Environmental Product Declaration

Reinforced Concrete Pipes (RCP)

manufactured by Humes in Pooraka

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021
Programme: The International EPD® System
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Geographical scope: Australia

EPD of multiple concrete pipe products from one location, based on a representative product.
The products declared in this EPD are listed on pages 20-23
An EPD should provide current information and may be updated if conditions change.
The stated validity is therefore subject to the continued registration and publication at www.epd-australasia.com

Contents

Disclaimer

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

Programme information and verification

An Environmental Product Declaration (EPD) is a standardised way of quantifying the potential environmental impacts of a product or system. EPDs are produced according to a consistent set of rules – Product Category Rules (PCR) – that define the requirements within a given product category. These rules are a key part of ISO 14025 as they enable transparency and comparability between EPDs. This EPD provides environmental indicators for Humes steel-reinforced concrete drainage pipes manufactured at Pooraka in Australia. This EPD is a "cradle-to-gate with options (A1-A3, A4, A5), modules C1-C4, and module D" declaration covering production, distribution, and end-of-life. Information regarding the installation and use of pipes is provided in the section "Other environmental information". This EPD is verified to be compliant with EN 15804. EPDs of construction products may not be comparable if they do not comply with specific requirements, as per the disclaimer on the previous page. Holcim (Australia) Pty Ltd, as the EPD owner, has the sole ownership, liability, and responsibility for the EPD.

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CEN standard EN 15804 served as the core PCR

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Humes

Humes Concrete Products (Humes) is a division of Holcim (Australia) Pty Ltd, one of the world's leading suppliers of cement and aggregates. Humes is the largest civil precast concrete manufacturer in Australia, employing over 600 people.

We have a number of Humes factories around Australia, with spun or dry cast reinforced concrete pipes produced in nine locations. This EPD covers pipes manufactured at Pooraka.

Humes has a long history of engineering precast and prestressed concrete solutions and, after 100 years of manufacture, our product range has never been more diverse, more competitive, or more in-tune with our clients' needs than it is today.

We offer a range of solutions for bridges and platforms, road and rail infrastructure, tunnels and shafts, retaining walls, pipeline systems, water treatment, reuse and detention, and traffic management. We can customise our solutions to ensure they create maximum value for your project, accommodating your site conditions, design requirements and construction factors.

The quality and reliability of Humes' products and services are the foundation of our success. Our ability to deliver to client specifications on major projects across Australia has established Humes as a valuable and reliable partner.

Our Strategy

Our vision is to become the global leader in innovative and sustainable building solutions. Through three strategic levers – Accelerating Growth, Expanding Solutions & Products, and Leading in Sustainability – we are transforming and Delivering Superior Performance.

Sustainability is at the core of our growth strategy. We are decarbonizing construction with innovative low-carbon and circular solutions. We are accelerating demand and capturing above-market profitable growth by engaging with partners across our value chain.

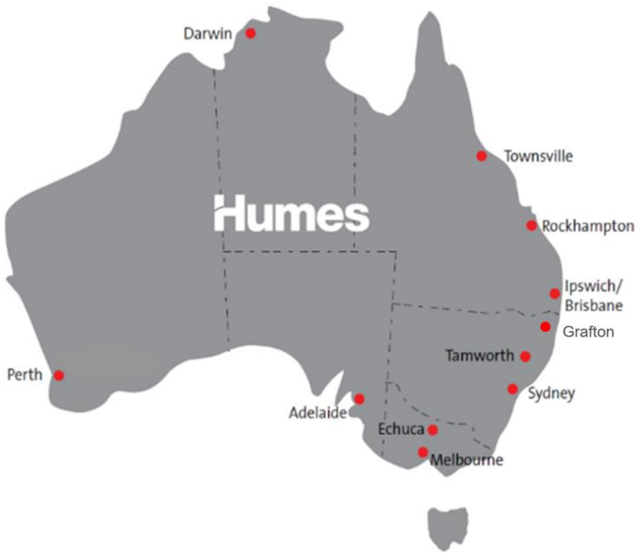


Figure 1 - Location of Humes' precast production facilities

(Note: pipes are not produced at Echuca and Tamworth)

Product description

As the leading manufacturer of reinforced concrete pipes (RCPs) and associated precast products in Australia, Humes pipes are available in a wide range of diameters, lengths and load and exposure classes with varying applications.

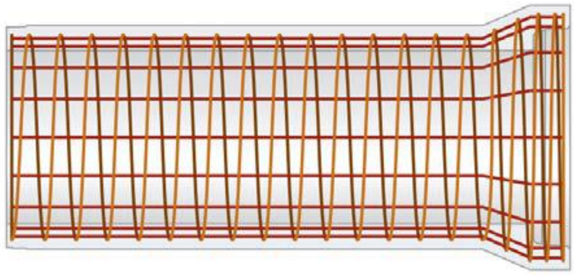
The primary application for RCP is for non-pressure stormwater drainage pipelines. Other uses for our RCP products are in sewerage and pressure pipe applications, or as jacking and shaft components of access chambers. Suitability in these conditions is project specific. Further details on product use and design for different applications can be found in Humes' *Concrete pipe reference manual* (see www.humes.com.au).

RCPs are made from coarse and fine aggregates, cement, water, and hard-drawn deformed steel reinforcement. Other materials used can include supplementary cementitious materials (SCMs) and chemical admixtures which have varied effects on the concrete depending on the admixture used.

RCPs are manufactured with varying joint types, including the two most common basic joint types - Flush Joint (FJ) and Rubber Ring Joint (RRJ) - to our jacking pipe and shaft range.

FJ pipes provide an interlocking joint which allows for a small degree of flexibility in the pipeline alignment. RRJ pipes, either belled-socket or in-wall joint depending on the diameter of the pipe and its application, are designed to accommodate change in pipeline alignment and settlement in a pipeline whilst still maintaining a watertight joint.

Figure 2 - Schematic of steel cage in a RRJ concrete pipe



The majority of Humes' pipe is manufactured in 2.44 metre effective lengths in the DN300 to DN2100 diameter range. Effective length is used to define an RCP's length as the physical length of the pipe includes the overlap of the joint. The standard effective lengths vary slightly at vertical cast factories due to manufacturing limitations. Other lengths and diameters of pipe can be manufactured to suit project requirements. RCPs are available in standard-strength (class 2-4) and super-strength (class 6-10).

Table 1: Summary of the reinforced concrete drainage pipe product range

Factory location	Pooraka
Technology	Spun
Class	Class 2 - Class 10
Nominal Diameter (mm)	DN300 - DN2100
Joint Type	RRJ, FJ, Jacking pipes & Shafts
Effective Length	2.44 metres

Representative product

Our Class 4 DN 600 Freshwater pipes were chosen as the representative product for this site because it makes up a substantial portion of total production by weight.

Product composition

The product as supplied is non-hazardous. The products included in this EPD do not contain any substances of very high concern (SVHC) as defined by European REACH regulation* in concentrations >0.1% (m/m).
Dust from this product is classified as Hazardous according to the Approved Criteria for Classifying Hazardous Substances 3rd Edition (NOHSC 2004). Precast concrete products and pipes are classified as non-dangerous goods according to the Australian Code for the Transport of Dangerous Goods by Road and Rail. When concrete products are cut, sawn, abraded or crushed, dust is created which contains crystalline silica, some of which may be respirable (particles small enough to go into the deep parts of the lung when breathed in), and which is hazardous. Exposure through inhalation should be avoided.

RCPs form part of the UN CPC 375 – "Concrete" industry classification and the ANZSIC 2034 – "Concrete Product Manufacturing" product group classification.

** Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals.*

Table 2: Product content

RCP constituent	Proportion (% t/t)	Post-consumer material, weight %	Biogenic material, weight %	Biogenic material, kg C per tonne pipe
General Purpose Cement ¤	11 - 18%	0%	0%	0
Fly Ash †,‡	2 - 5%	0%	0%	0
Ground granulated blast furnace slag (GGBFS) †, ‡	-	0%	0%	0
Coarse & Fine aggregates †	69 - 77%	0%	0%	0
Water	5 - 7%	0%	0%	0
Admixtures	-	0%	0%	0
Reinforcement steel	1.5 - 5.8%	0%	0%	0
Rubber rings	<0.1%	0%	<0.1%	<0.3
Sum	**100%**	**0%**	**<0.1%**	**<0.3**

¤ Cement in concrete contains traces of Chromium VI (hexavalent).
† Crystalline-silica (quartz) may be a constituent of sand, crushed stone, gravel, blast furnace slag and fly ash used in any particular concrete mix.
‡ Cementitious additives may contain traces of metals.

Technical Compliance

Humes' RCPs are manufactured, and proof tested to comply with AS/NZS 4058:2007 - Precast concrete pipes (pressure and non-pressure). Our RCP products have a service life of 100 years, when manufactured in accordance with AS/NZS 4058:2007 and installed in accordance with AS/NZS 3725: Design for Installation of Buried Concrete Pipes. AS/NZS 4058:2007 also covers performance requirements, e.g. load testing, water tightness, pressure testing, water absorption, etc.

Scope of the Environmental Product Declaration

This EPD covers life cycle modules A1-3, A4, A5, B3, B4, C1-4 and D. Life cycle modules A5, B3 and B4 are better modelled on a per metre basis. We have included more information on these three modules in the section "Additional environmental information". Stages B1-2 and B5-7 have not been included.

Table 3: Scope of EPD

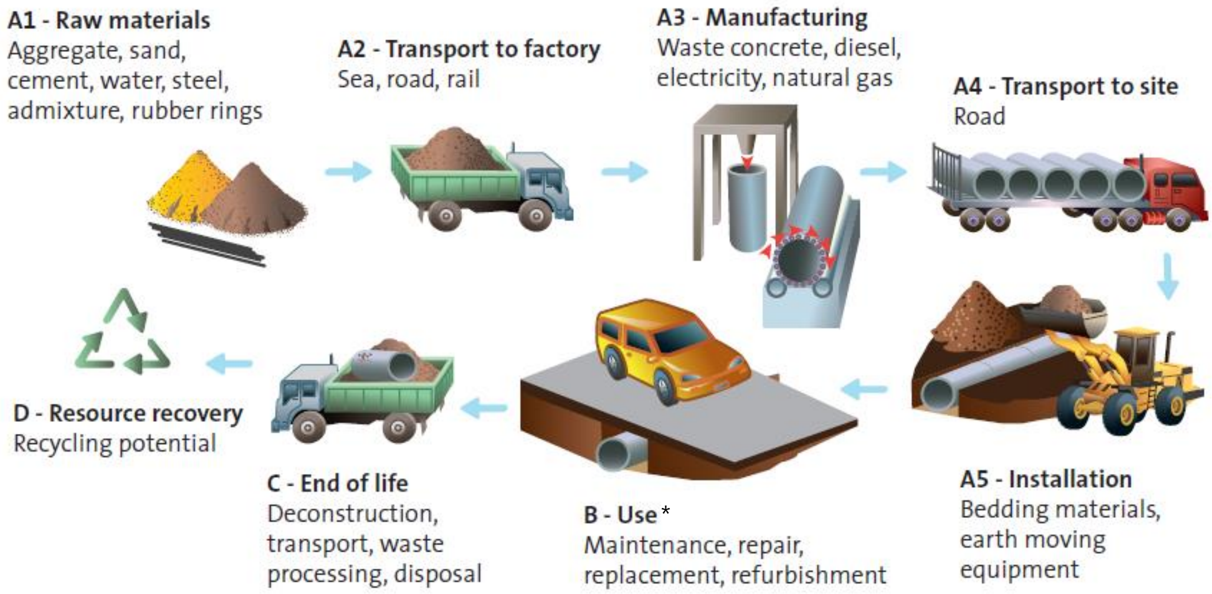
Stages	Product Stage			Construction Stage		Use Stage							End-of-life Stage				Benefits beyond system boundary
	Raw Materials	Transport	Production	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/Demolition	Transport	Waste Processing	Disposal	Reuse, recovery, recycling potential
Modules	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
				Scenario		Scenario							Scenario				Scenario
Module Declared	X	X	X	X	X	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	AU	AU	AU	AU	AU								AU	AU	AU	AU	AU
Specific Data	72%																
Variation Products	-15% to 52%																
Variation Sites	0%																

Module Declared indicates when a module is included in this study (marked by X). When a module is not accounted for, the stage is marked with "ND" (Not Declared). ND is used when we cannot define a typical scenario.

Geography indicates the geographical representation per module reported by ISO country code(s)

Specific data indicates the share of the GWP-GHG indicator results in A1-A3 coming from product-specific LCI data.

Figure 3 - Product lifecycle of steel reinforced concrete pipes



**Module B (B1-B7) is shown for illustrative purposes but has been excluded from this EPD as it requires a reference service life (RSL) to be defined.*

Product Stage

Raw Material – Module A1

All raw materials used in the production of RCP comply with the following standards as required by AS 4058:

- AS 3972 General purpose and blended cements
- AS 3582 Supplementary cementitious materials Parts 1, 2 and 3 Supplementary cementitious materials
- AS/NZS 4671 Steel reinforcing materials
- AS 2758.1 Aggregates and rock for engineering purposes Part 1: Concrete Aggregates
- AS 1478 Chemical admixtures for concrete, mortar and grout
- AS 1646 Elastomeric seals for waterworks purposes

Transportation – Module A2

Raw materials are typically transported to site via rigid or articulated trucks. The impact of transportation is determined from the specific supply sources for the manufacturing site.

Manufacturing – Module A3

The manufacturing process of RCP at Pooraka is a centrifugal spun process in the majority of Humes' pipe factories. Concrete is poured inside a spinning mould where the water in the concrete is slowly drawn to the interior of the pipe. Once the mould is filled with concrete the bore of the pipe is smoothed and the compaction process is complete.

RCP is cured in a curing chamber designed to accelerate the setting and strength gain of the pipes immediately after casting. Once RCPs have cured enough to be handled with lifting equipment, they are transferred to the outdoor yard storage area and continue to cure until they are transported to the installation site.

Construction stage

Transportation – Module A4

Average distribution distances vary from site to site. Transportation to the construction site is based on the weighted average delivery scenario for RCP products by site. Return-transport is empty.

Table 4: Transport to site parameters

Scenario information	Unit (expressed per functional unit or per declared unit)
Vehicle type used for transport; Fuel type and consumption	27% Truck 3.5-16 t capacity (fuel use 1.61 MJ diesel/tkm) 73% Truck 16-28 t capacity (fuel use 3.23 MJ diesel/tkm)
Distance	225 km transport
Capacity utilisation (including empty returns)	50% capacity utilisation (empty return)
Weight of transported products	13.3 tonnes on average
Volume capacity utilisation factor	1
GWP-GHG (IPCC AR5) intensity of A4 transport	0.22 kg CO_2e/km

Installation – Module A5

The installation of RCPs in a storm-water system is included in the LCA on the basis of a typical scenario. This EPD contains a range of scenarios as the installation scenario can have a significant impact on the environmental profile. Only trench type installation was considered due to the predictability of trench dimensions. The type of support is selected depending on the application (required performance) of the pipeline system. The required strength of a concrete pipe depends on both the load to be carried by the installed pipe, and the supporting ground installation conditions.
Installation processes include:

- Excavation of the trench
- Placement and compaction of bedding materials
- Placement of RCP
- Filling of the trench

Transport of imported and surplus materials is also included as per the installation scenarios. The values are expressed per metre of RCP of a particular diameter, regardless of the class of pipe or whether the pipe is made using the spun or dry-cast process. The environmental impacts correlate strongly to the pipe diameter.

Bedding types for pipes are H1, H2, HS1, HS2, HS3, and U. Where U denotes an unsupported fill, H denotes Haunch support, HS denotes Haunch and Side support, and 1, 2, and 3 denotes the level of support (compaction of fill) in the material used, see Figure 4. Further details are available in AS/NZS 3725: Design for Installation of Buried Concrete Pipes.

Further information on trench dimensions for the installation of RCP can be found in Humes' Concrete pipe reference manual (see www.humes.com.au).

Figure 4 – Type H and type HS support

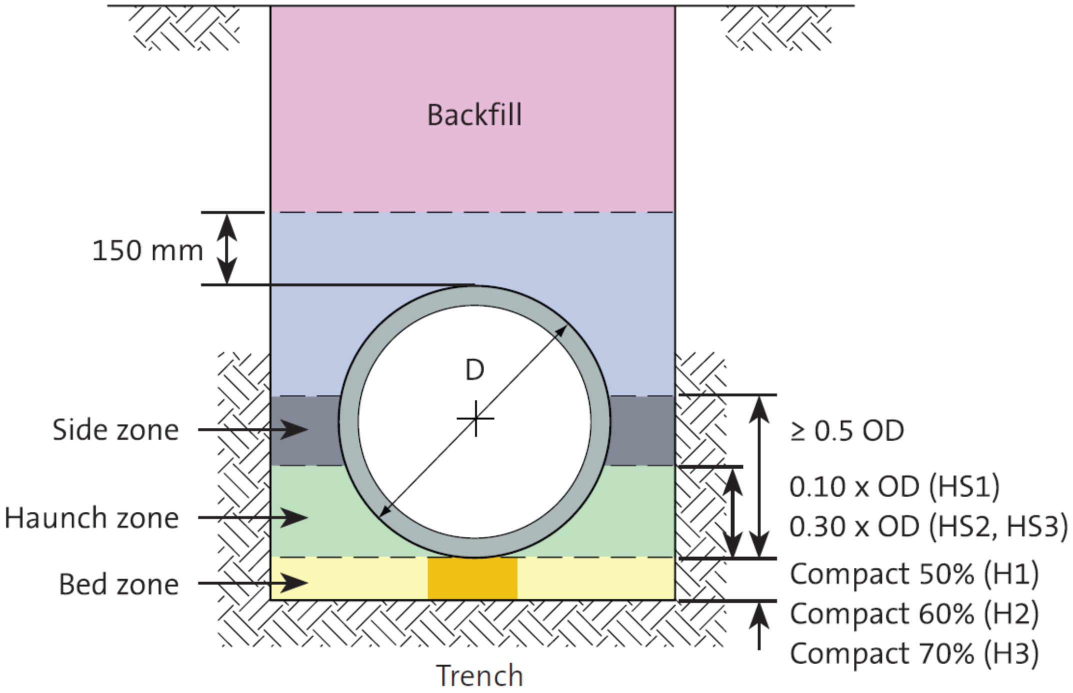


Table 5: Installation parameters (DN600 pipes)

Scenario information	Unit (expressed per functional unit or per declared unit)
Trench installation (type H1) for DN600 pipe	Trench width: 1,000 mm Bed zone: 0.110 m^3/m -> 0.056 m^3/tonne Haunch zone: 0.055 m^3/m -> 0.028 m^3/tonne Side + Overlay zone: 0.457 m^3/m -> 0.234 m^3/tonne Backfill: 1.000 m^3/m -> 0.513 m^3/tonne
Ancillary materials for installation	334 kg/m (= 171 kg/t pipe) sand (*Sand, at mine/CH U/AusSD U*) for bed zone and haunch zone. The sand is assumed to be imported over a distance of 50 km (*transport, truck, 16 to 28t, fleet average/AU U*).
Water use / Other resource use	n/a
Quantitative description of energy type and consumption during the installation process	Diesel for installation equipment (Excavation, hydraulic digger/RER U): assumed 0.13 L/t for excavation of the trench and 0.13 kg/t diesel for placing of the pipe.
Waste materials on the building site before waste processing, generated by the product's installation (specified by type)	Excess soil (in case of new installations) equals the volume taken up by the bed zone, haunch zone, and pipe. This is estimated at 876 kg/m (= 449 kg/t pipe). The excess soil is assumed to be transported off-site over a distance of 50 km (*transport, truck, 16 to 28t, fleet average/AU U*).
Output materials as result of waste processing at the building site	n/a
Direct emissions to ambient air, soil and water	n/a

Use Stage

Pipework which is installed correctly is relatively inert and does not consume energy or water to operate. As such, the life-cycle modules for use (B1), maintenance (B2), repair (B3), replacement (B4), refurbishment (B5), operational energy use (B6), and operational water use (B7) are not declared.

Note regarding Repair and Replacement – Modules B3 and B4

Based on anecdotal evidence, in our original RCP EPD (S-P-00998) we conservatively assumed that 1% of pipes require repair or replacement over a 100-year period. This was split evenly into 0.5% of pipes requiring repair and 0.5% of pipes requiring replacement.

Repair of RCP involves injecting an epoxy resin into cracks that exceed 30 cm in length and/or are greater than 0.15 mm wide (BCC 2016). Smaller cracks are assumed to re-seal under the natural action of the concrete's autogenous healing process. The impact of repair was shown to be marginal only.

Replacement of RCP involves impacts associated with all the other life cycle stages: product stage (A1-A3), transport to site (A4), installation (A5), and end-of-life (C1-C4).

End of life stage

At the end of their functional life, RCP pipes can enter into various disposal options. The two most likely scenarios are:

- left in the ground, abandoned
- exhumed and recycled

This EPD covers two options for the end-of-life stage, so that the reader can select the applicable scenario for their situation.

Deconstruction/Demolition – Module C1

When pipes are left in-ground, there is no activity attributed to module C1. In the recycling scenario, it is assumed that when the pipe is exhumed it is replaced with another new product, the excavation and back-filling of the trench is part of the next pipe's life cycle and is not included in the replaced pipe's end-of-life scenario. Removal of pipes is included.

Transport – Module C2

When pipes are left in-ground, there is no activity attributed to module C2. In the recycling scenario, the transportation includes taking the discarded pipe to a recycling site or transportation of waste to a final sorting yard or disposal site.

Waste Processing – Module C3

The waste processing includes crushing of waste pipes (recycling) into concrete rubble and steel scrap.

Disposal – Module C4

Waste disposal includes physical pre-treatment and management of the disposal site. For pipes that are left in-ground, emissions from concrete waste disposed to landfill are considered. Pipes that are left in the ground are assumed not to need any further waste processing.

Table 6: End-of-life scenario parameters

Processes	Quantity per tonne of RCP – left in ground scenario	Quantity per tonne of RCP – exhumed and recycled scenario	Unit
Collection process specified by type	0 0	1,000 0	kg collected separately kg collected with mixed construction waste
Transport from demolition site to recovery sites	0	50	km transport (*transport, truck, 16 to 28t, fleet average/AU U*)
Recovery system specified by type	0 0 0	0 1000 0	kg for re-use kg for recycling* kg for energy recovery
Disposal to landfill**	1,000	0	kg product or material for final deposition
Assumptions for scenario development	0	1	Assumed 1 m^3 of excavation (*Excavation, hydraulic digger/RER U/AusSD U*) per tonne of pipe (in module C1). This equates to 0.13 kg diesel use.***

** The process used to model recycling is "recycling brick rubble and concrete, at plant/AU U"*
*** We assumed abandoning pipes equals landfilling (Disposal, concrete, 5% water, to inert material landfill/CH U/AusSD U; minus energy used for management of the landfill site).*
**** The process relates to the removal of the pipe (excluding digging of the trench), where we conservatively assumed digging one m3 equals removing one tonne of pipe. This approach assumes that (if the pipe is removed at end of life) a new pipe will be installed (i.e. as part of an upgrade or replacement rather than removal). The excavation is considered part of module A5 (of the next life cycle) and as such it has not been double-counted in module C1 of this life cycle.*

Resource recovery stage

Reuse, recovery, recycling potential – Module D

The information in module D includes environmental benefits or loads resulting from recyclable materials leaving a product system. The concrete rubble and steel scrap produced in module C3 can replace natural coarse aggregates (crushed rock) and virgin steel (after further processing), respectively. Module D is only relevant when pipes are exhumed and recycled.

Table 7: Assumptions relating to Module D, pipe recycling scenario

Parameter	Unit / effect
$M_{MR\ out}$ = 100% 100%	Amount of material exiting the system that will be recycled in a subsequent system: concrete steel
$M_{MR\ in}$ = 0% 70%	Amount of recycled input material: concrete steel
$E_{MR\ after\ EoW\ out}$ = *n/a* *transport + recycling*	Specific emissions and resources consumed per unit of analysis arising from material recovery processes of a subsequent system after the end-of-waste state: concrete steel *transport:* 50 km transport, truck, 28t, fleet average/AU U *recycling process*: Steel, low-alloyed {RoW} | steel production, electric, low-alloyed | Cut-off, U
$E_{VMSub\ out}$ = virgin materials virgin aggregates virgin steel	specific emissions and resources consumed per unit of analysis arising from acquisition and pre-processing of the primary material, or average input material if primary material is not used, from the cradle to the point of functional equivalence where it would substitute secondary material that would be used in a subsequent system concrete: Gravel, crushed, at mine/CH U/AusSD U steel: Steel, low-alloyed {RoW}| steel production, converter, low-alloyed | Cut-off, U
$Q_{R\ out}$	quality of the outgoing recovered material
Q_{Sub}	quality of the substituted material
$Q_{R\ out}$ / Q_{Sub} = 1	quality ratio between outgoing recovered material and the substituted material is assumed to be 1 (equal quality)

Life Cycle Assessment (LCA) Methodology

Background Data

Primary data covers the 2022 calendar year and has been sourced from each of the Humes factories that manufacture RCP. The life cycle model has been built in SimaPro software v9.5.0.0.

Data for cement has been sourced from our supplier's EPD (EPD S-P-07448 and S-P-07450).

Data for reinforcing steel wire is based on our supplier's EN 15804+A1 compliant EPDs (S-P-00855 and S-P-00858). To calculate the EN 15804+A2 indicator results, ecoinvent v3 ("Reinforcing steel {RoW}| reinforcing steel production | Cut-off, U") data have been used, and GWP-GHG and ADP-fossil indicators have been adjusted to align with the published EPD. Our second supplier of reinforcement steel does not have an EPD. We have used ecoinvent v3.9.1 data without adjustment to model this steel. Data for steel that we use to make jacking pipe collars are sourced from our supplier (EPD S-P-00557).

Data for admixtures has been sourced from three EPDs published by EFCA (European Federation of Concrete Admixtures Associations) (EFCA 2021a, 2021b, 2023). Other background data is predominantly sourced from AusLCI and the AusLCI shadow database v1.42. Primary data is less than five years old as at the date of publication. Background data used is less than 10 years old or has been reviewed within this period.

Methodological choices have been applied in line with EN 15804:2012+A2:2019; deviations have been recorded.

Allocation

The processes and materials that require allocation are:

- Production of concrete pipes and other precast concrete products: All shared processes are attributed to concrete products based on their mass.
- Steel scrap leaving the pipe manufacturing process: the steel scrap generated at our sites has a negligible contribution to our revenue and therefore has been allocated with zero value.
- Fly ash: Economic allocation has been applied to fly ash (value of $0), meaning that all environmental impacts of the power plant have been allocated to electricity as the main product. Fly ash has only received the burdens of the transport to our sites. Sensitivity analysis confirmed that this choice does not have a significant effect on the GWP results.
- Steel slag: BFS is a by-product from steel-making. We have used the AusLCI data for BFS ('Blast Furnace Slag allocation, at steel plant / AU U'), which contain impacts from pig iron production allocated to blast furnace slag using economic allocation.
- Silica fume: silica-fume is a by-product of silicon metal or ferrosilicon alloys production. Economic allocation is used to attribute impacts between silica fume and ferrosilicon production.
- Use of steel scrap in reinforcement steel: Recycling allocation has followed the polluter pays principle in line with EN 15804. See InfraBuild's EPD (S-P-00855) of reinforcing rod and wire. Scrap entering ecoinvent datasets does not carry any environmental impacts either. Strictly speaking, this does not comply with the latest scrap requirements in PCR 2019:14 v1.3.3, but it is not possible to alter the underlying data in a meaningful manner. The treatment of scrap entering (in module A1) and leaving (in modules A3, C3) the product system is consistent within this LCA.

Cut-off criteria

- The cut-off criteria applied are 1% of renewable and non-renewable primary energy usage, 1% of the total mass input of a process and 1% of environmental impacts.
- The amount of packaging used for admixtures, rubber rings and mould oil is well below the materiality cut-off and packaging materials and quantities have therefore been estimated only.
- The rubber ring lubricant applied to the socket lead-in for skid joints is excluded from the LCA, as the amount used is negligible.
- Capital goods (production equipment and infrastructure) and personnel is excluded from the LCA as these processes are non-attributable, lack agreed definitions for inclusion, and they contribute less than 10% to GWP-GHG.

Key assumptions

- The concrete compositions at each site are taken from Humes internal operating systems.
- For cement, we have used EPDs from our cement suppliers where possible. Where data gaps existed (including missing EN 15804+A1 results), these have been filled using AusLCI data for general purpose cement. For missing EN 15804+A1 results, greenhouse gas emissions are matched to our supplier's EPD data as best as possible.
- For reinforcement steel, we have used ecoinvent data, with GWP-GHG and ADP-fossil indicators adjusted to align with our supplier's published EN 15804+A1 compliant EPDs where relevant.
- Allocation approaches may have a material effect on concrete products containing fly ash, ground granulated blast furnace slag and/or silica fume.
- Additional environmental impact indicators are not declared in the admixture EPDs, which results in underreporting of these indicators.

Electricity

Electricity has been modelled for core processes using adjusted AusLCI data to represent the estimated residual electricity grid mix in Australia. This is done by removing renewables from the Australian Energy Statistics 2023 data (Table O1.1). The GWP-GHG of the electricity is 0.91 kg CO_2e / kWh (aligned with NGA 2023). The proxy residual grid mix is made up of black coal (53.9%), brown coal (17.3%), natural gas (26.3%), and oil products (2.5%). The contribution of electricity to cradle-to-gate (A1-A3) GWP-GHG emissions is approximately 5-15%. Therefore, the choice for market-based or location-based electricity accounting will have a noticeable effect on the results

Declared unit

Reinforced concrete pipes are available in various classes (wall thickness related), diameters, lengths and joint types. After considering various options, it became clear that there is no reasonable option that allows different pipes to be grouped or averaged in a meaningful way that is clear for the EPD user. Therefore, we have opted to present the results (for modules A1-A3, A4, A5, C1-C4, and D) for a representative product for the production site, based on the functional unit of:

- 1 tonne of reinforced concrete pipe (RCP), including rubber rings, installed using the H1 bedding type.

For installation module A5 results are best expressed per metre of pipe length for a certain diameter, as results per tonne of pipe are not easily interpreted. As the use of multiple declared units are no longer accepted in EPDs, the GWPs for various module A5 scenarios are included in the section "Additional environmental information". Even then, care should be taken when comparing environmental impacts of installation processes across EPDs.

Life Cycle Assessment (LCA) results

An LCA serves as the foundation for this EPD. An LCA analyses the production systems of a product. It provides comprehensive evaluations of all upstream and downstream energy inputs and outputs. The results are provided in a form which covers a range of environmental impact categories.

Table 8: Environmental indicators legend (EN 15804+A2)

Indicator	Acronym	Unit
Climate change – total	GWP-total	kg CO_2 equivalent
Climate change – fossil	GWP-fossil	kg CO_2 equivalent
Climate change – biogenic	GWP-biogenic	kg CO_2 equivalent
Climate change – land use and land use change	GWP-luluc	kg CO_2 equivalent
Ozone layer depletion	ODP	kg CFC-11 equivalent
Acidification	AP	mol H^+ equivalent
Eutrophication aquatic freshwater	EP-freshwater	kg P equivalent
Eutrophication aquatic marine	EP-marine	kg N equivalent
Eutrophication terrestrial	EP-terrestrial	mol N equivalent
Photochemical ozone formation	POCP	kg NMVOC equivalent
Abiotic depletion potential - elements[1]	ADP minerals & metals	kg Sb equivalent
Abiotic depletion potential – fossil fuels[1]	ADP fossil	MJ, net calorific value
Water use[1]	WDP	m^3 world equivalent deprived
Indicator	**Acronym**	**Unit**
Global Warming Potential – Greenhouse gases	GWP-GHG	kg CO_2 eq
Particulate matter emissions	PM	disease incidence
Ionising radiation, human health[2]	IRP	kBq U235 equivalent
Ecotoxicity (freshwater)[1]	ETP-fw	CTUe
Human toxicity, cancer effects[1]	HTP-c	CTUh
Human toxicity, non-cancer effects[1]	HTP-nc	CTUh
Land use related impacts / soil quality[1]	SQP	- (dimensionless)
Indicator	**Acronym**	**Unit**
Carbon footprint in line with IPCC AR5	**GWP-GHG (IPCC AR5)**	**kg CO_2 eq**

Note regarding various GWP indicators.

GWP-total is calculated using the European Union's Joint Research Centre's (JRC) characterisation factors (CFs) based on the "EF 3.0 package" for CFs to be used in the EU's Product Environmental Footprint (PEF) framework. CFs listed by JRC include indirect radiative forcing, which results in higher numerical Global Warming Potential (GWP) values than the CFs in the internationally accepted (IPCC 2013).

The GWP-GHG indicator is identical to GWP-total except that the CFs for biogenic CO_2 are set to zero. The GWP-GHG indicator in PCR 2019:14 v1.3 differs from the GWP-GHG in earlier PCR 2019:14 versions.

The GWP-GHG IPCC AR 5 indicator is determined using the IPCC AR5 Global Warming Potentials (GWP) with a 100-year time horizon. This indicator is aligned with Australia's greenhouse gas reporting frameworks.

[1] The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

[2] This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Table 9: Legend for parameters describing resource use, waste and output flows

Parameter	Acronym	Unit
Parameters describing resource use		
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ_{NCV}
Use of renewable primary energy resources used as raw materials	PERM	MJ_{NCV}
Total use of renewable primary energy resources	PERT	MJ_{NCV}
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ_{NCV}
Use of non-renewable primary energy resources used as raw materials	PENRM	MJ_{NCV}
Total use of non-renewable primary energy resources	PENRT	MJ_{NCV}
Use of secondary material	SM	kg
Use of renewable secondary fuels	RSF	MJ_{NCV}
Use of non-renewable secondary fuels	NRSF	MJ_{NCV}
Use of net fresh water	FW	m^3
Waste categories		
Hazardous waste disposed	HWD	kg
Non-Hazardous waste disposed	NHWD	kg
Radioactive waste disposed	RWD	kg
Output flows		
Components for re-use	CRU	kg
Materials for recycling	MFR	kg
Materials for energy recovery	MER	kg
Exported energy	EE	MJ

Table 10: Legend for EN 15804+A1 indicators

Indicator	Acronym	Unit
Global warming potential	GWP	kg CO_2 equivalent
Ozone layer depletion potential	ODP	kg CFC-11 equivalent
Acidification potential	AP	kg SO_2 equivalent
Eutrophication potential	EP	kg PO_4^{3-} equivalent
Photochemical oxidation (Photochemical ozone creation) potential	POCP	kg ethylene equivalent
Abiotic depletion potential - elements	ADPE	kg Sb equivalent
Abiotic depletion potential – fossil fuels	ADPF	MJ_{NCV}

The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks.

The use of the results of modules A1-A3 (A1-A5 for services) without considering the results of module C is discouraged.

Table 11: **EN 15804+A2 indicators, Class 4, DN600, Fresh water RRJ pipe, Pooraka, abandonment scenario**

Environmental Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
Core Indicators									
GWP-total	kg CO_2-eq.	2.19E+02	5.02E+01	3.86E+01	0.00E+00	0.00E+00	0.00E+00	4.37E+00	8.89E+00
GWP-fossil	kg CO_2-eq.	2.20E+02	5.02E+01	3.86E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.89E+00
GWP-biogenic	kg CO_2-eq.	-1.36E+00	3.44E-03	1.15E-02	0.00E+00	0.00E+00	0.00E+00	4.08E+00	-3.25E-04
GWP-luluc	kg CO_2-eq.	4.65E-02	2.33E-05	1.71E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-6.19E-05
ODP	kg CFC11-eq.	6.82E-06	7.78E-06	5.64E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.05E-08
AP	mol H+ eq.	9.63E-01	4.34E-01	3.26E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.07E-02
EP-freshwater	kg P eq.	2.24E-02	2.97E-06	4.76E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.05E-04
EP-marine	kg N eq.	1.80E-01	1.37E-01	1.09E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.42E-03
EP-terrestrial	mol N eq.	2.75E+00	1.50E+00	1.20E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.49E-02
POCP	kg NMVOC eq.	8.19E-01	3.65E-01	2.91E-01	0.00E+00	0.00E+00	0.00E+00	5.11E-02	2.56E-02
ADP minerals & metals[1]	kg Sb eq.	1.49E-04	5.73E-08	5.06E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.62E-06
ADP fossil[1]	MJ (NCV)	1.84E+03	6.78E+02	5.26E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.43E+01
WDP[1]	m^3 world eq. deprived	8.28E+01	4.35E+00	7.37E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E+02
Additional indicators									
GWP-GHG	kg CO_2-eq.	2.20E+02	5.02E+01	3.86E+01	0.00E+00	0.00E+00	0.00E+00	3.82E+00	8.89E+00
PM	Disease incidence	9.24E-06	2.44E-06	3.38E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.87E-07
IRP[2]	kBq U235 eq.	3.97E+02	9.90E-04	9.46E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.36E-01
ETP-fw[1]	CTUe	5.05E+02	1.74E+02	1.28E+02	0.00E+00	0.00E+00	0.00E+00	5.08E-01	2.27E+02
HTP-c[1]	CTUh	5.94E-07	2.12E-10	5.06E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-5.39E-08
HTP-nc[1]	CTUh	7.78E-06	2.35E-08	4.12E-08	0.00E+00	0.00E+00	0.00E+00	1.07E-08	-1.76E-06
SQP[1]	-	2.06E+03	3.04E+00	1.59E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.88E+00
Carbon Footprint									
GWP-GHG (IPCC AR5	kg CO_2-eq.	217	49.4	38.0	0.00	0.00	0.0	2.9	8.4

Table 12: **Parameters, Class 4, DN600, Fresh water RRJ pipe, Pooraka, abandonment scenario**

Environmental Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PERE	MJ_{NCV}	6.16E+01	9.72E-01	3.24E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.75E-01
PERM	MJ_{NCV}	2.06E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	8.22E+01	9.72E-01	3.24E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.75E-01
PENRE	MJ_{NCV}	1.84E+03	6.78E+02	5.26E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.43E+01
PENRM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ_{NCV}	1.84E+03	6.78E+02	5.26E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.43E+01
SM	kg	3.45E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	4.94E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.64E+00	9.82E-02	1.71E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.89E-02
HWD	kg	1.43E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	1.12E+01	2.88E-03	9.57E-03	0.00E+00	0.00E+00	0.00E+00	1.00E+03	0.00E+00
RWD	kg	1.01E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	3.80E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	8.71E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Please note: *stage A1-A3 values reported in this EPD incorporate the full production process of the precast elements. This includes concrete, steel, rubber rings, and precast production processes including reinforcement cage manufacture, casting, curing (steaming and other curing methods), internal transport, checks and storage as well as routine consumables used in the manufacturing process. Therefore, these values should not be directly compared to A1-A3 values per tonne of concrete supplied by ready-mix, as these values do not account for additional embodied carbon in the precast production process, steel reinforcement and rubber.*

Variation (A1-A3) per impact category

The variations in the results for module A1-A3 is declared in the following table, based on the largest variation in GWP between products manufactured at Pooraka and the representative product.
The variation is determined using the tables thereafter, which show the GWP values for each product manufactured at this site as an example for how the environmental impacts vary by product type. The tables cover freshwater pipes, marine pipes, jacking pipes and shafts, respectively.

Table 13: **Variation in core EN 15804+A2 indicators**

Indicator	Variation against the representative product
GWP-total	-15% to 52%
ODP	-10% to 44%
AP	-13% to 76%
EP-freshwater	-15% to 323%
EP-marine	-12% to 71%
EP-terrestrial	-10% to 61%
POCP	-17% to 55%
ADP minerals & metals[1]	-47% to 10864%
ADP fossil[1]	-14% to 67%
WDP[1]	-12% to 41%

The large variations (e.g. in EP-freshwater and ADP minerals & metals) are caused by jacking pipe products with a stainless-steel collar.

Humes

Table 14: GWP-total, modules A1-A3, kg CO_2 eq per tonne of FRESH WATER pipe, Pooraka

Joint	RRJ												FJ											
Class	Class 2		Class 3		Class 4		Class 6		Class 8		Class 10		Class 2		Class 3		Class 4		Class 6		Class 8		Class 10	
Mix	S	LCS	S	LCS	S	LCS	M	LCM	M	LCM	M	LCM	S	LCS	S	LCS	S	LCS	M	LCM	M	LCM	M	LCM
DN300	207	196	218	207	242	231	280	269					207	195	219	207	245	234	272	260				
DN375	204	193	217	206	242	231	264	253	254	243	249	237	204	193	218	207	246	235	271	259			238	226
DN450	199	187	213	201	234	223	250	238	259	248			198	187	213	202	236	225	251	239	254	242		
DN525	212	200	206	194	215	203	251	239	247	235			211	199	225	214	212	201	248	236				
DN600	211	200	211	199	219	208	276	265					209	197	222	211	216	204	247	235				
DN675	209	198	213	201	220	209	252	240					206	195	220	208	217	206	255	243				
DN750	209	197	209	198	219	208	267	255					208	196	222	211	216	204	260	248				
DN825	211	199	209	197	216	205	259	247	272	260			208	196	225	214	217	206	255	243				
DN900	198	187	209	197	229	218	254	242					209	197	212	201	215	203	258	246				
DN1050	197	186	208	197	243	232	246	234					208	197	209	197	205	194	249	237				
DN1200	206	195	222	210	210	199	274	263					213	202	215	203	213	201	259	247				
DN1350	213	201	233	222	214	202	258	247					214	203	218	207	215	203	256	244				
DN1500	201	190	211	200	215	204	256	245					223	212	228	217	229	217	254	242				
DN1650	205	193	221	210	225	213	257	245					223	211	223	211	231	220	257	245				
DN1800	205	193	222	211	229	218	256	245					222	211	226	215	232	220	257	245				
DN1950													215	204	241	230	231	220	256	244				
DN2100													222	211	230	219	228	217	260	248				

The “codes” under the pipe classes refer to the mix designs:

LCS	Low Carbon Standard
LCM	Low Carbon Marine, Low Carbon Jacking
S	Standard
M	Marine, Jacking, Calcareous, Manhole

Table 15: GWP- total, modules A1-A3, kg CO_2 eq per tonne of Marine pipe, Pooraka

Joint	RRJ							
Class	Class 2		Class 3		Class 4		Class 6	
Mix	M	LCM	M	LCM	M	LCM	M	LCM
DN300	226	213	226	213	228	216	240	228
DN375	225	212	232	220	239	227	252	240
DN450	231	219	241	229	250	238	268	257
DN525	235	222	244	232	259	248	266	255
DN600	242	230	255	243	255	243	276	264
DN675	253	241	261	249	248	236	248	237
DN750	244	232	269	257	249	237	243	231
DN825	246	234	268	256	246	234	255	244
DN900	249	237	269	257	255	243	253	242
DN1050	241	229	261	249	247	235	250	238
DN1200	252	240	250	238	247	235	256	244
DN1350	256	244	262	250	244	232	254	242
DN1500	240	228	244	232	253	241	254	242
DN1650	252	240	252	240	253	241	253	242
DN1800	249	237	266	255	254	242	253	241
DN1950	244	231	255	243	259	247	260	248

The “codes” under the pipe classes refer to the mix designs:

LCS	Low Carbon Standard
LCM	Low Carbon Marine, Low Carbon Jacking
S	Standard
M	Marine, Jacking, Calcareous, Manhole

Table 16: GWP- total, modules A1-A3, kg CO_2 eq per tonne of Jacking pipe, Pooraka

Joint	Butt Joint	S Series	J Series	J Series
Class	Class 4	Class 4	Class 4	Class 4
Joint Type	Mild Steel	Stainless	Mild Steel	Stainless
Mix	M	M	M	M
DN 300	259	294		
DN 350		288		
DN 375	272			
DN400		281		
DN 450	276	280		
DN 500		273		
DN 525	300			
DN 600	290	284		
DN 675	292			
DN 700		282		
DN 750	288			
DN 800			277	309
DN 825	282			
DN 900	301		275	306
DN 1000			273	302
DN 1050	315			
DN 1100			272	299
DN 1200	300		279	304
DN 1350	310		293	331
DN 1500	308		288	323
DN 1600			271	295
DN 1650	299		284	317
DN 1800	326		280	310
DN 1950	333			
DN 2100	323			

The “codes” under the pipe classes refer to the mix designs:

LCS	Low Carbon Standard
LCM	Low Carbon Marine, Low Carbon Jacking
S	Standard
M	Marine, Jacking, Calcareous, Manhole

Humes

Variation

Table 17: GWP- total, modules A1-A3, kg CO_2 eq per tonne of Shafts, Pooraka

Description	Height (mm)	Mix M
PCAC,SHAFT,0600,FJ,0310	310	252
PCAC,SHAFT,0750,FJ,0310	310	248
PCAC,SHAFT,0825,FJ,0300	300	247
PCAC,SHAFT,0600,FJ,0610	610	245
PCAC,SHAFT,0900,FJ,0310	310	246
PCAC,SHAFT,1100,WR,0300,PLAIN,WR,SPUN	300	230
PCAC,SHAFT,0750,FJ,0610	610	244
PCAC,SHAFT,0825,FJ,0610	610	239
PCAC,SHAFT,1042,FJ,0300	300	239
PCAC,SHAFT,0600,FJ,0910	910	245
PCAC,SHAFT,1200,FJ,0310	310	248
PCAC,SHAFT,0900,FJ,0610,ROC	610	246
PCAC,SHAFT,0600,FJ,1220	1220	245
PCAC,SHAFT,1042,FJ,0450	450	239
PCAC,SHAFT,1100,WR,0600,PLAIN,SPUN	600	230
PCAC,SHAFT,0750,FJ,0910	910	244
PCAC,SHAFT,1050,FJ,310	310	277
PCAC,SHAFT,1050,FJ,1220	1220	224
PCAC,SHAFT,1050,FJ,0610	610	249
PCAC,SHAFT,0750,FJ,1220	1220	245
PCAC,SHAFT,1042,FJ,0600	600	239
PCAC,SHAFT,0900,FJ,0910	910	246
PCAC,SHAFT,0825,FJ,1220	1220	243
PCAC,SHAFT,1200,FJ,0610	610	247
PCAC,SHAFT,1100,WR,0900,PLAIN,SPUN	900	229
PCAC,SHAFT,1200,FJ,0910	910	235
PCAC,SHAFT,1050,FJ,0910	910	246
PCAC,SHAFT,0900,FJ,1220	1220	246
PCAC,SHAFT,1042,FJ,0900	900	239
PCAC,SHAFT,1100,WR,1200,PLAIN,SPUN	1200	230
PCAC,SHAFT,1042,FJ,1200	1200	239
PCAC,SHAFT,1500,FJ,0610,45-COVER,81-WALL	610	261
PCAC,SHAFT,1200,FJ,1220	1220	247
PCAC,SHAFT,1800,F,2,0600	600	256
PCAC,SHAFT,1500,FJ,0910,45-COVER,81-WALL	910	258
PCAC,SHAFT,1200,FJ,2440	2440	237
PCAC,SHAFT,1500,FJ,1220,45-COVER,81-WALL	1220	257
PCAC,SHAFT,1800,FJ,0910	910	255
PCAC,SHAFT,1800,FJ,1220	1220	256
PCAC,SHAFT,1950,FJ,1220,CA	1220	246
PCAC,SHAFT,1800,FJ,1220,60-COVER,119-WAL	1220	269
PCAC,SHAFT,2100,FJ,1220,45-COV,126-WALL	1220	258
PCAC,SHAFT,1800,FJ,2440	2440	254
PCAC,SHAFT,2100,FJ,2440,126-WALL	2440	258

EN 15804+A1 LCA results for backwards compatibility

Table 18: **EN 15804+A1 indicators, Class 4, DN600, Fresh water RRJ pipe, Pooraka, abandonment scenario**

Environmental Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP	kg CO_2 eq	2.15E+02	4.93E+01	3.80E+01	0.00E+00	0.00E+00	0.00E+00	2.86E+00	8.22E+00
ODP	kg CFC11 eq	4.77E-06	6.15E-06	4.45E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.58E-08
AP	kg SO_2 eq	8.12E-01	2.40E-01	1.90E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.52E-02
EP	kg PO_4^{3-} eq	1.08E-01	4.60E-02	3.69E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.20E-03
POCP	kg C_2H_4 eq	2.66E-02	1.55E-02	1.01E-02	0.00E+00	0.00E+00	0.00E+00	2.14E-02	6.91E-03
ADPE	kg Sb eq	1.65E-05	5.79E-08	5.09E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.61E-06
ADPF	MJ_{NCV}	1.59E+03	6.59E+02	5.26E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E+02

Installation of pipes (module A5)

The installation of pipes cannot be expressed per tonne of pipe in a meaningful way, as there are too many variables that would impact on the results. Instead, installation impacts are best described per length of pipe of a particular diameter.

Installation – Module A5

The installation of RCPs in a storm-water system is included in the LCA on the basis of a typical scenario. The actual installation scenario can have a significant impact on the environmental profile of module A5.

The type of support is selected depending on the application (required performance) of the pipeline system. The required strength of a concrete pipe depends on both the load to be carried by the installed pipe, and the supporting ground installation conditions.

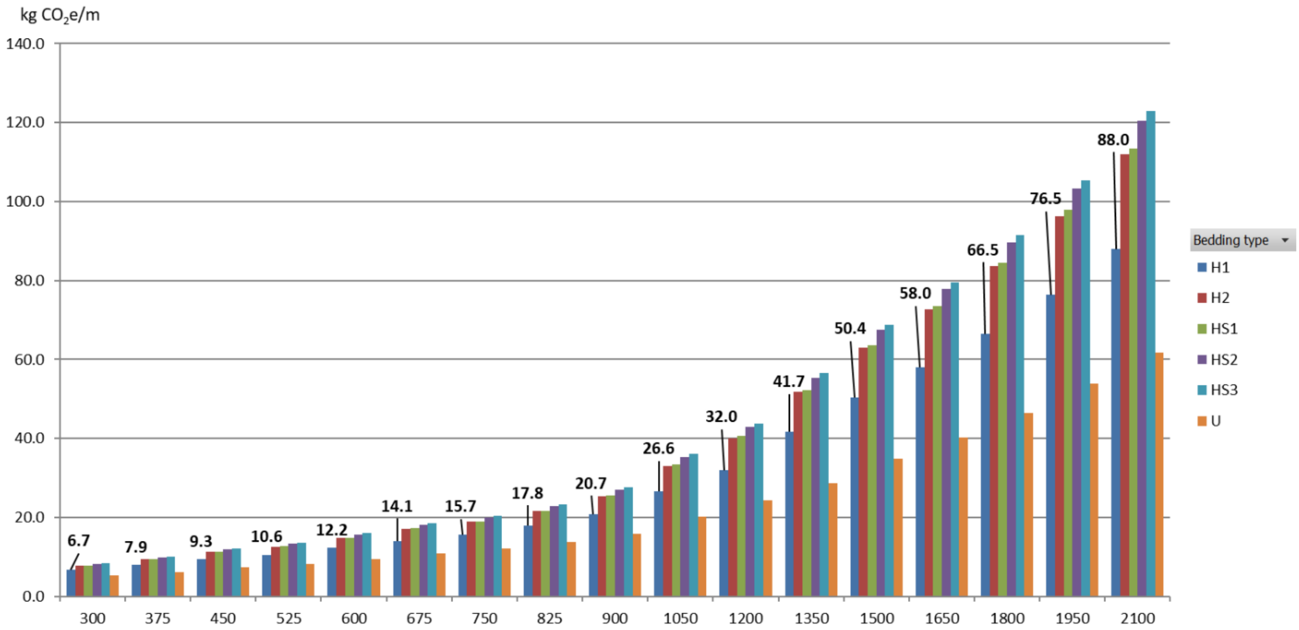
Installation processes include:

- Excavation of the trench
- Placement and compaction of bedding materials
- Placement of RCP
- Filling of the trench and compaction.

Transport of imported and surplus materials is also included as per the installation scenario. The values of installation should be calculated per metre of RCP of a particular diameter, regardless of the class of pipe or whether the pipe is made using the spun or dry-cast process. The environmental impacts correlate strongly to the pipe diameter (i.e. not to the mass of pipes).

Bedding types for pipes are H1, H2, HS1, HS2, HS3, and U. Where U denotes an Unsupported fill, H denotes Haunch support, HS denotes Haunch and Side support, and 1, 2, and 3 denotes the level of support (compaction of fill) in the material used. Further details are available in AS/NZS 3725: Design for Installation of Buried Concrete Pipes.
Further information on trench dimensions for the installation of RCP can be found in Humes' Concrete pipe reference manual (see www.humes.com.au).

The graph below shows how the GWP for module A5 (in kg CO_2e for installation of **one meter** of pipe) varies with pipe diameter and bedding type.



End-of-life scenario (modules C1-C4, D)

The default environmental profiles include end-of-life results for a scenario where pipes are abandoned and left in-ground at end-of-life. Alternatively, concrete pipes may be exhumed and recycled. In this case, the pipes are crushed to separate the concrete from the reinforcement steel, after which the concrete is assumed to replace virgin aggregates and the steel can be recycled to replace steel produced through the virgin route.

The module C1-C4, D results for the recycling scenario pertaining to the representative product are provided in the table below.

Table 19: **EN 15804+A2 indicator results, modules C1-C4, per tonne of representative product, Pooraka**

Indicator	Unit	Module C1	Module C2	Module C3	Module C4	Module D
GWP-total	kg CO_2 eq.	4.87E-01	7.81E+00	4.13E+00	4.37E+00	-3.71E+01
GWP-fossil	kg CO_2 eq.	4.87E-01	7.81E+00	4.13E+00	0.00E+00	-3.70E+01
GWP-biogenic	kg CO_2 eq.	3.59E-05	5.35E-04	4.31E-03	4.08E+00	-1.84E-02
GWP-luluc	kg CO_2 eq.	2.31E-07	3.63E-06	1.90E-06	0.00E+00	2.01E-04
ODP	kg CFC-11 eq.	7.72E-08	1.21E-06	5.18E-07	0.00E+00	-1.41E-07
AP	mol H^+ eq.	5.31E-03	6.75E-02	1.13E-02	0.00E+00	-1.28E-01
EP-freshwater	kg P eq.	5.98E-08	4.62E-07	3.04E-06	0.00E+00	-1.32E-03
EP-marine	kg N eq.	2.32E-03	2.13E-02	2.01E-03	0.00E+00	-2.21E-02
EP-terrestrial	mol N eq.	2.54E-02	2.33E-01	2.19E-02	0.00E+00	-2.59E-01
POCP	kg NMVOC eq.	6.10E-03	5.67E-02	5.86E-03	5.11E-02	-9.60E-02
ADP minerals & metals	kg Sb eq.	5.69E-10	8.91E-09	1.02E-06	0.00E+00	-1.30E-05
ADP fossil	MJ, net calorific value	6.74E+00	1.06E+02	5.86E+01	0.00E+00	-4.22E+02
WDP	m^3 world eq. deprived	4.32E-02	6.76E-01	1.27E+00	0.00E+00	-7.52E+02
Indicator	**Unit**					
GWP-GHG	kg CO_2 eq	4.87E-01	7.81E+00	4.13E+00	3.82E+00	-3.70E+01
PM	disease incidence	1.41E-07	3.80E-07	7.52E-08	0.00E+00	-1.14E-06
IRP	kBq U235 eq.	9.84E-06	1.54E-04	8.27E-04	0.00E+00	7.67E-01
ETP-fw	CTUe	1.73E+00	2.71E+01	1.33E+01	5.08E-01	-7.48E+02
HTP-c	CTUh	1.79E-11	3.29E-11	8.60E-11	0.00E+00	1.75E-07
HTP-nc	CTUh	1.84E-09	3.65E-09	3.96E-09	1.07E-08	5.71E-06
SQP	-	3.21E-02	4.74E-01	1.11E+04	0.00E+00	-2.01E+02
Indicator	**Unit**					
GWP-GHG (IPCC AR5)	**kg CO_2 eq**	**0.483**	**7.68**	**4.11**	**2.88**	**-3.53E+01**

Additional environmental information

Safety, Health and Environment (SHE) at Humes

Our safety, health and environment (SHE) management system aims to achieve high environmental standards. The Holcim executive committee closely monitors our performance in managing workplace safety and protection of the environment. The environmental component of the management system helps identify and manage potential environmental risks. Operations are assessed against the requirements and improvements made.

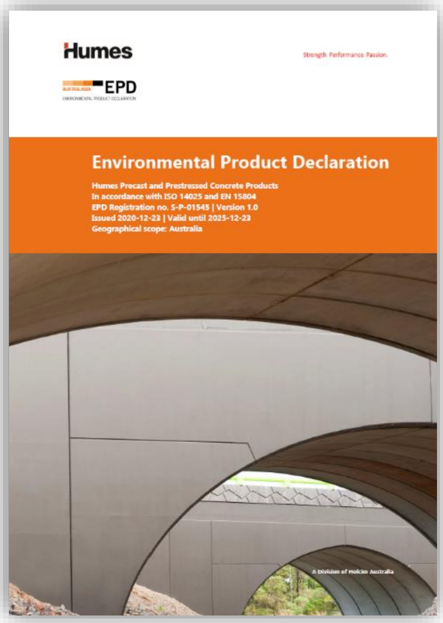
Infrastructure Sustainability

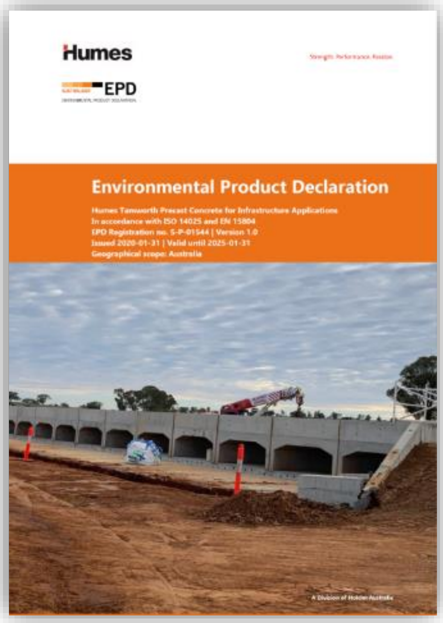
The Infrastructure Sustainability Council (ISC) is the peak industry body for advancing sustainability in Australia's infrastructure. As a division of Holcim Australia, Humes is a member of ISC and takes an interest and role in developing sustainable practices across design, construction and operation of infrastructure.

ISC has developed the Infrastructure Sustainability (IS) rating scheme which is Australia's only comprehensive rating scheme for evaluating sustainability for infrastructure. ISC evaluates the sustainability of infrastructure projects and assets and assigns credits across a number of categories which incentivise the use of sustainable practices.

Humes helps its customers optimise their ISC ratings through smart selection and design of precast products.

This is the updated Environmental Product Declaration for Reinforced Concrete Pipes. We have also developed an ISO 14025 and EN 15804 compliant EPD for Humes Precast and Prestressed Concrete Products, as well as for Humes Tamworth precast concrete for infrastructure applications. These EPDs are publicly available on the EPD Australasia website.





References

AS 1379	Specification and supply of concrete, prepared by Committee BD-049 Manufacture of Concrete, published on 20 September 2007 by Standards Australia, Sydney
AS 1478	AS 1478.1:2000 Chemical admixtures for concrete, mortar and grout, Part 1: Admixtures for concrete, Standards Australia, Sydney, 2000
AS 1646	AS 1646:2007 Elastomeric seals for waterworks purposes, published on 13 November 2007 by Standards Australia, Sydney
AS 2758.1	AS 2758.1:2014 Aggregates and rock for engineering purposes, Part 1: Concrete aggregates, published on 7 November 2014 by Standards Australia, Sydney
AS/NZS 3725	AS/NZS 3725:2007 Design for installation of buried concrete pipes, published on 23 January 2007 by Standards Australia and Standards New Zealand, Sydney & Wellington
AS 3972	AS 3972:2010 General purpose and blended cements, published on 22 October 2010 by Standards Australia, Sydney
AS/NZS 4058	AS/NZS 4058:2007 Precast concrete pipes (pressure and non-pressure), prepared by Joint Technical Committee WS-006, Concrete Pipes, published on 18 April 2007 by Standards Australia and Standards New Zealand, Sydney & Wellington
AS/NZS 4671	AS/NZS 4671:2001 Steel reinforcing materials, published on 2 April 2001, Sydney
AusLCI 2023	Australian Life Cycle Inventory database v1.42 published by the Australian Life Cycle Assessment Society, 2023
ECHA 2023	European Chemicals Association, Candidate List of substances of very high concern for Authorisation, published in accordance with Article 59(10) of the REACH Regulation, Helsinki Accessed on 1 June 2023 from: https://echa.europa.eu/candidate-list-table
EFCA 2021	European Federation of Concrete Admixtures Associations (EFCA), IBU EPD Declaration number EPD-EFC-20210193-IBG1-EN, Air entrainers, issued 16-12-2021
EFCA 2021	European Federation of Concrete Admixtures Associations (EFCA), IBU EPD Declaration number EPD-EFC-20210194-IBG1-EN, Set Accelerators, issued 16-12-2021
EFCA 2023	European Federation of Concrete Admixtures Associations (EFCA), IBU EPD Declaration number EPD-EFC-20210198-IBG2-EN, issued 2023-08-14, based on EN 15804 and PCR for concrete admixtures
Environdec 2021	International EPD System, General Programme Instructions for the International EPD System, Version 4.0, 29 March 2021
Environdec 2023	c-PCR-003 Concrete and concrete elements (EN 16757:2022), Product category rules for concrete and concrete elements, version 2 January 2023
EN 15804+A2	EN 15804:2012+A2:2019/AC:2021, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products, European Committee for Standardization (CEN), Brussels, August 2021
EN 15804+A1	Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products, European Committee for Standardization (CEN), Brussels, November 2013
EPD S-P-00557	BlueScope Steel Australia, EPD S-P-00557, Hot Rolled Coil – Medium Carbon Steel, 2020-11-27
EPD S-P-00855	InfraBuild, EPD S-P-00855 v1.2, Reinforcing Rod, Bar and Wire, published 2022-05-20
EPD S-P-00858	The Australian Reinforcing Company (ARC), EPD S-P-00858 v1.2, Reinforcing Bar and Mesh, published 2022-05-20
EPD S-P-05476	Adbri Cement, EPD S-P-05476 (Munster GP), published 2022-10-15
EPD S-P-07447	Cement Australia, EPD S-P-07447, Bulwer Island General Purpose Cement, published 2023-03-30
EPD S-P-07448	Cement Australia EPD S-P-07448, Gladstone General Purpose Cement, published 2023-03-30
EPD S-P-07449	Cement Australia EPD S-P-07449, Port Kembla General Purpose Cement, published 2023-03-30
EPD S-P-07450	Cement Australia EPD S-P-07450, Goliath General Purpose Cement, published 2023-03-30
ISO 14025	Environmental labels and declarations - Type III environmental declarations - Principles and procedures. International Organization for Standardization, Geneva, Switzerland, 2006
ISO 14040	Environmental management - Life cycle assessment - Principles and framework. International Organization for Standardization, Geneva, Switzerland, 2006
ISO 14044	Environmental management - Life cycle assessment - Requirements and guidelines. International Organization for Standardization, Geneva, Switzerland, 2006
NGA 2023	Australian National Greenhouse Accounts Factors, Australian Government Department of Climate Change, Energy, the Environment and Water, August 2023
NOHSC 2004	Australian Government, National Occupational Health and Safety Commission, Approved Criteria for Classifying Hazardous Substances, 3rd Edition, October 2004
NWR 2022	Blue Environment, National Waste Report 2022, prepared for The Department of Climate Change, Energy, the Environment and Water, Final version 1.2, 16 December 2022 (updated 10 February 2023)
PCR 2019:14	Product category rules for Construction products (EN 15804:A2), registration number 2019:14, version 1.3.3, published on 1 March 2024.
CPAA 2007	Concrete Pipe Association of Australasia (CPAA), The installation of steel reinforced concrete pipes – minimum pipe cover required for various compactors, published on 06 November 2007 by CPAA, 20 Bridge St Pymble NSW 2073

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