

Environmental Product Declaration

Reinforced Concrete Pipes (RCP)

manufactured by Humes in Blacktown

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021
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Regional Programme: EPD Australasia www.epd-australasia.com

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*EPD of multiple concrete pipe products from one location, based on a representative product.
The products declared in this EPD are listed on pages 20-22
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*

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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 Blacktown 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 Blacktown.

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.

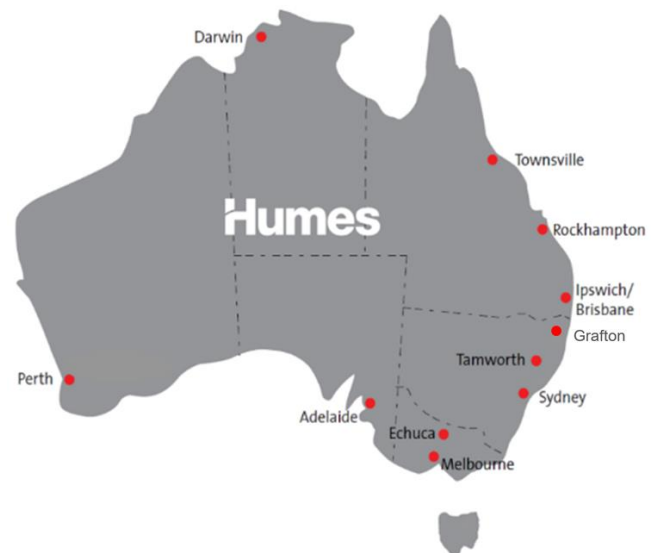


Figure 1 - Location of Humes' precast production facilities

(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.

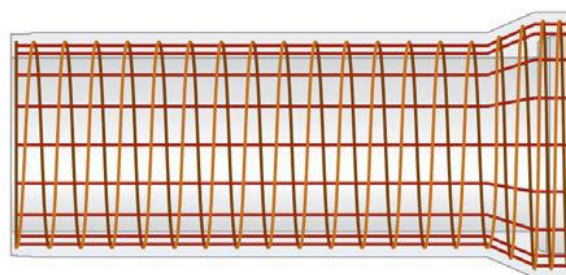
The primary application for RCP is for non-pressure stormwater drainage pipelines. Other uses for our RCP products are in sewerage and pressure pipe applications, or as jacking and shaft components of access chambers. Suitability in these conditions is project specific. Further details on product use 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	Blacktown
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 [‡]	10 - 19%	0%	0%	0
Fly Ash ^{†,‡}	0 - 7%	0%	0%	0
Ground granulated blast furnace slag (GGBFS) ^{†, ‡}	-	0%	0%	0
Coarse & Fine aggregates [†]	70 - 78%	0%	0%	0
Water	5 - 8%	0%	0%	0
Admixtures	-	0%	0%	0
Reinforcement steel	0.1 - 7.2%	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

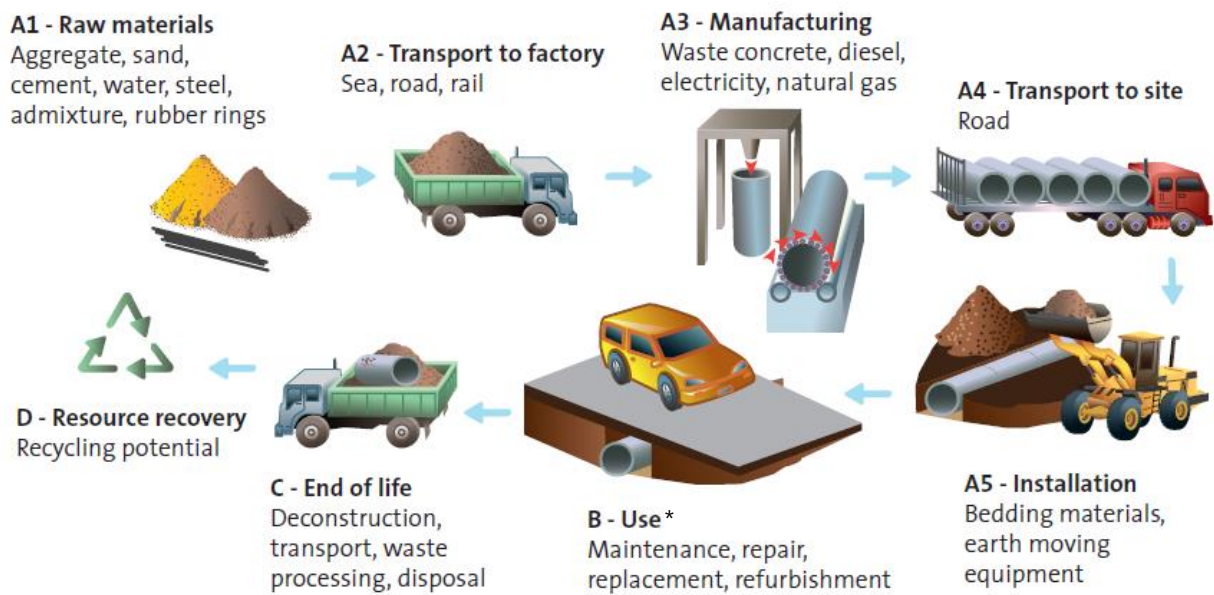
Stages	Product Stage			Construction Stage		Use Stage							End-of-life Stage				Benefits beyond system boundary
	Raw Materials	Transport	Production	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/Demolition	Transport	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				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	71%																
Variation Products	-20% to 46%																
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 Blacktown 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	23% Truck 3.5-16 t capacity (fuel use 1.44 MJ diesel/tkm) 77% Truck 16-28 t capacity (fuel use 2.88 MJ diesel/tkm)
Distance	152 km transport
Capacity utilisation (including empty returns)	50% capacity utilisation (empty return)
Weight of transported products	14.9 tonnes on average
Volume capacity utilisation factor	1
GWP-GHG (IPCC AR5) intensity of A4 transport	0.31 kg CO ₂ e/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

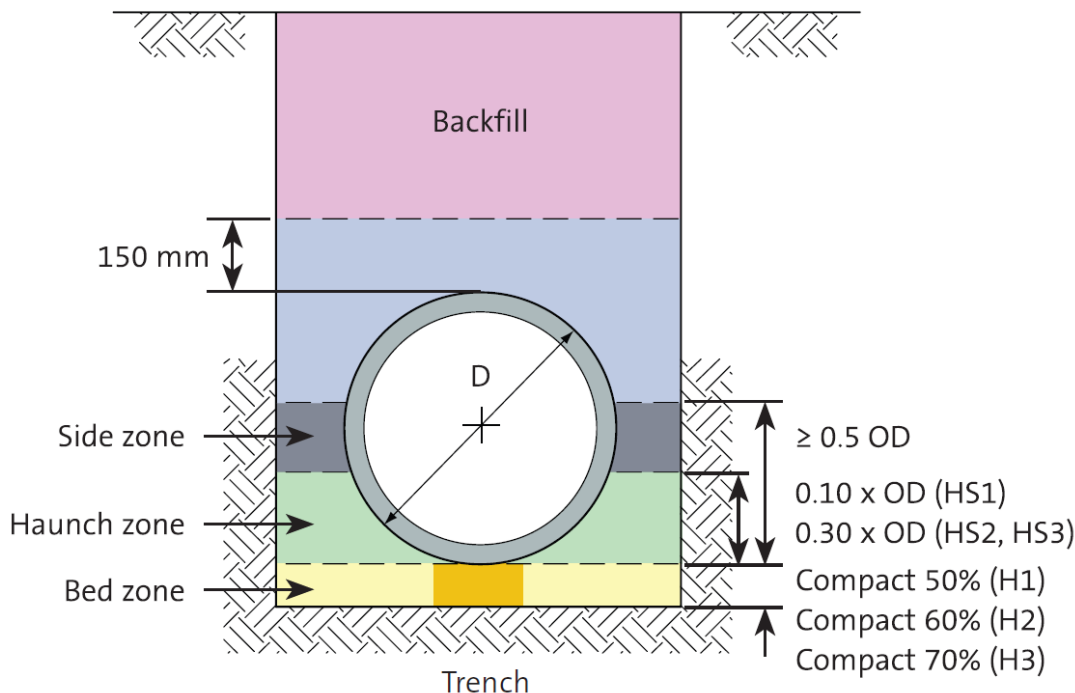


Table 5: Installation parameters (DN600 pipes)

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 (<i>Sand, at mine/CH U/AusSD U</i>) for bed zone and haunch zone. The sand is assumed to be imported over a distance of 50 km (<i>transport, truck, 16 to 28t, fleet average/AU U</i>).
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 (<i>transport, truck, 16 to 28t, fleet average/AU U</i>).
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	1,000	kg collected separately
	0	0	kg collected with mixed construction waste
Transport from demolition site to recovery sites	0	50	km transport (<i>transport, truck, 16 to 28t, fleet average/AU U</i>)
Recovery system specified by type	0	0	kg for re-use
	0	1000	kg for recycling*
	0	0	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 (<i>Excavation, hydraulic digger/RER U/AusSD U</i>) 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
$E_{MR\ after\ EoW\ out} =$ <i>n/a</i> <i>transport + recycling</i>	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 <i>transport:</i> 50 km transport, truck, 28t, fleet average/AU U <i>recycling process:</i> 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-07449).

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 CO₂e / 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 CO₂ 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 CO₂ 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, Blacktown, abandonment scenario

Environmental Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
Core Indicators									
GWP-total	kg CO ₂ -eq.	2.25E+02	4.85E+01	3.86E+01	0.00E+00	0.00E+00	0.00E+00	4.37E+00	8.97E+00
GWP-fossil	kg CO ₂ -eq.	2.27E+02	4.85E+01	3.86E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.97E+00
GWP-biogenic	kg CO ₂ -eq.	-1.36E+00	3.32E-03	1.15E-02	0.00E+00	0.00E+00	0.00E+00	4.08E+00	-3.28E-04
GWP-luluc	kg CO ₂ -eq.	5.36E-02	2.25E-05	1.71E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-6.25E-05
ODP	kg CFC11-eq.	5.70E-06	7.52E-06	5.64E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.06E-08
AP	mol H ⁺ eq.	1.07E+00	4.19E-01	3.26E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.10E-02
EP-freshwater	kg P eq.	2.79E-02	2.87E-06	4.76E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.08E-04
EP-marine	kg N eq.	1.25E-01	1.32E-01	1.09E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.46E-03
EP-terrestrial	mol N eq.	2.40E+00	1.45E+00	1.20E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.55E-02
POCP	kg NMVOC eq.	7.67E-01	3.52E-01	2.91E-01	0.00E+00	0.00E+00	0.00E+00	5.11E-02	2.59E-02
ADP minerals & metals ¹	kg Sb eq.	1.68E-04	5.54E-08	5.06E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.66E-06
ADP fossil ¹	MJ (NCV)	2.24E+03	6.55E+02	5.26E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.51E+01
WDP ¹	m ³ world eq. deprived	1.04E+02	4.20E+00	7.37E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.15E+02
Additional indicators									
GWP-GHG	kg CO ₂ -eq.	2.27E+02	4.85E+01	3.86E+01	0.00E+00	0.00E+00	0.00E+00	3.82E+00	8.97E+00
PM	Disease incidence	1.11E-05	2.36E-06	3.38E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.89E-07
IRP ²	kBq U235 eq.	1.15E+03	9.57E-04	9.46E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.38E-01
ETP-fw ¹	CTUe	4.99E+02	1.68E+02	1.28E+02	0.00E+00	0.00E+00	0.00E+00	5.08E-01	2.29E+02
HTP-c ¹	CTUh	7.01E-07	2.05E-10	5.06E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-5.44E-08
HTP-nc ¹	CTUh	8.90E-06	2.27E-08	4.12E-08	0.00E+00	0.00E+00	0.00E+00	1.07E-08	-1.77E-06
SQP ¹	-	8.63E+02	2.94E+00	1.59E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.95E+00
Carbon Footprint									
GWP-GHG (IPCC AR5)	kg CO ₂ -eq.	224	47.7	38.0	0.0	0.0	0.0	2.9	8.5

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

Environmental Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PERE	MJ _{NCV}	6.19E+01	9.40E-01	3.24E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.77E-01
PERM	MJ _{NCV}	2.11E+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}	8.30E+01	9.40E-01	3.24E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.77E-01
PENRE	MJ _{NCV}	2.14E+03	6.55E+02	5.26E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.51E+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}	2.14E+03	6.55E+02	5.26E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.51E+01
SM	kg	4.02E+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}	2.42E+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}	4.22E+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	1.86E+00	9.49E-02	1.71E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.95E-02
HWD	kg	1.59E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	1.23E+01	2.78E-03	9.57E-03	0.00E+00	0.00E+00	0.00E+00	1.00E+03	0.00E+00
RWD	kg	1.12E-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	1.03E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	9.67E-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 Blacktown 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	-20% to 46%
ODP	-32% to 52%
AP	-20% to 67%
EP-freshwater	-20% to 268%
EP-marine	-40% to 86%
EP-terrestrial	-22% to 62%
POCP	-35% to 65%
ADP minerals & metals ¹	-71% to 9947%
ADP fossil ¹	-23% to 54%
WDP ¹	-12% to 34%

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

Table 14: GWP-total, modules A1-A3, kg CO₂ eq per tonne of FRESH WATER pipe, Blacktown

Joint	RRJ												FJ							
Class	Class 2		Class 3		Class 4		Class 6		Class 8		Class 10		Class 2		Class 3		Class 4		Class 6	
Mix	S	LCS	S	LCS	S	LCS	M	S	M	S	M	S	S	LCS	S	LCS	S	LCS	M	S
DN300	224	207	230	213	247	230	234	211	247	224	253	231	209	191			250	233		
DN375	219	202	230	212	251	234	241	219	246	224	236	213	220	203	241	224	264	247	237	214
DN450	211	193	218	201	241	224	246	224	235	212	237	214	212	194	234	216	250	234	244	221
DN525	220	202	211	194	221	204	242	220	264	241	239	216	224	207	232	215	219	201		
DN600	217	200	213	195	225	208	254	231	242	219			215	197	229	211	222	205		
DN675	216	198	218	200	230	213	243	221					212	194	226	208	223	205		
DN750	211	193	211	193	222	204	255	232					210	192	224	207	218	200	252	229
DN825	213	195	211	193	205	186	251	228					210	192	228	210	220	202	247	224
DN900	200	182	211	193	232	214	246	224					211	193	215	197	217	200	250	227
DN1050	207	190	216	199	221	203	234	212			253	230	219	201	233	215	208	190	241	218
DN1200	208	190	224	207	221	203	249	226	240	217			216	198	217	199	215	197	251	228
DN1350	215	197	236	219	216	198	251	228					216	199	221	203	217	199	248	225
DN1500	203	185	213	196	217	200	249	226			241	218	225	208	231	213	231	214	246	223
DN1650	207	189	224	206	227	210	249	226					225	208	225	208	234	217	249	226
DN1800					232	215							225	207	229	211	234	217	249	226
DN1950													218	200	244	227	234	216	248	225
DN2100													225	207	233	216	231	213	252	230

Table 15: GWP-total, modules A1-A3, kg CO₂ eq per tonne of Marine pipe, Blacktown

Joint	RRJ							
Class	Class 2		Class 3		Class 4		Class 6	
Mix	M	S	M	S	M	S	M	S
DN300								
DN375	216	193	226	204	230	207	244	221
DN450	222	200	233	210	242	219	261	238
DN525	221	199	235	213	245	222	252	230
DN600	237	214	247	225	247	224	269	246
DN675	245	222	248	226	240	217	240	217
DN750	236	213	261	238	241	218	235	212
DN825	238	215	260	238	238	215	247	225
DN900	240	217	261	239	247	224	254	231
DN1050	233	210	253	231	247	224	242	219
DN1200	243	221	241	219	239	216	248	225
DN1350	248	225	254	231	235	212	246	223
DN1500	232	209	238	215	247	224	246	223
DN1650	244	221	244	221	245	222	245	223
DN1800	241	218	259	236	246	223	245	222
DN1950	235	212	247	224	251	229	252	229
DN2100	234	212	247	224	250	228	251	228

The "codes" under the pipe classes refer to the mix designs:

LCS Low Carbon Standard
 S Standard, Low Carbon Marine,
 Low Carbon Jacking
 M Marine, Jacking, Dry Cast

Table 16: GWP-total, modules A1-A3, kg CO₂ eq per tonne of Jacking pipe, Blacktown

Joint	Butt Joint	S Series	J Series	J Series
Class	Class 4	Class 4	Class 4	Class 4
Collar	Mild Steel	Stainless	Mild Steel	Stainless
Mix	M	M	M	M
DN 300	251	288		
DN 350		282		
DN 375	266			
DN 400		274		
DN 450	270	273		
DN 500		266		
DN 525	295			
DN 600	284	278		
DN 675	286			
DN 700		275		
DN 750	282			
DN 800			271	304
DN 825	277			
DN 900	296		269	301
DN 1000			267	297
DN 1050	310			
DN 1100			266	294
DN 1200	295		273	299
DN 1350	305		288	327
DN 1500	304		283	319
DN 1600			265	290
DN 1650	294		279	312
DN 1800	323		274	306
DN 1950	330			
DN 2100	320			

Table 17: GWP-total, modules A1-A3, kg CO₂ eq per tonne of Shafts, Blacktown

Description	Height (mm)	Mix S	Mix M
PCAC,SHAFT,1050,FJ,1100,BO	1100	194	217
PCAC,SHAFT,1050,FJ,1250,BO	1250	194	217
PCAC,SHAFT,1050,WR,1300	1300	194	217
WELL,SHAFT,1200,F,1179090,0300	300	207	230
WELL,SHAFT,1200,F,1179090,0600	600	201	224
WELL,SHAFT,1200,F,1179090,0900	900	200	222
WELL,SHAFT,1200,F,1179090,1200	1200	198	221
WELL,SHAFT,1200,F,1179090,2440	2440	199	222
WELL,SHAFT,1500,F,1456110,0750,ST407A	750	192	215
WELL,SHAFT,1500,F,1456110,0900,ST407A	900	192	215
WELL,SHAFT,1500,F,1456110,1300,ST407A	1300	189	212
WELL,SHAFT,1500,F,1456110,1200,ST407A	1200	192	215
WELL,SHAFT,1500,F,1456110,1500,ST407A	1500	192	215
WELL,SHAFT,1500,EJ,1456110,1680,ST407A	1680	190	213
WELL,SHAFT,1500,EJ,1456110,1855	1855	190	213
WELL,SHAFT,1500,F,1456110,1800,ST407A	1800	192	215
WELL,SHAFT,1500,EJ,1456110,2050,BUTB	2050	190	213
WELL,SHAFT,1500,F,1456110,2100,ST407A	2100	192	215
WELL,SHAFT,1500,F,1394141,1200,SPECIAL	1200	202	225
WELL,SHAFT,1500,F,1456110,2300,BUTT	2300	192	215
WELL,SHAFT,1500,F,1456110,2440,ST407A	2440	192	215
WELL,SHAFT,1800,F,1772117,0900,ST407A	900	193	216
WELL,SHAFT,1800,F,1746130,2246,LS3	2246	180	203
WELL,SHAFT,1800,F,1772117,0950,STD	950	197	220
WELL,SHAFT,1800,F,1772117,1150,BUTT	1150	196	219
WELL,SHAFT,1800,F,1772117,1600,BUTT	1600	194	217
WELL,SHAFT,1800,F,1772117,1665	1665	194	217
WELL,SHAFT,1800,F,1772117,1665,BUTT	1665	194	217
WELL,SHAFT,1800,F,1772117,1300,ST407A	1300	203	225
WELL,SHAFT,1800,F,1772117,1900,BUTT	1900	193	216
WELL,SHAFT,1800,F,1772117,1650,BUTT	1650	193	216
WELL,SHAFT,1800,F,1772117,2050,BUTT	2050	194	216
WELL,SHAFT,1800,F,1772117,2250	2250	193	216
WELL,SHAFT,1800,F,1772117,1600,ST407A	1600	203	225
WELL,SHAFT,1800,F,1772117,1800	1800	199	222
WELL,SHAFT,1800,F,1772117,1900,ST407A	1900	208	231
WELL,SHAFT,1800,F,1746130,2200,DTC	2200	202	224
WELL,SHAFT,1800,F,1828089,1670	1670	299	322
WELL,SHAFT,2100,F,2136126,1050,BUTT	1050	218	240
WELL,SHAFT,2100,F,2136126,1250,ST407A	1250	215	237
WELL,SHAFT,2100,F,2136126,1500,BUTT&B	1500	215	237
WELL,SHAFT,2100,F,2136126,1400,ST407A	1400	218	241
WELL,SHAFT,2100,F,2136126,1600,BUTT	1600	215	237
WELL,SHAFT,2100,F,2136126,1600,ST407A	1600	215	237
WELL,SHAFT,2100,F,2136126,1500,ST407A	1500	216	239
WELL,SHAFT,2100,F,2136126,1320,ST407A,PC	1320	201	224
WELL,SHAFT,2100,F,2136126,2050,BUTT	2050	218	240
WELL,SHAFT,2100,F,2136126,2400,ST407A	2400	215	237

EN 15804+A1 LCA results for backwards compatibility

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

Environmental Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP	kg CO ₂ eq	2.21E+02	4.76E+01	3.80E+01	0.00E+00	0.00E+00	0.00E+00	2.86E+00	8.29E+00
ODP	kg CFC11 eq	4.77E-06	5.94E-06	4.45E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.60E-08
AP	kg SO ₂ eq	8.12E-01	2.32E-01	1.90E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.54E-02
EP	kg PO ₄ ³⁻ eq	1.08E-01	4.45E-02	3.69E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.23E-03
POCP	kg C ₂ H ₄ eq	2.66E-02	1.50E-02	1.01E-02	0.00E+00	0.00E+00	0.00E+00	2.14E-02	6.97E-03
ADPE	kg Sb eq	1.65E-05	5.60E-08	5.09E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.64E-06
ADPF	MJ _{NCV}	1.59E+03	6.37E+02	5.26E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.02E+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.

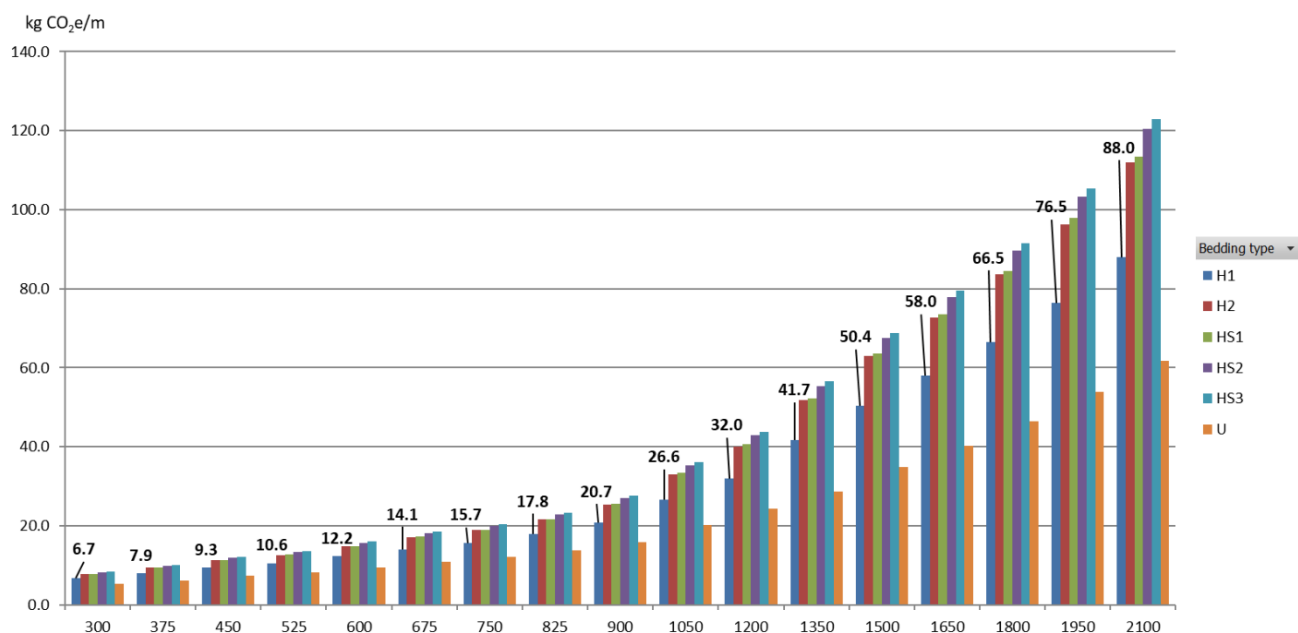
Installation processes include:

- 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 CO₂e 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, Blacktown

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	-3.73E+01
GWP-fossil	kg CO ₂ eq.	4.87E-01	7.81E+00	4.13E+00	0.00E+00	-3.72E+01
GWP-biogenic	kg CO ₂ eq.	3.59E-05	5.35E-04	4.31E-03	4.08E+00	-1.83E-02
GWP-luluc	kg CO ₂ eq.	2.31E-07	3.63E-06	1.90E-06	0.00E+00	2.02E-04
ODP	kg CFC-11 eq.	7.72E-08	1.21E-06	5.18E-07	0.00E+00	-1.38E-07
AP	mol H ⁺ eq.	5.31E-03	6.75E-02	1.13E-02	0.00E+00	-1.29E-01
EP-freshwater	kg P eq.	5.98E-08	4.62E-07	3.04E-06	0.00E+00	-1.34E-03
EP-marine	kg N eq.	2.32E-03	2.13E-02	2.01E-03	0.00E+00	-2.22E-02
EP-terrestrial	mol N eq.	2.54E-02	2.33E-01	2.19E-02	0.00E+00	-2.61E-01
POCP	kg NMVOC eq.	6.10E-03	5.67E-02	5.86E-03	5.11E-02	-9.67E-02
ADP minerals & metals	kg Sb eq.	5.69E-10	8.91E-09	1.02E-06	0.00E+00	-1.31E-05
ADP fossil	MJ, net calorific value	6.74E+00	1.06E+02	5.86E+01	0.00E+00	-4.24E+02
WDP	m ³ world eq. deprived	4.32E-02	6.76E-01	1.27E+00	0.00E+00	-7.58E+02
Indicator	Unit					
GWP-GHG	kg CO ₂ eq	4.87E-01	7.81E+00	4.13E+00	3.82E+00	-3.73E+01
PM	disease incidence	1.41E-07	3.80E-07	7.52E-08	0.00E+00	-1.15E-06
IRP	kBq U235 eq.	9.84E-06	1.54E-04	8.27E-04	0.00E+00	7.74E-01
ETP-fw	CTUe	1.73E+00	2.71E+01	1.33E+01	5.08E-01	-7.54E+02
HTP-c	CTUh	1.79E-11	3.29E-11	8.60E-11	0.00E+00	1.77E-07
HTP-nc	CTUh	1.84E-09	3.65E-09	3.96E-09	1.07E-08	5.76E-06
SQP	-	3.21E-02	4.74E-01	1.11E+04	0.00E+00	-2.01E+02
Indicator	Unit					
GWP-GHG (IPCC AR5)	kg CO₂ eq	0.483	7.68	4.11	2.88	-3.55E+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.

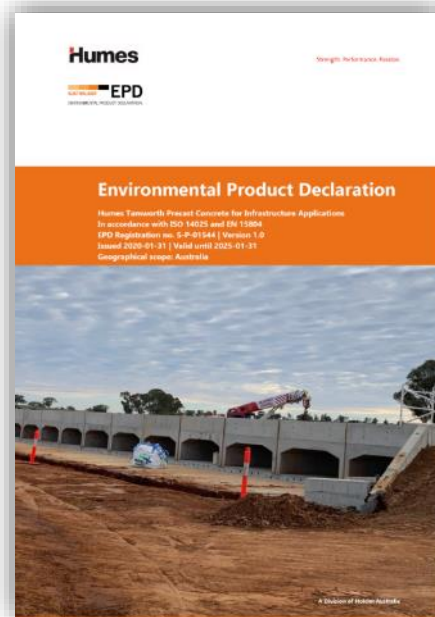
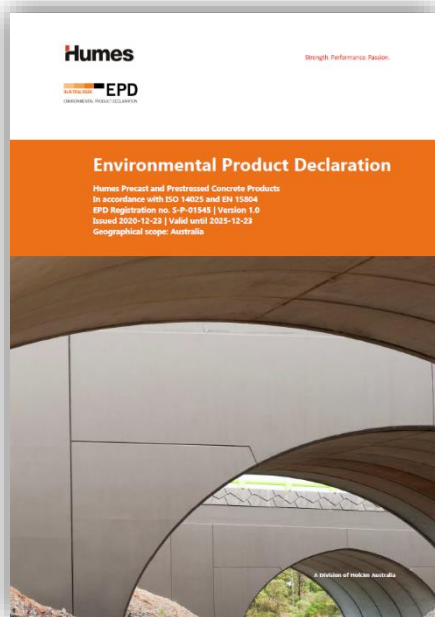
Infrastructure Sustainability

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.



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