 1916:2002/ Concrete pipes and fittings, unreinforced, steel fibre and reinforced and /BS 5911-1:2002+A2:2010 /Concrete pipes and ancillary concrete products

The products covered by this EPD are CE marked. If

you require CE marking declaration of performance information contact your CPSA pipe supplier.

Constructional data

Name	Value	Unit
Gross density (Concrete)	2350	kg/m^3
Tensile strength	3.2 - 3.5	N/mm^2
Modulus of elasticity	34 - 35	N/mm^2
Longitudinal bending strength	Dimensionally adequate	-
Durability	DC4	-
Strength Class	120	-
Water tightness (Batch test)	50	KPa
Water cement ratio	<0.45	
Minimum crushing load	72	kN/m
Water absorption by mass	6	%
Dimensional tolerances relevant to joints (BS EN 1916)	Joint validation by method 1 or 2 / 12.5mm angular defection	-
Max chloride content	1	%
Characteristic concrete strength (minimum)	40	N/mm2

The information contained within the Constructional Data table is based on CPSA Technical Committee agreed Performance data of the product in accordance with the Declaration of Performance with respect to its Essential Characteristics according to /EN 1916:2002, Concrete Pipes and fittings, unreinforced, steel fibre and reinforced/ and /BS 5911-1:2002+A2:2010, Concrete Pipes and ancillary concrete products

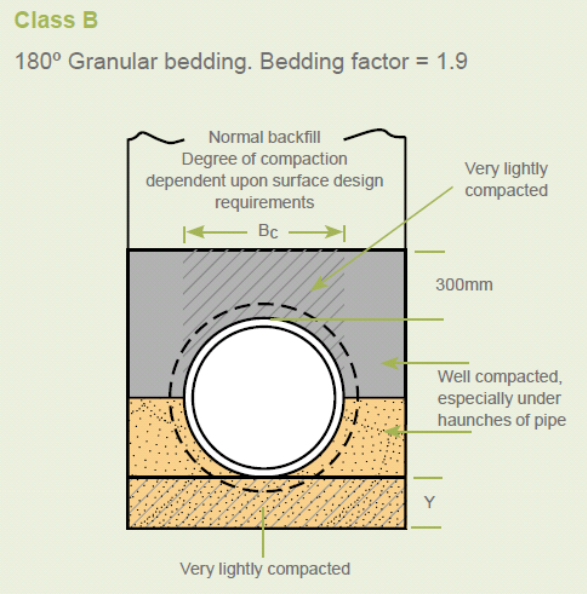
Base materials / Ancillary materials
The concrete mix proportions are as follows: aggregates 80% cement 17%; water 3%.
No /REACH/ substances of very high concern are included.

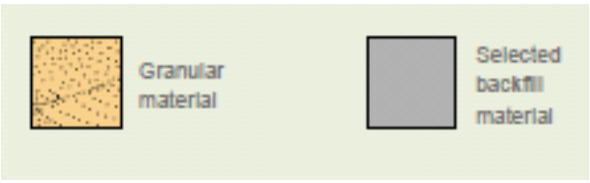
Reference service life
/BS 8500/, the UK's concrete specification standard complementary to /EN 206/, sets durability requirements for precast concrete elements. With regard to requirements set out in /BRE Special Digest 1/ the reference service life (RSL) for the declared unit is 100 years.

LCA: Calculation rules

Declared Unit
The declared unit is 1m length of DN600 precast concrete pipe with class B bedding. The data used in the LCA calculations is an average based on total annual production figures from 3 members of the CPSA. DN600 pipes are manufactured in 2.5m lengths as standard. Information on density and other physical characteristics are shown in the table below.

Class B Bedding – 180□ Granular Bedding with normal backfill.





Bedding volume -According to the CPSA online calculator (https://www.concretepipes.co.uk/calculators/material-cost) DN600 pipe Class B requires 0.49 cubic metres of imported granular material (per metre run).

Bedding mass - Assuming bulk density is 2.2 tonnes per cubic metre, the mass of granular bedding is 2.2 x 0.49 = 1078kg (per metre run)

Pipe mass - Mass of pipe is taken from manufacturer information (average of the participating companies), the average mass of 1m of DN600 pipe is 488kg.

Declared unit

Name	Value	Unit
Density (excluding bedding)	2350	kg/m^3
Declared unit	1.566	t

System boundary
Type of EPD: Cradle to Gate with all options declared. The modules considered in the Life Cycle Assessment are modules A1-C4 inclusive.

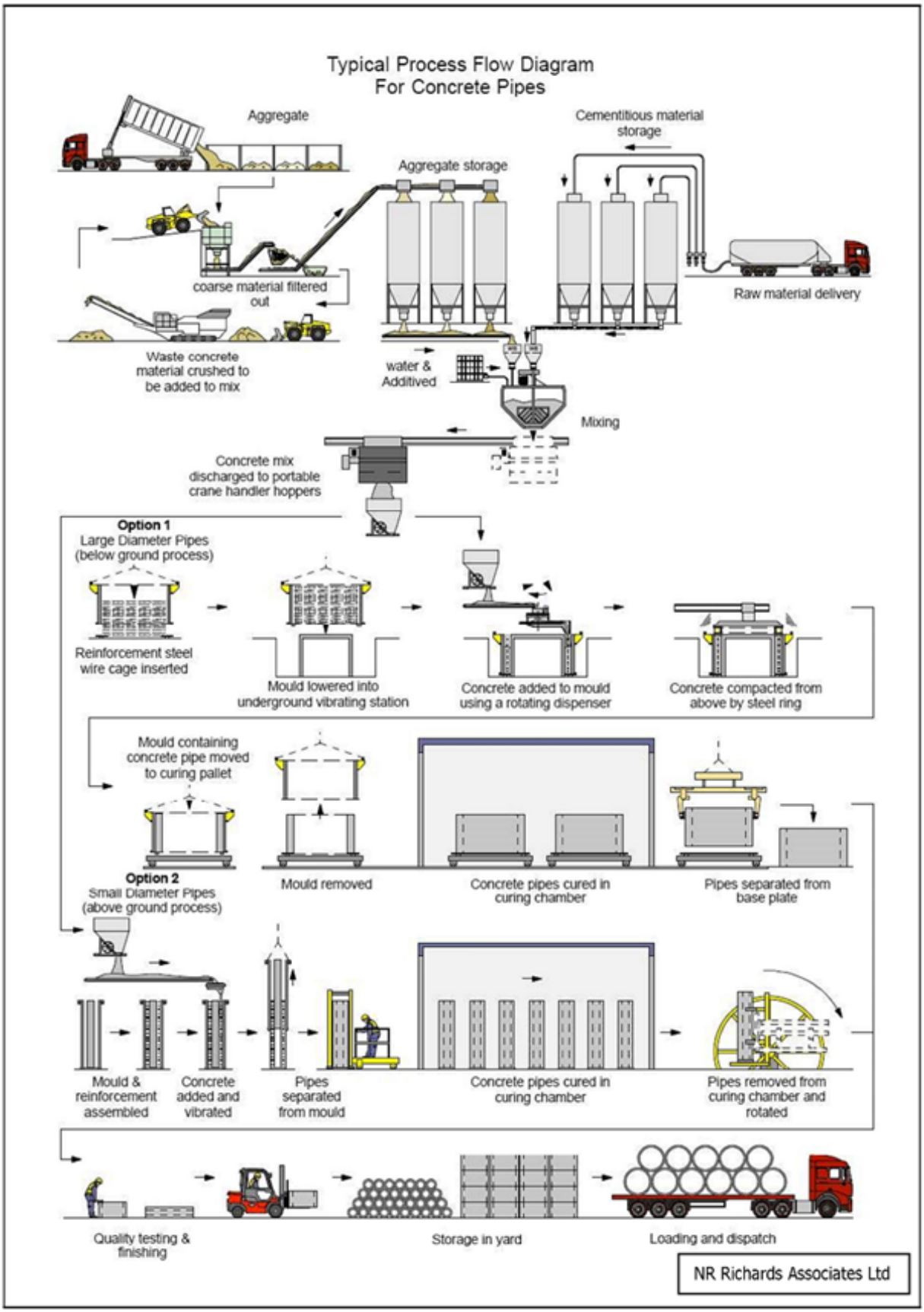
Cut-off criteria
/EN 15804/ requires that where there are data gaps or insufficient input data for a unit process the cut-off criteria shall be 1% of renewable and non-renewable

primary energy usage and 1% of the total mass of this unit process. The total neglected flows from a product stage must be no more than 5% of product inputs by mass or 5% of primary energy contribution.
In this assessment, all information gathered from data collection for the production of precast concrete has been modelled, i.e. all raw materials used, the electrical energy and other fuels used, use of ancillary materials and all direct production waste. Transport data on input and output flows are also considered. Scenarios have been developed to account for downstream processes such as fabrication, installation, demolition and waste treatment. No cut-offs have been made. Hence this study complies with the cut-off criteria defined in the /PCR/.

Background data
Background data is based primarily on a generic dataset /GaBi 2014 ts software database/ integrated into the IBU verified bespoke British Precast Envision EPD tool. The background data also includes UK specific cement data supplied by members of the Mineral Products Association (MPA). (Tool Verified 07/03/17).

Allocation
All allocation is performed according to the PCR. As no co-products are produced, the flow of materials and energy and also the associated release of substances and energy into the environment are related exclusively to the concrete produced.

Process Flow Diagram - See Below



characteristics of performance, are taken into account.
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Comparability
Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific

LCA: Scenarios and additional technical information

The following information supports the declaration of modules A1-C3 inclusive.

Transport to the building site (A4)

Name	Value	Unit
Transport distance	174	km
Capacity utilisation (including empty runs)	50	%

Installation into the building (A5)

Name	Value	Unit
Material loss	0.5	%

Use or application of the installed product (B1)

In practice, given the nature of the product and its application, no impacts are associated with the use stage of concrete over the lifetime of the pipeline. However, carbonation of concrete will occur during the lifetime of the pipeline and is included in module B1. Carbonation is calculated using the approach recommended by the Mineral Products Association and BPCF and follows the methodology developed by Pommer et al. /Pommer 2005/ and used by BRE in its PCR /BRE 2013/.

For precast concrete carbonation factors based on BPCF research and expert judgment have been used. The depth of carbonation on each surface has been modelled as 1.59 mm based on average conditions for a precast element of this type. The surface area is assumed to be 1.88 m^2 based on one exposed surface for a concrete pipe. Carbonation of the pipes outer surface will depend on ground conditions and so was not modelled in this EPD.

The study period is assumed to be 100 years (the RSL).

Modules B2 - B7 (Maintenance, Repair, Replacement, Refurbishment, Operational Energy Use, Operational Water Use)

The precast concrete pipe covered by this EPD does not require maintenance, repair, replacement or refurbishment during its lifetime. Consequently, the impacts associated with these lifecycle stages are zero. There is no operational energy or operational water requirement associated with the product.

Reference service life

Name	Value	Unit
Reference service life	100	a

Modules C1-C4 End-of-Life (Deconstruction, demolition, transport, waste processing and disposal)

For this assessment BPCF has modelled a scenario for the end of life of concrete pipes based on expert advice and CESWI 7. At end-of-life, 100% of precast concrete pipes are assumed to be abandoned underground, sealed and filled with grout. When pipes are abandoned CESWI 7 states that two options are available, sealing with no grouting and sealing with grouting. BPCF is aware that in a large proportion of cases where pipes are decommissioned and abandoned, contracts require pipes to be filled in with grout to prevent collapse and gas build-up. There is currently insufficient information to model the exact proportion of pipes treated in this way.
The grout used to fill the void in the pipe is modelled as G3 grout with a density of 1680 kg/m^3 and a mass per metre run of 475kg. The grout mix is assumed to be 30.87kg CEMI, 308.7kg primary aggregate (Sand) and 0.136m^3 of water.

LCA: Results

In Table 1 "Description of the system boundary", all declared modules are indicated with an "X"; Module D, which is not declared, is indicated with "MND". Indicator values are declared to three significant digits.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	MND

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1m DN600 Concrete Pipe (Class B Bedding)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
GWP	[kg CO_2-Eq.]	7.03E+1	9.67E+0	1.64E-2	-2.70E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.48E+1
ODP	[kg CFC11-Eq.]	5.15E-7	6.56E-12	3.60E-13	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.42E-7
AP	[kg SO_2-Eq.]	1.23E-1	4.04E-2	6.01E-5	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	7.76E-2
EP	[kg $(PO_4)^{3-}$-Eq.]	1.18E-2	9.89E-3	1.21E-5	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	8.52E-3
POCP	[kg ethene-Eq.]	3.75E-2	-1.51E-2	7.50E-6	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.03E-2
ADPE	[kg Sb-Eq.]	1.33E-4	1.82E-7	1.23E-8	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	8.87E-5
ADPF	[MJ]	397.50	133.10	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	231.40

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources

RESULTS OF THE LCA - RESOURCE USE: 1m DN600 Concrete Pipe (Class B Bedding)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
PERE	[MJ]	36.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.28
PERM	[MJ]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PERT	[MJ]	36.35	2.71	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.94
PENRE	[MJ]	435.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	216.00
PENRM	[MJ]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENRT	[MJ]	435.40	133.50	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	246.50
SM	[kg]	92.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.05
RSF	[MJ]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRSF	[MJ]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FW	[m^3]	8.39E-2	8.67E-3	7.59E-5	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.66E-1

Caption	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1m DN600 Concrete Pipe (Class B Bedding)

Parameter	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
HWD	[kg]	8.02E-3	6.21E-7	1.04E-8	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	5.34E-3
NHWD	[kg]	5.91E+1	2.33E-3	6.23E-4	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.83E+1
RWD	[kg]	1.58E-2	1.43E-4	8.23E-6	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	5.92E-3
CRU	[kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFR	[kg]	0.00	0.00	2.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.30
MER	[kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EEE	[MJ]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EET	[MJ]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Caption	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EEE = Exported thermal energy

Interpretation

Interpretation of the results has been carried out considering the methodology, data-related assumptions and any limitations declared in the EPD.

Interrogation of the LCA results show that the cradle-to-grave **GWP** (Global Warming Potential) impact of 1m length of DN600 concrete pipe with class B bedding is 122 kgCO2e (Modules A1-C4).

For **GWP**, A1-A3 accounts for 57% of the lifecycle impact with carbonation in the use phase reducing the overall impact by 2%. The process of grouting a pipe at the end of life contributes 37% of the cradle to grave **GWP** impact. .

The LCA results show that the cradle-to-grave primary energy demand of the declared unit is 863 MJ (Modules A1-C4).

For primary energy demand, A1-A3 accounts for 55% of the lifecycle impact.

The cradle-to-grave Net use of fresh water (**FW**) is 0.26m^3 (Modules A1-C4) with the product stage (A1-A3) accounting for 32% of this.

Additional Environmental Information

This EPD has declared one end-of-life scenario for module C4 to comply with current scheme requirements. The declared end-of-life scenario is that the pipeline is abandoned underground, sealed and then filled with grout to prevent collapse or gas accumulation. British Precast acknowledges that other scenarios are possible. The first alternate scenario is that 100% of precast concrete pipes are assumed to be abandoned underground and sealed only. When pipes are abandoned CESWI 7 states that two options are available, sealing with no grouting and sealing with grouting. Abandonment where pipes are sealed only is deemed to have little or no environmental impact. In CESWI 7 section 5.23: Sewers and Manholes to be Abandoned, additional clause 3 states that “Unless otherwise specified, sewers and pipelines to be abandoned shall be sealed either end with a concrete plug”. Across the full length of a pipeline this concrete plug is deemed to have a negligible impact and as such can be ignored under cut-off rules.

A second alternative scenario exists where 100% of precast concrete pipes are assumed to be exhumed from the ground and crushed. The crushed concrete is then assumed to remain on site for 5 weeks before being transported to waste processing. It can then be assumed that 90% of concrete is recycled and 10% is sent to inert landfill.
As a result of assumptions made, no carbonation is assumed to take place in modules C1 or C3 for the end of life scenarios declared. In the second alternative scenario, carbonation will occur when the concrete pipes are crushed. This additional carbonation in the end-of-life modules and removing the need to grout the pipe would result in an aggregated C1-C4 **GWP** value of -3 $kgCO_2e$ compared with the 45 $kgCO_2e$ declared in this EPD.

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thinkstep
GaBi 2014 ts software database

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