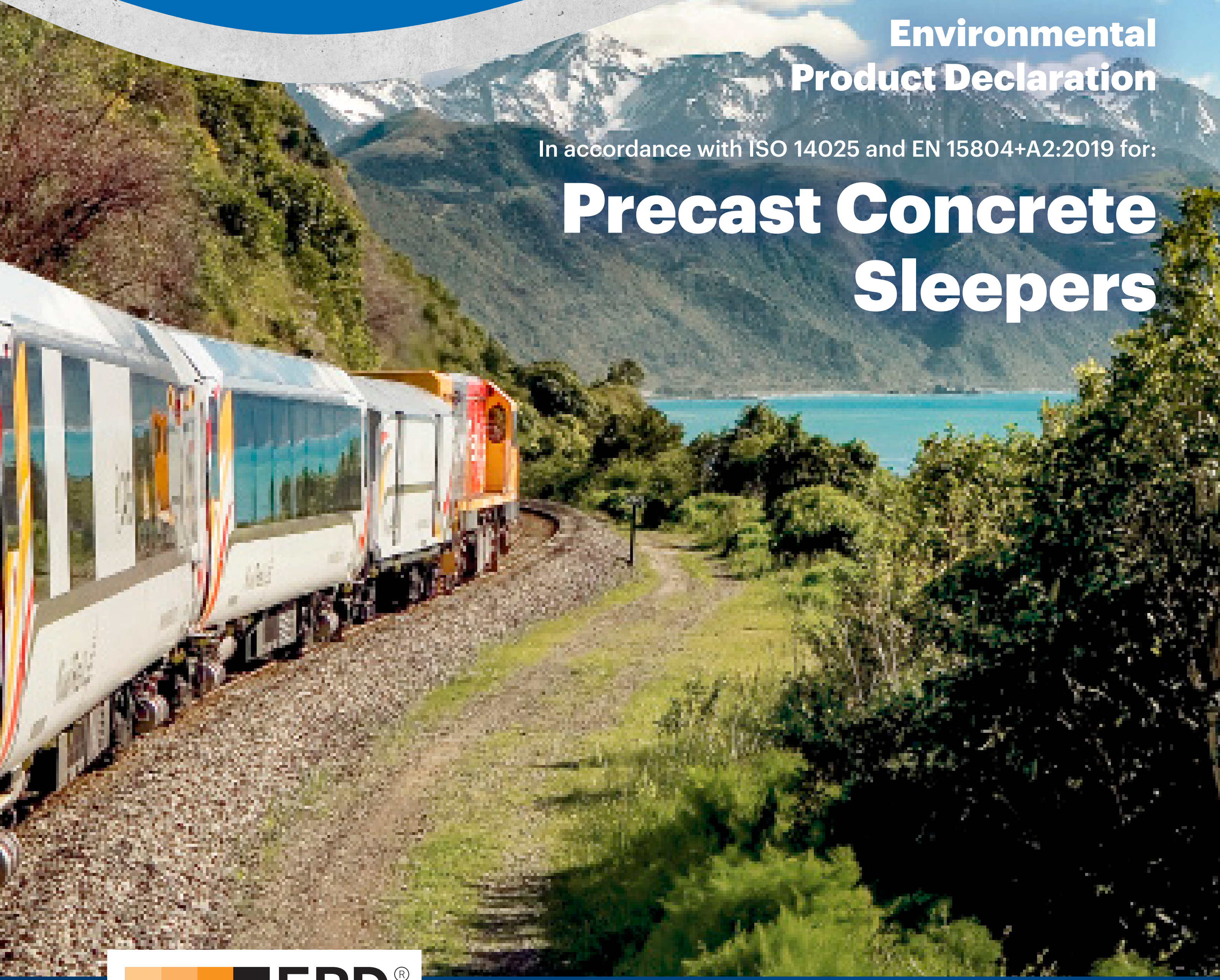
Environmental Product Declaration

In accordance with ISO 14025 and EN 15804+A2:2019 for:

Precast Concrete Sleepers



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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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Contents

General Information

An Environmental Product Declaration, or EPD, is a standardised and verified way of quantifying the environmental impacts of a product based on a consistent set of rules known as a PCR (Product Category Rules).

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804. The results for EN15804+A1 compliant EPDs are not comparable with EN15804+A2 compliant studies as the methodologies are different. EN 15804+A1 compliant results are included in this document to assist comparability across EPDs.

Declaration Owner	**Humes Pipeline Systems**	
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Geographical Scope	**New Zealand**	
Reference Year for Data	**2018-07-01 to 2019-06-30**	
EPD produced by	**thinkstep Ltd**	
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PCR	PCR 2019.14 Construction Products Version 1.11, 2021-02-05 c-PCR-003 Concrete and Concrete Elements (EN 16757:2017), 2019-12-20 (valid until 2024-12-30)	
PCR review was conducted by	The Technical Committee of the International EPD® System	
Chair	Claudia A. Peña. Contact via info@environdec.com	
Independent verification of the declaration and data, according to ISO 14025	☐ EPD process certification (Internal) ☑ EPD verification (External)	
Third party verifier	Rob Rouwette (start2see Pty Ltd) Email: rob.rouwette@start2see.com.au	
Verifier approved by	EPD Australasia	
Procedure for follow-up of data during EPD validity involved third-party verifier	☐ Yes ☑ No	

About us

Founded in 1923 by pioneering industrialist, Walter Hume, **Humes Pipeline Systems** is a company built on the principals of innovation, manufacturing expertise and quality products supported by a team of capable people who are proud to serve their customers

For over 100 years, Humes have been sourcing and distributing a range of products of various materials, and also manufactures a range of concrete pipe and precast structures for the infrastructure, drain laying and rural markets throughout New Zealand. Humes is a standalone business unit within the Concrete division of the Fletcher Building Group.

The Humes business is supported by a team of over 250+ employees working across 23 sites (manufacturing and sales) all over New Zealand providing extensive product and service coverage and is supported by a team in their Auckland Support Office.

- **Innovative expertise since 1923**
- **Connecting communities with smarter solutions**
- **Cleaning up waterways**
- **Pioneers in the industry**
- **Building lifelong assets**

Humes holds current certifications under AS/NZS 9001:2015 for Quality Management Systems, as well as being licensed under various product certification schemes.

Product Description

This EPD covers **prestressed concrete sleepers** manufactured by Humes, at our Hamilton Civil Manufacturing Plant in Te Rapa (Hamilton).

Humes manufactures concrete sleepers to AS 1085.14, primarily for use by KiwiRail in its nationwide rail network. Concrete sleepers offer a high durability, high strength solution, and have been specifically designed to meet and exceed the needs required by KiwiRail for it's heavy rail system.
Sleepers are manufactured with the "E-Clip" fastening system, to enable quick and easy assembly, and a secure and safe assembly for the final rail system.

Sleepers come in two variations, being "Standard" and "Galvanised", with the only difference being the material used in the pandrol shoulders, allowing for use in different environments in New Zealand.

Table 1 – Industry Classification

PRODUCT	CLASSIFICATION	CODE	CATEGORY
Prestressed Concrete Sleeper	UN CPC Ver.2	37550	Prefabricated structural components for building or civil engineering, of cement, concrete or artificial stone
	ANZSIC 2006	2034	Concrete Product Manufacturing

Declared Unit

Humes prestressed concrete sleepers are designed and manufactured according to AS1085.14:2019 (Railway Track Material, Part 14: Prestressed concrete sleepers), and have a designed service life of 50 years.

The environmental profile for the galvanised sleeper has been declared as representative for both products.
The differences in environmental profile between the standard sleeper and the galvanised sleeper sits within the 10% tolerance for GWP-GHG permitted by EN 15804.
As such, the declared unit for this EPD is "1 prestressed concrete sleeper", with mass of 213 kg.

Content Declaration

Table 2 – Content declaration (per 1 tonne product)

PRODUCT COMPONENTS	WEIGHT, KG	POST-CONSUMER RECYCLED MATERIAL, WEIGHT-%	RENEWABLE MATERIAL, WEIGHT-%
Steel (reinforcement)	30.1	0*	0
Galvanised steel (pandrols)	18.2	0	0
Concrete	952	0	0
Total	1000		

Table 3 – Packaging (per 1 tonne product)

PACKAGING MATERIALS	WEIGHT, KG	WEIGHT-% (VERSUS THE PRODUCT)	WEIGHT BIOGENIC CARBON, KG C/KG
Timber dunnage	6.35	0.6%	0.5
Total	6.35	0.6%	

* The composition of the scrap input to the steel reinforcement is not known, so no post-consumer recycled material has been declared. The scrap input is 23.1% for rebar and 6.7% for steel wire, made up of a mix of pre-consumer and post-consumer scrap.

The product as supplied is non-hazardous. The products included in this EPD do not contain any substances of very high concern as defined by European REACH regulation in concentrations >0.1% (m/m). Precast concrete products are classified as non-dangerous goods according to the Land Transport Rule: Dangerous Goods 2005. 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. Dust from this product is classified as Hazardous under the Hazardous Substances and New Organisms Act 1996 (HSNO Act) and is subject to Workplace Exposure Standards (WorkSafe NZ WES-BEI indices Edition 13, April 2022).

Manufacturing Process

To produce precast concrete components, reinforcement steel is placed into re-useable and largely fixed moulds, and concrete is poured, and cured. This manufacturing process allows for a high turnover of repeatable, consistent products manufactured to the same design each time.

Precast Concrete (Ready-Mix) is manufactured offsite by a specialised supplier, who transport it to the manufacturing site, where it is immediately discharged into the mould for placement. The concrete is a high strength, self compacting mix, which requires no additional vibration after placement.

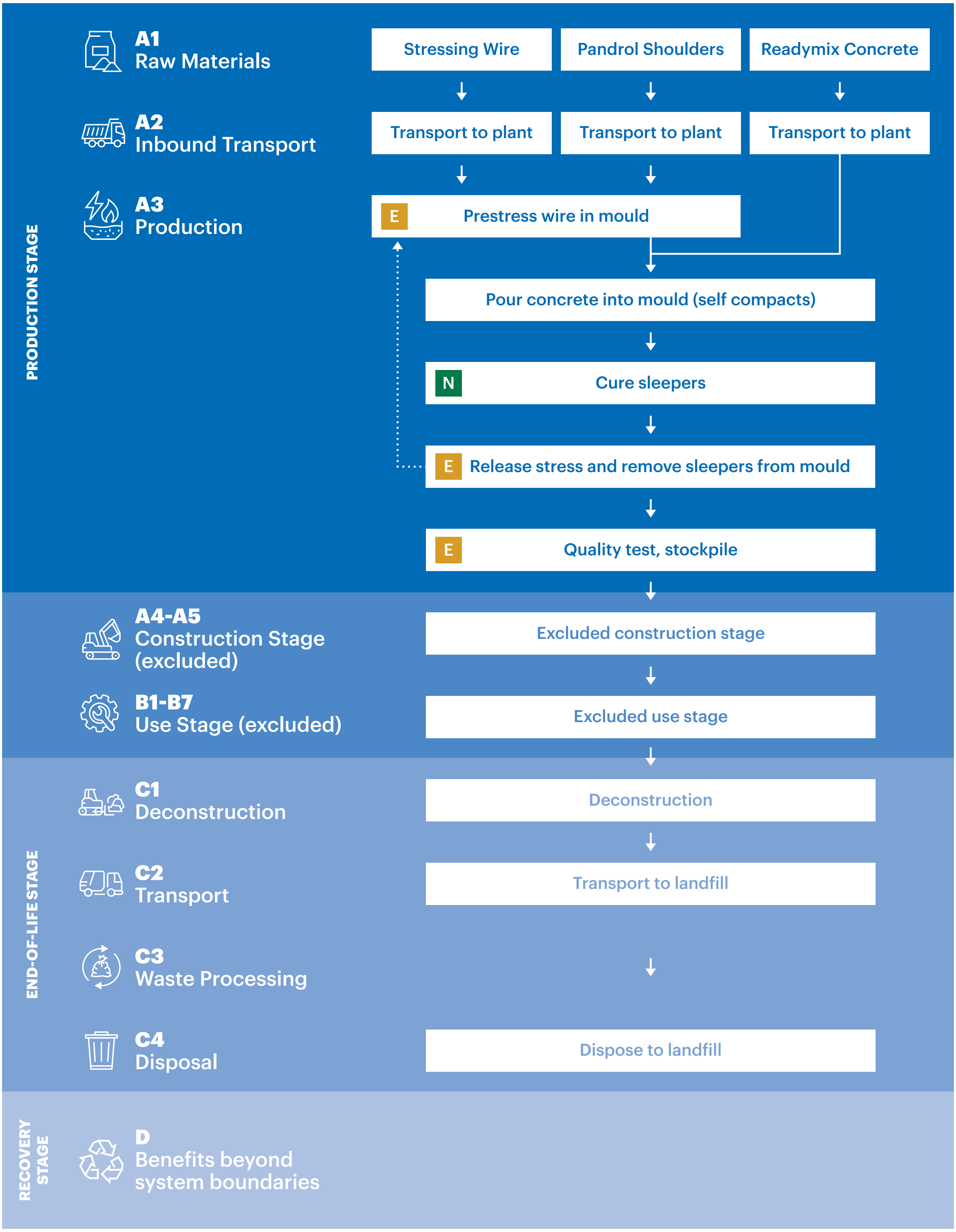
Specialised stressing wire for reinforcement is shipped from a foundry in Taiwan, to the site, where it is stored in coils until used. Prior to sleeper manufacture, the stressing wire is cut to a fixed length to match the mould, and has either end "buttoned" to allow it to be tensioned. It is then placed on to a large spindle, which allows it to be laid through the mould. The steel is tensioned to its design strength prior to the concrete pour, and the tension is maintained until the sleepers have reached a specific concrete strength.

Every sleeper has two pandrol shoulders cast into it, to allow future connection between the sleeper and the railway track. These are purchased in, and stored on site until used, and are placed in the mould prior to the concrete pour.

Once all components are in the mould, the moulds are covered, and steam is introduced around it, to allow for a consistent curing profile, and an appropriate level of strength to be obtained prior to stress release.

Once cured, the stress is released from the wire, and the railway sleepers are cut to size, before being removed from the moulds, and stored awaiting dispatch to the customer.

System Boundaries



Legend Manufacturing energy inputs E Electricity N Natural Gas

System Boundaries

This EPD is of the type 'cradle-to-gate with modules C1-C4 and module D (A1-A3 + C + D)'. Construction phase (A4-A5) and use phase (B1-B7) modules are dependent on particular scenarios and best considered at the project level.

The modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation are shown in Table 9.

Table 4 – Modules included in the scope of the EPD

	PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				RESOURCE RECOVERY
	Raw material supply	Transport of raw materials	Manufacturing	Transport to customer	Construction / Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport to waste processing	Waste processing	Disposal	Reuse - Recovery- Recycling- potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	GLO	GLO	NZ										NZ	NZ	NZ	NZ	GLO
Specific data	>90%																
Variation - products	<10%																
Variation - sites	0%																

X = included in the EPD; ND = Module not declared (such a declaration shall not be regarded as an indicator result of zero).

Production (Module A1-A3)

The production stage includes the environmental impacts associated with raw materials extraction and processing of inputs, transport to, between and within the manufacturing site, manufacturing of average product at the exit gate of the manufacturing site and transport of product to customer.

The raw materials are supplied by third parties and typically transported to site by truck. The ready-mix concrete is supplied from a concrete batching plant adjacent to the site.

End-of-life (C1-C4)

At the end of their functional life, concrete sleepers are disposed of to landfill. Due to high uncertainty in the parameters and lack of data, CO_2-uptake (carbonation) has not been included at end-of-life.

End-of-life processes are based on scenarios. The landfill scenario is currently in use and is representative for (one of) the most probably alternatives.

The waste flows and a brief description of the landfill scenario at end-of-life are shown in Table 5.

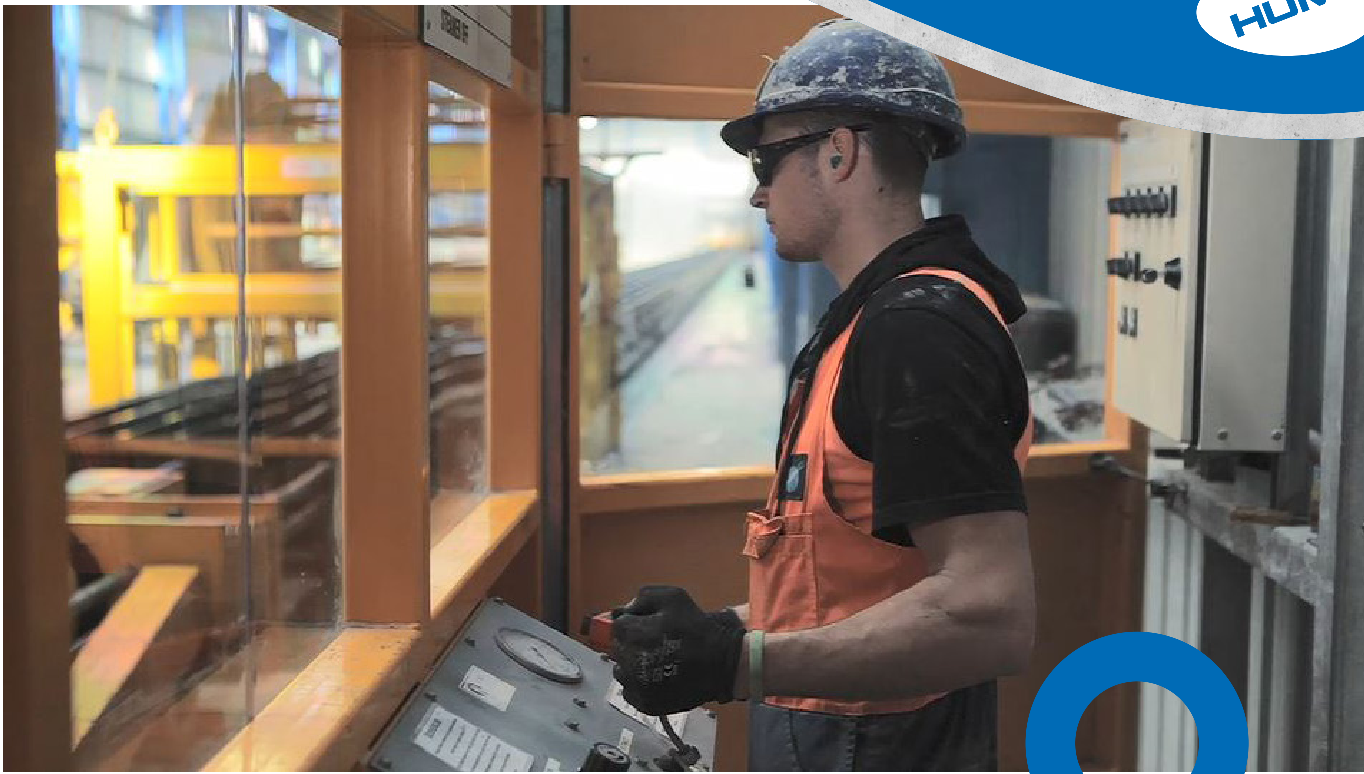
Table 5 – End-of-life scenario, processes and parameters, per declared unit (1 sleeper).

SCENARIO / MODULE	PARAMETER	PRESTRESSED SLEEPERS
Product Definition	Declared Unit	1 sleeper (213 kg)
	Assumed composition	3.5% steel, 96.5% concrete
Deconstruction (C1)	Process and assumptions	Demolition using a 100 kW excavator using 0.172 kg diesel per tonne.
	kg collected separately	213
Transport (C2)	Process and assumptions	Transport 100 km by truck
	kg transported	213
Waste processing (C3)	Process and assumptions	N/A (sent directly to landfill)
	kg crushed	0
	kg for recycling (concrete)	N/A
	kg for recycling (steel)	N/A
Disposal (C4)	Process and assumptions	100% of sleeper sent to inert landfill.
	kg disposed	213

Recovery (module D)

Module D starts at the "end of waste" state, when the sleeper is no longer a product in the current life cycle and starts to be a potential input for the next life cycle.

For the landfill scenario, no material is available for recycling, so no environmental impacts occur.



Life cycle assessment methodology

Primary data were used for all manufacturing operations up to the factory gate, including upstream data for ready-mix concrete. Primary data for Humes' operations was sourced from the period 01 July 2018 to 30 June 2019. Background data was used for input materials sourced from other suppliers, and for the raw materials used in the ready-mix concrete.

All data in the background system were from the GaBi Life Cycle Inventory Database 2021.2 (Sphera, 2021) . Most datasets have a reference year between 2017 and 2020 and all fall within the 10 year limit allowable for generic data under EN 15804.

Upstream data

Data for steel input is taken from worldsteel LCI data. Data for cement input is taken from the Golden Bay Cement EPD. Electricity and water were modelled to reflect New Zealand conditions.
Other upstream (supply chain) data used were Australian, or European due to a lack of consistent LCI data for New Zealand at the time this study was conducted.

Electricity

The composition of the electricity grid mix is modelled in GaBi and updated annually. The New Zealand electricity grid consumption mix (2017) is made up of hydro (59.30%), geothermal (17.96%) natural gas (12.93%), wind (4.66%), coal gases (2.15%) hard coal (1.36%), biomass (0.70%), biogas (0.69%), and photovoltaics (0.27%), lignite (0.05%) and fuel oil (0.03%). The emission factor for the New Zealand national grid mix 1kV-60kV for the GWP-GHG indicator is 0.145 kg CO2e/kWh.

Transport

Where transport data was not available for any material, a standard value of 100 km was used.

Explanation of Representative Products & Variation

The impacts for both sleepers are represented by the galvanised steel sleeper, which will have slightly higher GWP-GHG impacts lined to the galvanising, as well as higher impacts for ADP-m&m.

Cut off criteria

The cut-off criteria applied are 1% of cumulative mass input and 1% of cumulative energy usage, providing the minor flows do not have significant environmental relevance.

Inputs knowingly excluded from the inventory are packaging materials for minor inputs such as mould oil, which is used in small quantities. These materials are well below the materiality cut-off and have been excluded. Personnel is excluded as per section 4.3.1 in the PCR (EPD International, 2021). thinkstep-anz consistently excludes environmental impacts from infrastructure, construction, production equipment, and tools that are not directly consumed in the production process, ('capital goods') regardless of potential significance. High-quality infrastructure-related data isn't always available and there is no clear cut-off for what to include. For this reason, capital goods data are applied to LCA studies inconsistently. This is expected to lead to reduced consistency and comparability of EPDs. Capital goods were previously excluded from EPDs, thus including capital goods in current EPDs would further reduce their comparability.

Allocation

Te Rapa precast site data covered both the open air cured precast products ad the natural gas cured prestressed sleepers. Natural gas is only used for the sleeper curing process and was fully allocated to the sleepers. All other site-level inputs and outputs were allocated by mass. Allocation for input materials that contain secondary material occurs in the upstream datasets. Fly ash and silica fume used in the concrete mixes have environmental impacts allocated based on economic value in the background data.

Assumptions

No data was available for the quantity or waste treatment of excess reinforcing steel or concrete, and these have not been modelled.

Assessment Indicators

The results tables describe the different environmental indicators for each product per declared unit, for each declared module.

Tables 5 presents the covered indicators, including the core and additional environmental impact indicators, life cycle inventory indicators, describing resource use and waste and other outputs, indicators used in the previous standard (EN15804+A1), and the biogenic carbon content of the product and its packaging.

For concrete sleepers, the following indicators are not relevant, hence result in zero values:

- Components for re-use (CRU) is zero since there are none produced.
- Materials for recycling (MFR) is zero since no waste is available for recycling.
- Materials for energy recovery (MER) is zero since no waste is available for energy recovery.
- Exported electrical energy (EEE) is zero since there is none produced.
- Exported thermal energy (EET) is zero since there is none produced.

Table 5 - Assessment indicators

INDICATOR	INDICATORS, ABBR.	UNITS
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS		
Climate change – total	GWP-total	kg CO_2-eq.
Climate change – fossil	GWP-fossil	kg CO_2-eq.
Climate change – biogenic	GWP-biogenic	kg CO_2-eq.
Climate change – land use and land use change	GWP-luluc	kg CO_2-eq.
Ozone depletion	ODP	kg CFC11-eq.
Acidification	AP	Mole of H^+ eq.
Eutrophication aquatic freshwater	EP-freshwater	kg P eq.
Eutrophication aquatic marine	EP-marine	kg N eq.
Eutrophication terrestrial	EP-terrestrial	Mole of N eq.
Photochemical ozone formation	POCP	kg NMVOC eq.
Depletion of abiotic resources – minerals and metals*	ADP-m&m	kg Sb-eq.
Depletion of abiotic resources – fossil fuels*	ADP-fossil	MJ
Water Depletion Potential*	WDP	m^3 world equiv.
EN15804+A2 RESOURCE USE INDICATORS		
Renewable primary energy as energy carrier	PERE	MJ
Renewable primary energy resources as material utilization	PERM	MJ
Total use of renewable primary energy resources	PERT	MJ
Non-renewable primary energy as energy carrier	PENRE	MJ
Non-renewable primary energy as material utilization	PENRM	MJ
Total use of non-renewable primary energy resources	PENRT	MJ
Use of secondary material	SM	kg
Use of renewable secondary fuels	RSF	MJ
Use of non-renewable secondary fuels	NRSF	MJ
Use of net fresh water	FW	m^3
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW INDICATORS		
Hazardous waste disposed	HWD	kg
Non-hazardous waste disposed	NHWD	kg
Radioactive waste disposed	RWD	kg
Components for reuse	CRU	kg
Materials for recycling	MFR	kg
Materials for energy recovery	MER	kg
Exported electrical energy	EEE	MJ
Exported thermal energy	EET	MJ
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS		
IPCC AR5 Global Warming Potential **	GWP-GHG	kg CO_2-eq.
Particulate Matter emissions	PM	Disease incidences
Ionising Radiation – human health ***	IRP	kBq U235 eq.
Eco-toxicity (freshwater)	ETP-fw	CTUe
Human Toxicity, cancer *	HTPc	CTUh
Human Toxicity, non-cancer *	HTPnc	CTUh
Lan use related impacts / soil quality *	SQP	Pt
EN15804+A2 BIOGENIC CARBON CONTENT INDICATORS		
Biogenic carbon content - product	BCC-prod	kg C
Biogenic carbon content - packaging	BCC-pack	kg C
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS		
Global warming potential	GWP	kg CO_2 eq.
Ozone depletion potential	ODP	kg CFC 11 eq.
Acidification potential	AP	kg SO_2 eq.
Eutrophication potential	EP	kg $(PO_4)^{3-}$ eq.
Photochemical ozone creation potential	POCP	kg C_2H_4 eq.
Abiotic depletion potential for non-fossil resources	ADPe	kg Sb eq.
Abiotic depletion potential for fossil resources	ADPf	MJ

* 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 experience with the indicator.
** This indicator is calculated using the characterisation factors from the IPCC AR5 report (IPCC 2013) and has been included in the EPD following the PCR. The indicator is more likely to be in line with other GHG reporting in Australia and New Zealand.

*** 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 some construction materials, is also not measured by this indicator.

Environmental Performance

For 1 prestressed concrete sleeper (213kg)

Table 6

INDICATORS, ABBR.	UNITS	A1-A3	C1	C2	C3	C4	D
EN15804+A2 CORE ENVIRONMENTAL IMPACT INDICATORS							
GWP-total	kg CO_2-eq.	59.4	0.133	1.87	0	3.14	0
GWP-fossil	kg CO_2-eq.	59.0	0.132	1.87	0	3.22	0
GWP-biogenic	kg CO_2-eq.	0.417	1.59E-05	9.44E-04	0	-0.0936	0
GWP-luluc	kg CO_2-eq.	0.0134	2.01E-06	3.77E-05	0	0.00946	0
ODP	kg CFC11-eq.	7.03E-11	1.50E-17	2.76E-16	0	1.25E-14	0
AP	Mole of H^+ eq.	0.142	6.30E-04	0.00336	0	0.0229	0
EP-freshwater	kg P eq.	1.37E-04	2.34E-08	3.08E-07	0	5.41E-06	0
EP-marine	kg N eq.	0.0438	3.05E-04	0.00140	0	0.00596	0
EP-terrestrial	Mole of N eq.	0.470	0.00334	0.0154	0	0.0654	0
POCP	kg NMVOC eq.	0.129	8.52E-04	0.00327	0	0.0180	0
ADP-m&m	kg Sb-eq.	3.76E-04	2.16E-09	2.90E-08	0	3.04E-07	0
ADP-fossil	MJ	481	1.77	24.9	0	42.7	0
WDP	m^3 world equiv.	10.4	0.00103	0.0123	0	0.346	0
EN15804+A2 RESOURCE USE INDICATORS							
PERE	MJ	85.1	0.00509	0.121	0	5.76	0
PERM	MJ	0	0	0	0	0	0
PERT	MJ	85.1	0.00509	0.121	0	5.76	0
PENRE	MJ	482	1.77	24.9	0	42.8	0
PENRM	MJ	0	0	0	0	0	0
PENRT	MJ	482	1.77	24.9	0	42.8	0
SM	kg	0.628	0	0	0	0	0
RSF	MJ	60.2	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0
FW	m^3	0.456	1.55E-05	2.41E-04	0	0.0105	0
EN15804+A2 WASTE MATERIAL AND OUTPUT FLOW INDICATORS							
HWD	kg	6.39E-04	5.32E-12	8.97E-11	0	4.54E-09	0
NHWD	kg	4.19	2.80E-05	5.95E-04	0	213	0
RWD	kg	0.00268	4.14E-08	3.43E-06	0	4.49E-04	0
CRU	kg	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0
MER	kg	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0
EN15804+A2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS							
GWP-GHG	kg CO_2-eq.	58.9	0.132	1.87	0	3.21	0
PM	Disease incidences	2.06E-06	7.15E-09	2.39E-08	0	2.85E-07	0
IRP	kBq U235 eq.	0.305	4.63E-06	4.02E-04	0	0.0472	0
ETP-fw	CTUe	191	0.473	9.50	0	24.4	0
HTPc	CTUh	2.38E-08	7.99E-12	1.62E-10	0	3.59E-09	0
HTPnc	CTUh	3.91E-07	4.85E-10	5.87E-09	0	3.96E-07	0
SQP	Pt	526	0.00367	0.0638	0	8.63	0
EN15804+A2 BIOGENIC CARBON CONTENT INDICATORS							
BCC-prod	kg C	0					
BCC-pack	kg C	0.577					
EN15804+A1 ENVIRONMENTAL IMPACT INDICATORS							
GWP	kg CO_2 eq.	58.2	0.131	1.85	0	3.05	0
ODP	kg CFC 11 eq.	1.32E-10	2.00E-17	3.68E-16	0	1.67E-14	0
AP	kg SO_2 eq.	0.111	4.37E-04	0.00242	0	0.0182	0
EP	kg $(PO_4)^{3-}$ eq.	0.0172	1.02E-04	4.76E-04	0	0.00207	0
POCP	kg C_2H_4 eq.	0.0120	4.24E-05	-3.87E-04	0	0.00140	0
ADPe	kg Sb eq.	3.77E-04	2.16E-09	2.90E-08	0	3.07E-07	0
ADPf	MJ	469	1.76	24.8	0	41.5	0

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