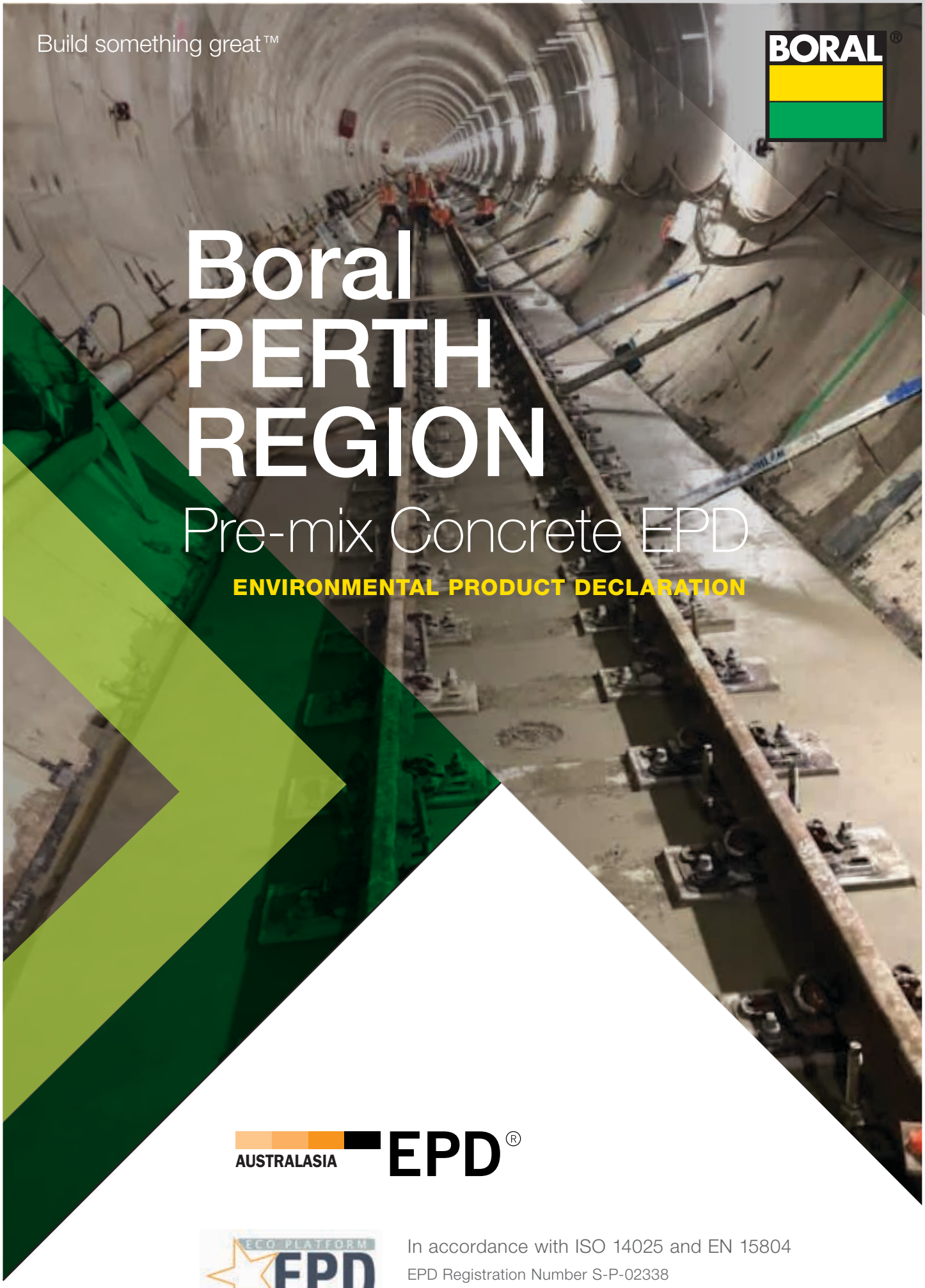
Build something great™



Boral PERTH REGION

Pre-mix Concrete EPD

ENVIRONMENTAL PRODUCT DECLARATION

AUSTRALASIA EPD®

In accordance with ISO 14025 and EN 15804

EPD Registration Number S-P-02338
Issued 1st August 2021 | Valid until 1st August 2026
Geographical Scope: PERTH REGION.

CONTENTS

Cover image: Kenwick, Perth, WA

PROGRAM 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, ISO 14040 and ISO 14044 as they enable transparency and comparability between EPDs. This EPD provides cradle-to-gate environmental indicators for a range of normal class pre-mix concrete products, lower-carbon concrete (e.g. ENVISIA® and Envirocrete®) and concrete for special applications manufactured by Boral.

This EPD is verified to be compliant with EN 15804. EPDs of construction products may not be comparable if they do not comply with EN 15804. EPDs within the same product category but from different programs or utilising different PCRs may not be comparable. Boral, as the EPD owner, has the sole ownership, liability and responsibility for the EPD.

Declaration Owner	BORAL®	**Boral**	Address: Level 18 15 Blue Street North Sydney NSW 2060 Web: www.boral.com.au Phone: +612 9220 6300
EPD Program Operator	AUSTRALASIA EPD®	**EPD Australasia Limited**	Address: 315a Hardy Street Nelson 7010, New Zealand Web: www.epd-australasia.com Email: info@epd-australasia.com Phone: 1800 733 560
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EPD Version:	1.0
Reference year for data:	2018-01-01/2018-12-31

CEN standard EN 15804 served as the core PCR	
PCR:	PCR 2012:01 Construction Products and Construction Services, Version 2.33, 2020-09-18 PCR 2012:01-SUB-PCR-G Concrete and concrete elements, 2020-09-18
PCR review was conducted by:	The Technical Committee of the International EPD® System. Chair: Massimo Marino. Contact via info@environdec.com
Independent verification of the declaration and data, according to ISO 14025:	☐ EPD process certification (Internal) ☒ EPD verification (External)
Procedure for follow-up of data during EPD validity involved third-party verifier:	☐ No ☒ Yes

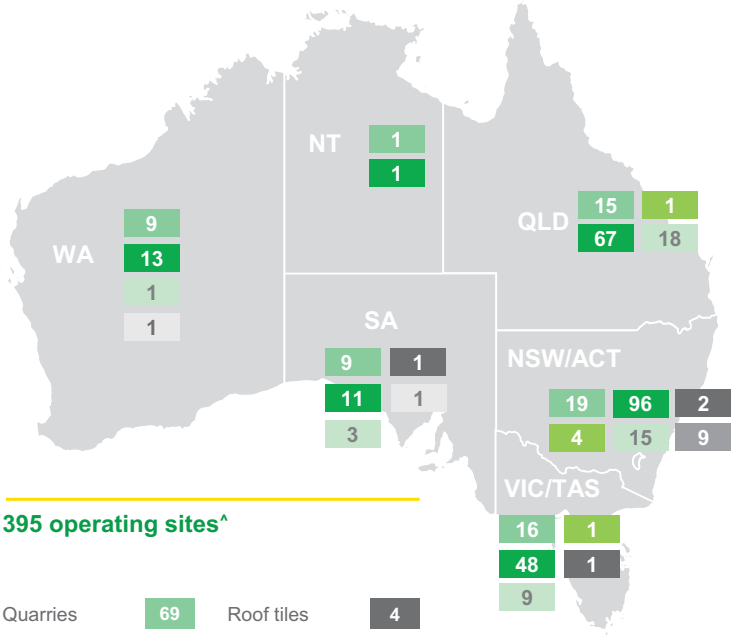
ABOUT BORAL

Boral is the largest integrated construction materials company in Australia, with a leading position underpinned by strategically located quarry reserves and an extensive network of operating sites. We also manufacture and supply a range of building products.

Boral Concrete has over 230 pre-mix concrete plants around Australia producing a wide range of concrete mixes in metropolitan and country areas.

In Western Australia, Boral Concrete supplies pre-mix concrete to all segments of the construction industry including infrastructure, social, commercial, and residential construction.

This EPD covers the majority of the concrete products supplied from Boral plants in Perth.



395 operating sites^

Quarries	69	Roof tiles	4
Concrete	236	Timber	9
Asphalt	46	Masonry	2
Cement	6		

^ As at 30 June 2019. Includes clay pits, transport, recycling and R&D sites. Concrete sites include mobile plants. Excludes mothballed plants.

HOW WE WORK

At Boral, we have a culture of 'working together' with a focus on Zero Harm Today. This ensures all of our employees, contractors, partners and communities in which we operate are free from harm, injury and illnesses.

Boral has a team of full-time Health, Safety, Environment and Quality specialists who operate across our integrated business, offering a single interface for safety communications and innovation across raw materials, logistics, operations and placement.

INNOVATION & TECHNICAL CAPABILITY

The Innovation Factory is Boral's in-house centre of excellence responsible for developing advanced cement and concrete solutions for our customers. Through consultation with our customers, the Innovation Factory is central to enabling transformation through innovative products at Boral.

Our focus on engagement and action is backed by intensive research and development through our dedicated and talented team who work in collaboration with many sections of the company to Build something great™.

ABOUT BORAL

TECHNICAL SERVICES

As one of Australia's largest construction materials companies, Boral is committed to excellence, providing customers with quality products and reliable service. Our aim is to provide products backed up by specialised testing as well as extensive quality control testing and technical support.

To ensure we remain at the forefront, we constantly improve, develop and refine our products to maintain the high standards customers have come to expect.

Our production, technical and quality managers are committed to quality excellence in our manufacturing process. We have committed additional resources to research and we strive to develop whole-of-life solutions that offer a sustainable future. Our innovative products are designed in collaboration with our clients.

Not only are we the only Australian construction materials company to maintain a full-service construction materials laboratory in Australia, **Boral Materials Technical Services is also the largest facility of its kind in the country**, providing special and standard testing and product development services to Boral and our customers.

Boral maintains an ISO 9001-certified Quality System to ensure we conduct a regular regime of physical properties testing on all materials to certify they:

- Meet Australian Standards in the civil and structural construction industry;
- Comply with applicable legislation, regulations and industry standards;
- Meet project specifications; and
- Allow for continuous improvement.

Boral laboratory facilities have a quality management system that meets international standards and they are NATA-accredited for construction materials testing and chemical testing. These customer-focused services have earned Boral the reputation of a market leader in its approach.

SUSTAINABILITY AT BORAL

We recognise that our commitment and progress in managing sustainability outcomes is vital to our business and meeting the expectations of our customers.

We strive to:

- Deliver innovative, superior performing and more sustainable products and solutions that respond to a changing world and better meet our customers' needs
- Drive safety performance towards world's best practice and invest in our people to enable them to deliver on our strategy
- Reduce our environmental footprint and build our resilience to climate impacts, and
- Be a socially responsible member of the communities in which we operate.

In recent years, we have substantially reshaped our business to respond and adapt to changing commercial, technological, and environmental factors. We have invested in growing our lower carbon concrete products.

We are increasing our investment in innovation to enable us to expand our products and solutions that have a lower carbon footprint and thereby positively contribute to an effective transition to a lower carbon economy.

Boral's ENVISIA® and Envirocrete®/Plus products underpin this improved sustainable concrete range.

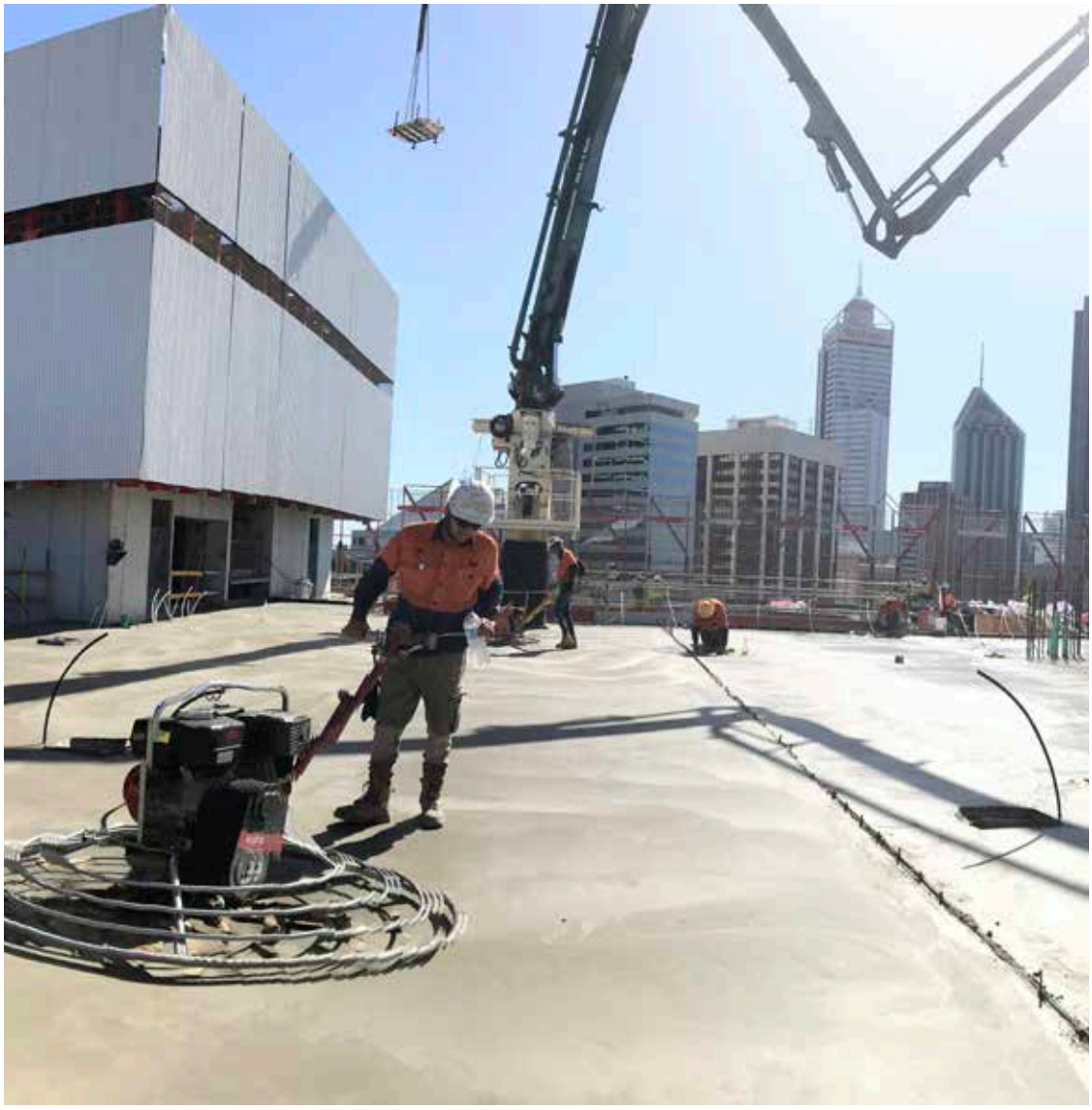
We monitor and report on our sustainability performance to drive progress and continuous improvement and are responding to increasing expectations of our customers on the disclosure of our sustainability risks and opportunities.

ABOUT BORAL

OUR COMMITMENT

Our overarching goal is to deliver Zero Harm Today. This means we target zero injuries to our people and seek to eliminate adverse environmental impacts. Where elimination is not possible, we seek to minimise any harmful effects from our operations. At an absolute minimum, this means complying with environmental legislation, regulations, standards and codes of practice.

- Reducing greenhouse gas emissions from our processes, operations and facilities.
- Reducing waste in all forms including through the efficient use of energy, conservation of water, minimising and recycling waste materials and energy, prevention of pollution, and effective use of virgin and recovered resources and supplemental materials.
- Protecting biodiversity values at and around our facilities.
- Openly and constructively engaging with communities surrounding our operations.



Capital Square Tower, Perth, WA

GEOGRAPHICAL SCOPE

PERTH REGION, WA

The concrete plants considered for this Environmental Product Declaration comprise of those in the Perth Region, WA. Boral Concrete Osborne Park was assessed for life cycle assessment, and local surrounding similar raw material sources were included in the datasets.

Red pins = plants that are being modelled in Perth Region EPD

Green pins = surrounding plants covered in Perth Region EPD scope

Orange pins = out of scope for the Perth Region EPD

DECLARED PRODUCTS

PRODUCTS CONSIDERED FOR THE PERTH REGION ENVIRONMENTAL PRODUCT DECLARATION

The products considered for the EPD fall into three broad categories: normal class products, lower carbon concrete products and special concrete products. A brief description of each category is given below, followed by a full list of the products.

1) NORMAL CLASS CONCRETE PRODUCTS

Normal class concrete products are suitable for general applications and designed to meet the requirements of AS 1379 (Specification and supply of concrete). The normal class concrete products have been grouped according to the cement blend they contain as follows.

Normal Class concrete category	Cementitious type
Normal Class GP blend	General Purpose (GP) cement
Normal Class GP/GGBFS	General Purpose (GP) cement and ground granulated blast furnace slag (GGBFS)

2) LOWER CARBON CONCRETE PRODUCTS

Lower carbon concrete products have been designed to have low portland cement contents and low embodied carbon contents. The lower carbon concrete products have been further categorised according to their portland cement reduction and their performance, as per the sub categories below.

Lower Carbon Concrete Product	Portland cement reduction*	Typical properties
Envirocrete®	≥40%	• Complies with AS 1379
Envirocrete® Plus	≥45%	• Complies with AS 1379 • Improved early age strength and drying shrinkage compared to the Envirocrete® products
ENVISIA®	≥50%	• Complies with AS 1379 • Improved early age strength and drying shrinkage compared to the Envirocrete® and Envirocrete® Plus products

* The percentages indicate the minimum portland cement reduction against default concrete mixes as defined in the Green Building Council of Australia (GBCA) and Infrastructure Council of Australia (ISCA) rating tools.

DECLARED PRODUCTS

Envirocrete® Concrete

Boral's Envirocrete® concrete is a lower carbon concrete product which complies with AS 1379. It contains supplementary cementitious materials to reduce the portland cement content. Envirocrete® has a minimum portland cement reduction of 40% compared to the GBCA and ISCA reference case. Envirocrete® is ideal for general applications where high-performance concrete is not required.

Envirocrete® Plus Concrete

Boral's Envirocrete® Plus concrete is a lower carbon concrete product which complies with AS 1379. It contains supplementary cementitious materials to reduce the portland cement and the minimum reduction in portland cement compared to the GBCA and ISCA reference case is 45%. Envirocrete® Plus also has enhanced engineering properties compared to the Envirocrete® range. The early age strength and drying shrinkage are superior to Envirocrete®.

ENVISIA® Concrete

Boral's ENVISIA® concrete is a lower carbon concrete product which complies with AS 1379 and has excellent engineering properties. It has a low portland cement content and a high supplementary cementitious content which results in reduced greenhouse gas emissions. ENVISIA® combines a proprietary cement technology (ZEP®) which gives it good early age strength, low shrinkage characteristics and excellent durability characteristics. An overview of the sustainability, durability, engineering and architectural properties are given below.

Lower Carbon

- ENVISIA® has a low portland cement content and is suitable for projects seeking to maximise the number of green star points from concrete.
- ENVISIA® has a lower carbon content and is suitable for projects seeking compliance with the Green Building Council of Australia (GBCA) or the Infrastructure Sustainability Council of Australia (ISCA).

Workability

- ENVISIA® can be placed, pumped and finished like conventional concrete

Superior Engineering properties

- ENVISIA® will achieve early-age strength equivalent to conventional concrete mixes with higher portland cement content (e.g post-tensioned and precast concrete.
- ENVISIA® has 20 percent greater flexural strength compared to conventional concrete of the same grade.
- ENVISIA® achieves up to 50 percent reduction in shrinkage when compared to conventional sustainable concrete mixes. The low shrinkage of ENVISIA® will allow for more engineering options such as the design of larger slabs with fewer joints.

Superior Durability

- ENVISIA® provides improved durability, through greater protection to steel reinforcement against chloride induced corrosion.
- ENVISIA® has improved sulphate and acid resistance properties.
- ENVISIA® mitigates the potential expansion due to alkali aggregate reactivity.

Architectural Presence

- ENVISIA® can achieve a range of architectural benefits because of its off-form finish and lighter colour.
- ENVISIA®'s lighter colour will enhance the use of colour oxides.

SPECIAL CONCRETE PRODUCTS

Boral's special concrete products have been designed to meet specific project requirements in addition to the requirements of AS 1379. They include products that have been designed for infrastructure projects, multi-residential buildings, commercial buildings and civil works.

DECLARED PRODUCTS

PRODUCTS COVERED BY THIS ENVIRONMENTAL PRODUCT DECLARATION

The products covered in the EPD are listed below. The environmental impacts of products not referenced in the EPD can be provided on request. Boral is developing an environmental impact calculator allowing us to provide environmental profiles for virtually any mix design from any of our concrete plants in Australia. We intend to have the calculator independently verified in line with the same standards this EPD is based on, so that the results are of similar standing.

Normal Class Concrete Products

- NORMAL CLASS GP BLEND 20 MPa
- NORMAL CLASS GP BLEND 25 MPa
- NORMAL CLASS GP BLEND 32 MPa
- NORMAL CLASS GP BLEND 40 MPa
- NORMAL CLASS GP BLEND 50 MPa
- NORMAL CLASS GP/GGBFS BLEND 20 MPa
- NORMAL CLASS GP/GGBFS BLEND 25 MPa
- NORMAL CLASS GP/GGBFS BLEND 32 MPa
- NORMAL CLASS GP/GGBFS BLEND 40 MPa
- NORMAL CLASS GP/GGBFS BLEND 50 MPa

Lower Carbon Concrete Products

- ENVIROCRETE® 20 MPa
- ENVIROCRETE® 25 MPa
- ENVIROCRETE® 32 MPa
- ENVIROCRETE® 40 MPa
- ENVIROCRETE® 50 MPa
- ENVIROCRETE® PLUS 20 MPa
- ENVIROCRETE® PLUS 25 MPa
- ENVIROCRETE® PLUS 32 MPa
- ENVIROCRETE® PLUS 40 MPa
- ENVIROCRETE® PLUS 50 MPa
- ENVISIA® 20 MPa
- ENVISIA® 25 MPa
- ENVISIA® 32 MPa
- ENVISIA® 40 MPa
- ENVISIA® 50 MPa
- ENVISIA® 65 MPa
- ENVISIA® 80 MPa

Concrete for Special Applications

- S40/80 GB MCC 400 (MAIN ROADS)
- S40/100 LH MCC 400 (MAIN ROADS)
- S50@56/100 LH MCC 420 (MAIN ROADS)
- ENVISIA® SLIP FORM 32 MPa (MAIN ROADS)
- SLIPFORM 32 MPa (MAIN ROADS)
- ENVIROCRETE® POST TENSIONED 40 MPa 22@3
- S50/180 LH 50 MPa@90DAY
- S50/220 GB
- S65/220 LH MCC:350
- S65/220 GB MCC:350
- S50/120 GB
- S40 DIAPHRAGM WALL MIX
- TRACK SLAB S40 GB
- ENVISIA® TRACK SLAB S32
- ENVISIA® 40 MPa INDUSTRIAL FLOOR CONCRETE
- S50/180 GB 22 MPa@4DAYS 2GS
- STABILISED SAND 6%
- KERB MACHINE 25 MPa
- KERB MACHINE 32 MPa
- SHOTCRETE 40 MPa
- NO FINES 6:1
- HIGH STRENGTH 50 MPa
- HIGH STRENGTH 65 MPa
- HIGH STRENGTH 80 MPa
- 40 MPa 10MM TREMIE LH
- 40 MPa 14MM TREMIE LH
- 40 MPa 10MM TREMIE GB

PRE-MIX CONCRETE PRODUCTION

Concrete production is the process of combining water, aggregates, cementitious binders and additives. These different 'ingredients' are mixed at a specialised facility known as a 'batching' plant.

A batching plant stores the ingredients in cement silos, aggregate bins and admixture tanks. The plants use calibrated weigh scales and flow meters to accurately weigh the ingredients which are then mixed in a mixer compliant with item C3 of AS 1379. Most concrete plants mix the concrete in a transit mixer (concrete truck) which then delivers the concrete to the project. However, some plants use a stationary mixer before discharging the mixed concrete into a concrete truck which then delivers the concrete to the project.

Depending on the proposed application of the final product, the concrete may contain other ingredients such as colour oxides and fibres and the production process may include heaters or chillers. Concrete production is time-sensitive, once the ingredients are mixed, workers must put the concrete in place before it loses workability.

Kenwick, Perth, WA

ENVISIA® CASE STUDY

FORRESTFIELD AIRPORT LINK
ENVISIA® CONCRETE
CASE STUDY

Location	Perth, WA
Project name	Forrestfield Airport Link / Rail
Owner	Public Transport Authority (PTA)
Construction company	Salini Impregilo NRW JV
Concrete offered	ENVISIA® (32 MPa) + plastic fibre 5kg/m^3

The Forrestfield-Airport Link is a new rail service to the eastern suburbs of Perth, WA through twin-bored tunnels. Three train stations will also be built. Salini Impregilo NRW JV (SINRW) was awarded the design and construct contract by the WA Govternment in 2016. Boral commenced concrete supply to the project in late 2016, including tunnel segment concrete. In collaboration with SINRW Boral commenced track slab concrete trials in late 2019, this was before SINRW had established the placement methodology and appointed a subcontractor (subsequently Martinus Rail was appointed).

Concrete Performance

ENVISIA® 32 MPa

Portland cement reduction**	50%
1-day strength*	13 MPa
2-day strength*	22 MPa
3-day strength*	29 MPa
4-day strength*	35 MPa
7-day strength*	38 MPa
28-day strength*	46 MPa
56-day strength*	49 MPa
Drying Shrinkage @ 56 Day	320 Microstrain

What was the customer looking for:

- The specification required low shrinkage and high durability concrete to meet the 120 year design life.
- The client specification called for strict maximum crack width requirements.
- Placement methodology played a significant role and changed during trials from underground transit vehicle delivery to concrete pumping (>1km) to transfer the concrete into the tunnels.

Project outcomes

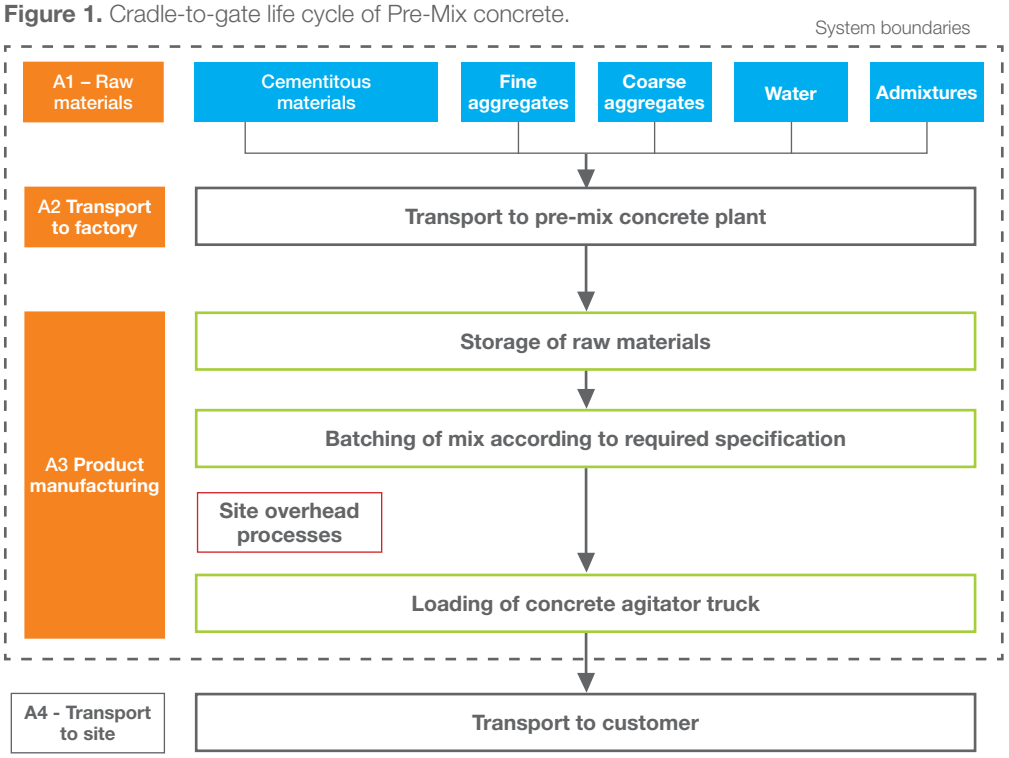
- The client originally considered ENVISIA® and alternative mixes, however during placement trials it was apparent that ENVISIA® concrete was easier to pump and place than non-ENVISIA® concrete
- At 1.5km the ENVISIA® concrete pumped at 40Bar lower than non-ENVISIA®. This greatly lowered the risk of blockage (in a tunnel) of steel pipe line thus ENVISIA® became preferred.

* Mean results. **cf Green Building Council of Australia reference case. 17199 May2021

CRADLE-TO-GATE LIFE CYCLE

This EPD covers the cradle-to-gate life cycle stages (A1-A3), as per diagram below. Downstream stages have not been included.

Figure 1. Cradle-to-gate life cycle of Pre-Mix concrete.



RAW MATERIAL STAGE A1

All raw materials used in the production of Boral's normal class concrete, lower carbon concrete and special concrete products comply with the following standards as required by AS 3600 Concrete Structures (SA 2018) & AS 1379 Specification and Supply of Concrete (SA 2007/R2017):

- AS/NZS 3972: General purpose and blended cements (SA 2010)
- AS 3582.2 Supplementary cementitious materials
  Part 2: Slag - Ground granulated blast furnace (SA 2016)
- AS 2758.1 Aggregates and rock for engineering purposes
  Part 1: Concrete Aggregates (SA 2014)
- AS 1478.1 Chemical admixtures for concrete, mortar and grout (SA 2000)

CRADLE-TO-GATE LIFE CYCLE

TRANSPORTATION STAGE A2

Raw materials are typically transported to our sites via rigid trucks. Coarse aggregates, manufactured sands and natural sands are sourced from our network of quarries, as well as third-party quarries. General Purpose Cement (GP) and GGBFS are the two main cementitious materials used in the WA market. They are supplied by a local supplier in Western Australia using imported ingredients and delivered to our sites in rigid trucks. ZEP® additive is transported by articulated truck from Sydney; other admixtures are sourced from locally based suppliers and transported using rigid trucks.

Table 1: Scope of EPD

Product Stage			**Construction Stage**		**Use Stage**							**End-of-life Stage**				**Benefits beyond system boundary**
RAW MATERIAL SUPPLY	TRANSPORT	MANUFACTURING	TRANSPORT	CONSTRUCTION-INSTALLATION PROCESS	USE	MAINTENANCE	REPAIR	REPLACEMENT	REFURBISHMENT	OPERATIONAL ENERGY USE	OPERATIONAL WATER USE	DECONSTRUCTION DEMOLITION	TRANSPORT	WASTE PROCESSING	DISPOSAL	REUSE, RECOVERY, RECYCLING POTENTIAL
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
			Scenario		Scenario							Scenario				
✔	✔	✔	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**

✔ = module is included in this study MND = module is not declared*

* When a module is not accounted for, the stage is marked with “MND” (Module Not Declared).
MND is used when we cannot define a typical scenario.

Kenwick, Perth, WA

CRADLE-TO-GATE LIFE CYCLE

MANUFACTURING STAGE A3

The typical manufacturing process of Boral's normal class concrete, lower carbon concrete and special concrete products is by mixing concrete constituents comprising of cement and supplementary cementitious materials (SCM) (AS 3972/AS 3582.1,2), and fine/coarse aggregates (AS 2758.1), plus admixtures/additives (AS 1478.1) and water (AS 1379) directly in the truck referred to as the dry batch method, or in selected locations pre-mixing in a wet mix fashion, before delivery by agitator truck.

The entire process is covered under AS 1379 Specification and Supply of concrete and verified by third party under ISO9001. This manufacturing stage (A3) includes activities associated with sourcing and delivery of individual concrete constituents, up to the point of mixing at the batch plant, but not including delivery and placement of concrete at the project location. This is typically described as the Cradle (A1) to Gate (A3) cycle, of the boundary conditions for concrete life cycle inventory.

Kenwick, Perth, WA

LIFE CYCLE ASSESSMENT (LCA) METHODOLOGY

BACKGROUND DATA

Boral has supplied primary data from our Orange Grove and Gaskell Avenue quarries, and Osborne Park (Perth) concrete production site. The LCA shows that this site is representative for the Perth region. Where aggregates are sourced from other quarries, we use the unweighted average for those materials across all the Boral quarries that have provided data nationally. Data for admixtures have been sourced from EPDs published in December 2015 by EFCA (European Federation of Concrete Admixtures Associations) (EFCA 2015a-e). Background data (e.g. for energy and transport processes, cement and blast furnace slag) have predominantly been sourced from AusLCI and the AusLCI shadow database.

The quarry data, cement production data and concrete production data have been collected for calendar year 2018. The vast majority of the environmental profiles of our products are based on life cycle data that are less than five years old. Background data used is less than 10 years old.

Methodological choices have been applied in line with EN 15804 (CEN 2013); deviations have been recorded.

REPRESENTATIVE PLANTS IN EACH REGION

Boral operates 12 concrete plants in Western Australia. This EPD covers a sub-section of our plants in the Perth region. Our background LCA report shows that the Boral Concrete Osborne Park plant is representative for surrounding Perth plants that have similar supply chains and mix designs.

- Boral Concrete Muchea
- Boral Concrete Neerabup
- Boral Concrete Bayswater
- Boral Concrete Spearwood
- Boral Concrete Canning Vale
- Boral Concrete Rockingham

Red pins = plants that are being modelled in WA EPD

Green pins = surrounding plants covered in WA EPD scope

Orange pins = out of scope for the WA EPD

LIFE CYCLE ASSESSMENT (LCA) METHODOLOGY

ALLOCATION

The key material production processes that require allocation are:

- **Pre-mix concrete**: Boral manufactures a range of pre-mix concrete products at its sites. At each manufacturing site, energy use for concrete production has been allocated to the products based on a volume basis (total m^3 of pre-mix concrete products).
- **Cementitious binders**: Boral manufactures concrete using type GP cement inclusive of limestone mineral addition and slag cement sourced from third-party suppliers. The cement production data is taken from the AusLCI data set. Silica fume (micro-silica) is a by-product of silicon metal or ferrosilicon alloys production.
- **Aggregates**: aggregates are produced through crushing of rock, which is graded in different sizes. The energy required for the crushing and screening does not differentiate between products. Therefore, aggregate production (including manufactured sand) has been allocated based on the mass of product.
- **BFS:** blast furnace 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.

CUT-OFF CRITERIA

- The contribution of capital goods (production equipment and infrastructure) and personnel is outside the scope of the LCA, in line with the PCR (Environdec 2020a).
- The amount of packaging used for admixtures is well below the materiality cut-off. Nonetheless, packaging materials and quantities are included in the admixture EPD data.

KEY ASSUMPTIONS

- Admixture data are based on generic EPDs that are valid for a range of different chemicals, including the admixtures used by Boral.
- Water consumption is not measured consistently across quarries. We have used AusLCI water consumption data per tonne of coarse and fine aggregates instead.
- Blast furnace slag receives some environmental impacts from pig iron production. This allocation decision has an effect on the environmental profile of products that use ZEP®, Enviroment® cement or ground-granulated blast furnace slag (GGBFS).

PRODUCT COMPOSITION

CONTENT DECLARATION

Table 2. Perth Region product compositions

Constituent (% by weight)	Normal Class GP BLEND	Normal Class GP/GGBFS	Special
General Purpose cement	10-20%	6-14%	3-17%
Ground granulated blast furnace slag	-	3-6%	1-13%
Silica fume	-	-	<1.5%
Coarse aggregate	42-46%	42-46%	0-66%
Manufactured sand	11-18%	11-18%	4-43%
Natural sand	19-27%	19-27%	0-42%%
Admixtures	<0.1%	<0.1%	<0.7%
Water	7-8%	7-8%	3-12%

Table 3. Continued Perth Region product composition.

Constituent (% by weight)	Envirocrete®	Envirocrete® Plus*	ENVISIA®*
General Purpose cement	6-12%	5-11%	4-14%
Ground granulated blast furnace slag	4-8%	4-10%	4-14%
Coarse aggregate	39-43%	39-43%	39-46%
Manufactured sand	9-13%	9-13%	9-13%
Natural sand	25-32%	24-30%	19-27%
Admixtures	<0.1%	<0.3%	<0.6%
Water	7-8%	7-8%	7-8%

The products as supplied are 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). *May include ZEP® technology

DECLARED UNIT

The background LCA serves as the foundation for this EPD. An LCA analyses the environmental processes in the value chain of a product. It provides a comprehensive evaluation of all upstream (and sometimes downstream) material and energy inputs and outputs. The results are provided for a range of environmental impact categories, in line with EN 15804 (CEN 2013).

Pre-mix concrete is available in various strength grades and with characteristics that are specifically designed for each application. The declared unit that covers all of the products is: 1 cubic metre (m^3) of pre-mix concrete (as ordered by client) with a given strength grade and identifying characteristics. This declared unit has been adapted from the sub-PCR (Environdec 2020b).

All results are presented per declared unit and cover the A1-A3 life cycle stages (cradle-to-gate).

The product code for pre-mix concrete is UN CPC 375 (Articles of concrete, cement and plaster) and ANZSIC 20330 (Concrete – ready mixed – except dry mix).

Kenwick, Perth, WA

ENVIRONMENTAL INDICATORS

Table 4. Impact categories included in this assessment

Impact category	Acronym	Unit
Global Warming Potential	GWP	kg CO_2 equivalents
Ozone Depletion Potential	ODP	kg CFC-11 equivalents
Acidification Potential of soil and water	AP	kg SO_2 equivalents
Eutrophication Potential	EP	kg PO_4^{3-} equivalents
Photochemical Ozone Creation Potential	POCP	kg C_2H_4 equivalents
Abiotic Depletion Potential for Mineral Elements	ADPE	kg Sb equivalents
Abiotic Depletion Potential for Fossil Fuels	ADPF	MJ

Table 5: Parameters describing resource use, waste and output flows

Resource use	Acronym	Unit
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

ENVIRONMENTAL PROFILES

VARIATION (A1-A3) PER IMPACT CATEGORY

The results of the LCA are based on data from one representative plant for the Perth WA region (Osborne Park).

The environmental profiles of concrete manufactured at other plants in the Perth region are largely similar, with variations mainly due to differences in transport distances for raw materials supplied to the concrete plant. The largest variation is found in stabilised sand 6%, as this is the product with the smallest footprint and the largest contribution from transport. In Rockingham, the variations in stabilised sand are larger than 10% for global warming potential (11%), ozone layer depletion (44%), acidification (16%), eutrophication (18%), photochemical oxidant creation (38%) and abiotic depletion (fossil fuels) (18%), which are caused by differences in aggregates and cement transport.

The variation across included sites for other concrete products is considerably lower, and most mandatory indicators stay well within the ±10% range as required by the PCR (Environdec 2020a). The variations do remain larger than ±10% for ozone depletion potential and photochemical ozone creation potential for plants that are located furthest from Osborne Park, which is caused by differences in (aggregates) transport.

We therefore believe it is reasonable to use Boral Concrete Osborne Park as representative for the wider Perth region.

PERTH REGION >

Environmental profiles and parameters.

PRODUCT TABLE LIST

Summary of GWP of all products can be found in Table 6

Normal Class Concrete Products

Table No. 7 and 8

- NORMAL CLASS GP BLEND 20 MPa
- NORMAL CLASS GP BLEND 25 MPa
- NORMAL CLASS GP BLEND 32 MPa
- NORMAL CLASS GP BLEND 40 MPa
- NORMAL CLASS GP BLEND 50 MPa

Table No. 9 and 10

- NORMAL CLASS GP/GGBFS BLEND 20 MPa
- NORMAL CLASS GP/GGBFS BLEND 25 MPa
- NORMAL CLASS GP/GGBFS BLEND 32 MPa
- NORMAL CLASS GP/GGBFS BLEND 40 MPa
- NORMAL CLASS GP/GGBFS BLEND 50 MPa

Lower Carbon Concrete Products

Table No. 11 and 12

- ENVIROCRETE® 20 MPa
- ENVIROCRETE® 25 MPa
- ENVIROCRETE® 32 MPa
- ENVIROCRETE® 40 MPa
- ENVIROCRETE® 50 MPa

Table No. 13 and 14

- ENVIROCRETE® PLUS 20 MPa
- ENVIROCRETE® PLUS 25 MPa
- ENVIROCRETE® PLUS 32 MPa
- ENVIROCRETE® PLUS 40 MPa
- ENVIROCRETE® PLUS 50 MPa

Table No. 15 and 16

- ENVISIA® 20 MPa
- ENVISIA® 25 MPa
- ENVISIA® 32 MPa
- ENVISIA® 40 MPa
- ENVISIA® 50 MPa
- ENVISIA® 65 MPa
- ENVISIA® 80 MPa

Concrete for Special Applications

Table No. 17 and 18

- S40/80 GB MCC 400 (MAIN ROADS)
- S40/100 LH MCC400 (MAIN ROADS)
- S50@56/100 LH MCC:420 (MAIN ROADS)
- ENVISIA® SLIP FORM 32 MPa (MAIN ROADS)
- SLIPFORM 32 MPa (MAIN ROADS)

Table No. 19 and 20

- ENVIROCRETE POST TENSIONED 40 MPa 22@3
- S50/180 LH 50 MPa@90DAY
- S50/220 GB
- S65/220 LH MCC:350
- S65/220 GB MCC:350
- S50/120 GB

Table No. 21 and 22

- S40 DIAPHRAGM WALL MIX
- S50/180 GB 22 MPa@4DAYS 2GS
- TRACK SLAB S40 GB
- ENVISIA® TRACK SLAB S32
- ENVISIA® 40 MPa INDUSTRIAL FLOOR CONCRETE

Table No. 23 and 24

- STABILISED SAND 6%
- KERB MACHINE 25 MPa
- KERB MACHINE 32 MPa
- SHOTCRETE 40 MPa
- NO FINES 6:1

Table No. 25 and 26

- HIGH STRENGTH 50 MPa
- HIGH STRENGTH 65 MPa
- HIGH STRENGTH 80 MPa
- 40 MPA 10MM TREMIE LH
- 40 MPA 14MM TREMIE LH
- 40 MPA 10MM TREMIE GB

PERTH REGION

Table 6. Summary of the **GWP** Indicators in kg CO_2 equivalents per m^3 of pre-mix concrete, Perth

Normal Class GP blend	20MPa	25MPa	32MPa	40MPa	50MPa		
	244	263	295	356	468		
Normal Class GP/GGBFS blend	20MPa	25MPa	32MPa	40MPa	50MPa		
	193	205	236	278	357		
ENVIROCRETE	20MPa	25MPa	32MPa	40MPa	50MPa		
	180	196	222	273	337		
ENVIROCRETE PLUS	20MPa	25MPa	32MPa	40MPa	50MPa		
	170	189	214	260	313		
ENVISIA	20MPa	25MPa	32MPa	40MPa	50MPa	65MPa	80MPa
	165	177	207	241	301	365	388

PERTH REGION

Table 7. Environmental profiles (A1-A3), normal class concrete, Perth, per m^3

Indicator	Unit	Normal Class GP blend 20MPa	Normal Class GP blend 25MPa	Normal Class GP blend 32MPa	Normal Class GP blend 40MPa	Normal Class GP blend 50MPa
GWP	**kg CO_2 eq**	**244**	**263**	**296**	**357**	**469**
ODP	kg CFC11 eq	3.53E-06	3.63E-06	3.70E-06	3.93E-06	4.33E-06
AP	kg SO_2 eq	0.565	0.603	0.665	0.786	1.01
EP	kg PO_4^{3-} eq	0.118	0.125	0.138	0.163	0.208
POCP	kg C_2H_4 eq	0.0439	0.0460	0.0488	0.0550	0.0662
ADPE	kg Sb eq	2.17E-06	2.29E-06	2.53E-06	3.02E-06	3.81E-06
ADPF	MJ_{NCV}	1560	1670	1840	2170	2780

Table 8. Environmental parameters (A1-A3), normal class concrete, Perth, per m^3

Parameter	Unit	Normal Class GP blend 20MPa	Normal Class GP blend 25MPa	Normal Class GP blend 32MPa	Normal Class GP blend 40MPa	Normal Class GP blend 50MPa
PERE	MJ_{NCV}	2.30E+01	2.45E+01	2.70E+01	3.20E+01	4.09E+01
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	2.30E+01	2.45E+01	2.70E+01	3.20E+01	4.09E+01
PENRE	MJ_{NCV}	1.59E+03	1.70E+03	1.87E+03	2.21E+03	2.82E+03
PENRM	MJ_{NCV}	4.84E+00	5.26E+00	5.99E+00	7.56E+00	9.89E+00
PENRT	MJ_{NCV}	1.60E+03	1.70E+03	1.88E+03	2.21E+03	2.83E+03
SM	kg	2.05E-03	2.22E-03	2.53E-03	3.11E-03	4.18E-03
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	3.33E+00	3.34E+00	3.29E+00	3.31E+00	3.32E+00
HWD	kg	5.19E-06	5.64E-06	6.43E-06	8.11E-06	1.06E-05
NHWD	kg	1.63E-01	1.76E-01	1.97E-01	2.39E-01	3.13E-01
RWD	kg	9.04E-04	9.82E-04	1.12E-03	1.41E-03	1.85E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

PERTH REGION

Table 9. Environmental profiles (A1-A3), normal class concrete, Perth, per m^3

Indicator	Unit	Normal Class GP/GGBFS blend 20MPa	Normal Class GP/GGBFS blend 25MPa	Normal Class GP/GGBFS blend 32MPa	Normal Class GP/GGBFS blend 40MPa	Normal Class GP/GGBFS blend 50MPa
GWP	**kg CO_2 eq**	**193**	**205**	**236**	**279**	**357**
ODP	kg CFC11 eq	3.90E-06	4.04E-06	4.21E-06	4.53E-06	5.12E-06
AP	kg SO_2 eq	0.583	0.616	0.699	0.815	1.03
EP	kg PO_4^{3-} eq	0.105	0.110	0.124	0.144	0.179
POCP	kg C_2H_4 eq	0.0447	0.0467	0.0506	0.0565	0.0675
ADPE	kg Sb eq	1.96E-06	2.06E-06	2.32E-06	2.69E-06	3.37E-06
ADPF	MJ_{NCV}	1390	1470	1660	1920	2410

Table 10. Environmental parameters (A1-A3), normal class concrete, Perth, per m^3

Parameter	Unit	Normal Class GP/GGBFS blend 20MPa	Normal Class GP/GGBFS blend 25MPa	Normal Class GP/GGBFS blend 32MPa	Normal Class GP/GGBFS blend 40MPa	Normal Class GP/GGBFS blend 50MPa
PERE	MJ_{NCV}	2.09E+01	2.20E+01	2.49E+01	2.89E+01	3.62E+01
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	2.09E+01	2.20E+01	2.49E+01	2.89E+01	3.62E+01
PENRE	MJ_{NCV}	1.43E+03	1.50E+03	1.69E+03	1.96E+03	2.45E+03
PENRM	MJ_{NCV}	4.40E+00	4.69E+00	5.55E+00	6.69E+00	8.80E+00
PENRT	MJ_{NCV}	1.43E+03	1.51E+03	1.70E+03	1.97E+03	2.46E+03
SM	kg	7.18E+01	7.70E+01	9.05E+01	1.09E+02	1.44E+02
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	3.21E+00	3.26E+00	3.20E+00	3.21E+00	3.22E+00
HWD	kg	4.72E-06	5.03E-06	5.95E-06	7.18E-06	9.44E-06
NHWD	kg	1.47E-01	1.56E-01	1.80E-01	2.13E-01	2.75E-01
RWD	kg	8.21E-04	8.75E-04	1.04E-03	1.25E-03	1.64E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

PERTH REGION

Table 11. Environmental profiles (A1-A3), lower carbon concrete, Perth, per m^3

Indicator	Unit	ENVIROCRETE 20MPa	ENVIROCRETE 25MPa	ENVIROCRETE 32MPa	ENVIROCRETE 40MPa	ENVIROCRETE 50MPa
GWP	**kg CO_2 eq**	**180**	**196**	**222**	**273**	**337**
ODP	kg CFC11 eq	4.17E-06	4.32E-06	4.53E-06	5.01E-06	5.48E-06
AP	kg SO_2 eq	0.604	0.653	0.731	0.888	1.08
EP	kg PO_4^{3-} eq	0.103	0.111	0.123	0.147	0.177
POCP	kg C_2H_4 eq	0.0465	0.0490	0.0528	0.0610	0.0702
ADPE	kg Sb eq	1.93E-06	2.21E-06	2.45E-06	2.96E-06	3.82E-06
ADPF	MJ_{NCV}	1370	1480	1650	1980	2390

Table 12. Environmental parameters (A1-A3), lower carbon concrete, Perth, per m^3

Parameter	Unit	ENVIROCRETE 20MPa	ENVIROCRETE 25MPa	ENVIROCRETE 32MPa	ENVIROCRETE 40MPa	ENVIROCRETE 50MPa
PERE	MJ_{NCV}	2.06E+01	2.24E+01	2.49E+01	3.01E+01	3.67E+01
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	2.06E+01	2.24E+01	2.49E+01	3.01E+01	3.67E+01
PENRE	MJ_{NCV}	1.41E+03	1.52E+03	1.68E+03	2.02E+03	2.44E+03
PENRM	MJ_{NCV}	4.50E+00	5.47E+00	6.31E+00	7.99E+00	1.10E+01
PENRT	MJ_{NCV}	1.41E+03	1.52E+03	1.69E+03	2.03E+03	2.45E+03
SM	kg	9.78E+01	1.08E+02	1.25E+02	1.58E+02	2.00E+02
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	3.22E+00	3.24E+00	3.20E+00	3.19E+00	3.11E+00
HWD	kg	4.82E-06	5.87E-06	6.77E-06	8.57E-06	1.18E-05
NHWD	kg	1.45E-01	1.61E-01	1.83E-01	2.27E-01	2.86E-01
RWD	kg	8.40E-04	1.02E-03	1.18E-03	1.49E-03	2.06E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

PERTH REGION

Table 13. Environmental profiles (A1-A3), lower carbon concrete, Perth, per m^3

Indicator	Unit	ENVIROCRETE PLUS 20MPa	ENVIROCRETE PLUS 25MPa	ENVIROCRETE PLUS 32MPa	ENVIROCRETE PLUS 40MPa	ENVIROCRETE PLUS 50MPa
GWP	**kg CO_2 eq**	**170**	**189**	**214**	**260**	**313**
ODP	kg CFC11 eq	4.30E-06	4.65E-06	5.04E-06	5.63E-06	6.04E-06
AP	kg SO_2 eq	0.618	0.691	0.794	0.959	1.11
EP	kg PO_4^{3-} eq	0.101	0.112	0.125	0.149	0.174
POCP	kg C_2H_4 eq	0.0472	0.0517	0.0573	0.0661	0.0738
ADPE	kg Sb eq	1.94E-06	2.16E-06	2.44E-06	2.92E-06	3.42E-06
ADPF	MJ_{NCV}	1350	1500	1690	2020	2360

Table 14. Environmental parameters (A1-A3), lower carbon concrete, Perth, per m^3

Parameter	Unit	ENVIROCRETE PLUS 20MPa	ENVIROCRETE PLUS 25MPa	ENVIROCRETE PLUS 32MPa	ENVIROCRETE PLUS 40MPa	ENVIROCRETE PLUS 50MPa
PERE	MJ_{NCV}	2.04E+01	2.31E+01	2.62E+01	3.13E+01	3.66E+01
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	2.04E+01	2.31E+01	2.62E+01	3.13E+01	3.66E+01
PENRE	MJ_{NCV}	1.39E+03	1.52E+03	1.71E+03	2.04E+03	2.38E+03
PENRM	MJ_{NCV}	4.59E+00	5.16E+00	6.12E+00	7.65E+00	9.18E+00
PENRT	MJ_{NCV}	1.39E+03	1.55E+03	1.74E+03	2.08E+03	2.42E+03
SM	kg	1.19E+02	1.35E+02	1.66E+02	2.08E+02	2.39E+02
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	3.20E+00	3.22E+00	3.19E+00	3.19E+00	3.13E+00
HWD	kg	4.92E-06	5.54E-06	6.56E-06	8.20E-06	9.85E-06
NHWD	kg	1.44E-01	1.66E-01	1.92E-01	2.35E-01	2.80E-01
RWD	kg	8.57E-04	9.64E-04	1.14E-03	1.43E-03	1.71E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

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Table 15. Environmental profiles (A1-A3), lower carbon concrete, Perth, per m^3

Indicator	Unit	ENVISIA 20MPa	ENVISIA 25MPa	ENVISIA 32MPa	ENVISIA 40MPa	ENVISIA 50MPa	ENVISIA 65MPa	ENVISIA 80MPa
GWP	**kg CO_2 eq**	**165**	**177**	**207**	**241**	**301**	**365**	**388**
ODP	kg CFC11 eq	4.51E-06	4.66E-06	5.07E-06	5.47E-06	6.28E-06	6.93E-06	7.18E-06
AP	kg SO_2 eq	0.622	0.664	0.770	0.891	1.11	1.33	1.41
EP	kg PO_4^{3-} eq	0.100	0.107	0.122	0.139	0.170	0.203	0.215
POCP	kg C_2H_4 eq	0.0487	0.0511	0.0570	0.0633	0.0753	0.0869	0.0910
ADPE	kg Sb eq	3.17E-06	3.60E-06	4.21E-06	4.93E-06	6.17E-06	1.27E-05	1.35E-05
ADPF	MJ_{NCV}	1360	1450	1670	1910	2350	2830	2990

Table 16. Environmental parameters (A1-A3), lower carbon concrete, Perth, per m^3

Parameter	Unit	ENVISIA 20MPa	ENVISIA 25MPa	ENVISIA 32MPa	ENVISIA 40MPa	ENVISIA 50MPa	ENVISIA 65MPa	ENVISIA 80MPa
PERE	MJ_{NCV}	2.23E+01	2.39E+01	2.76E+01	3.16E+01	3.93E+01	5.12E+01	5.41E+01
PERM	MJ_{NCV}	1.92E-02	2.40E-02	2.89E-02	3.46E-02	4.42E-02	1.37E-01	1.47E-01
PERT	MJ_{NCV}	2.23E+01	2.39E+01	2.76E+01	3.16E+01	3.94E+01	5.12E+01	5.42E+01
PENRE	MJ_{NCV}	1.40E+03	1.49E+03	1.71E+03	1.96E+03	2.40E+03	2.88E+03	3.04E+03
PENRM	MJ_{NCV}	5.82E+00	6.56E+00	7.88E+00	9.45E+00	1.21E+01	2.11E+01	2.25E+01
PENRT	MJ_{NCV}	1.38E+03	1.46E+03	1.68E+03	1.92E+03	2.35E+03	2.84E+03	3.01E+03
SM	kg	1.20E+02	1.30E+02	1.56E+02	1.87E+02	2.39E+02	2.96E+02	3.17E+02
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	3.21E+00	3.20E+00	3.22E+00	3.21E+00	3.20E+00	3.15E+00	3.13E+00
HWD	kg	8.95E-06	1.04E-05	1.25E-05	1.50E-05	1.92E-05	4.18E-05	4.48E-05
NHWD	kg	3.58E-01	4.21E-01	5.02E-01	5.95E-01	7.59E-01	1.82E+00	1.94E+00
RWD	kg	1.25E-03	1.43E-03	1.71E-03	2.05E-03	2.63E-03	5.08E-03	5.44E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

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Table 17. Environmental profiles (A1-A3), concrete for special applications, Perth, per m^3

Indicator	Unit	S40/80 GB MCC:400 MAIN ROADS	S40/100 LH MCC:400 MAIN ROADS	S50@56/100 LH MCC:420 MAIN ROADS	ENVISIA SLIP FORM 32MPa MAIN ROADS	SLIP FORM 32MPa BS MAIN ROADS
GWP	**kg CO_2 eq**	**328**	**224**	**222**	**227**	**273**
ODP	kg CFC11 eq	5.06E-06	5.93E-06	5.90E-06	5.15E-06	4.51E-06
AP	kg SO_2 eq	0.952	0.992	1.00	0.838	0.809
EP	kg PO_4^{3-} eq	0.167	0.142	0.142	0.131	0.141
POCP	kg C_2H_4 eq	0.0650	0.0673	0.0671	0.0602	0.0566
ADPE	kg Sb eq	5.56E-06	3.92E-06	3.51E-06	9.73E-06	9.69E-06
ADPF	MJ_{NCV}	2250	1920	1920	1800	1900

Table 18. Environmental parameters (A1-A3), concrete for special applications, Perth, per m^3

Parameter	Unit	S40/80 GB MCC:400 MAIN ROADS	S40/100 LH MCC:400 MAIN ROADS	S50@56/100 LH MCC:420 MAIN ROADS	ENVISIA SLIP FORM 32MPa MAIN ROADS	SLIP FORM 32MPa BS MAIN ROADS
PERE	MJ_{NCV}	3.56E+01	3.04E+01	3.04E+01	2.96E+01	3.01E+01
PERM	MJ_{NCV}	3.99E-02	2.00E-02	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	3.56E+01	3.04E+01	3.04E+01	2.96E+01	3.01E+01
PENRE	MJ_{NCV}	2.30E+03	1.97E+03	1.97E+03	1.84E+03	1.94E+03
PENRM	MJ_{NCV}	1.09E+01	8.54E+00	1.07E+01	3.70E+00	3.72E+00
PENRT	MJ_{NCV}	2.31E+03	1.98E+03	1.98E+03	1.85E+03	1.94E+03
SM	kg	1.30E+02	2.76E+02	2.84E+02	1.77E+02	1.06E+02
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	3.24E+00	3.16E+00	3.13E+00	3.16E+00	3.17E+00
HWD	kg	1.73E-05	1.20E-05	1.15E-05	1.18E-05	1.18E-05
NHWD	kg	6.83E-01	4.34E-01	2.37E-01	2.77E+00	2.36E+00
RWD	kg	2.37E-03	1.76E-03	1.99E-03	2.48E-03	2.47E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

PERTH REGION

Table 19. Environmental profiles (A1-A3), concrete for special applications, Perth, per m^3

Indicator	Unit	ENVIROCRETE POST TENSIONED 40 MPA 22@3	S50/180 GB 22 MPA@ 4DAYS 2GS	S50/180 LH 50 MPA@ 90DAY	S50/220 GB	S65/220 LH MCC:350	S65/220 GB MCC:350
GWP	**kg CO_2 eq**	**275**	**331**	**260**	**344**	**277**	**370**
ODP	kg CFC11 eq	4.95E-06	5.37E-06	5.98E-06	5.48E-06	6.26E-06	5.83E-06
AP	kg SO_2 eq	0.892	1.06	1.08	1.10	1.16	1.19
EP	kg PO_4^{3-} eq	0.148	0.174	0.157	0.180	0.166	0.193
POCP	kg C_2H_4 eq	0.0611	0.0701	0.0711	0.0721	0.0750	0.0762
ADPE	kg Sb eq	6.65E-06	1.08E-05	8.77E-06	1.21E-05	9.64E-06	1.03E-05
ADPF	MJ_{NCV}	2010	2440	2150	2520	2270	2620

Table 20. Environmental parameters (A1-A3), concrete for special applications, Perth, per m^3

Parameter	Unit	ENVIROCRETE POST TENSIONED 40 MPA 22@3	S50/180 GB 22 MPA@ 4DAYS 2GS	S50/180 LH 50 MPA@ 90DAY	S50/220 GB	S65/220 LH MCC:350	S65/220 GB MCC:350
PERE	MJ_{NCV}	3.33E+01	4.35E+01	3.78E+01	4.56E+01	3.96E+01	4.45E+01
PERM	MJ_{NCV}	6.21E-02	8.85E-02	8.17E-02	1.15E-01	1.32E-01	1.40E-01
PERT	MJ_{NCV}	3.34E+01	4.36E+01	3.79E+01	4.58E+01	3.97E+01	4.46E+01
PENRE	MJ_{NCV}	2.05E+03	2.47E+03	2.20E+03	2.55E+03	2.32E+03	2.67E+03
PENRM	MJ_{NCV}	1.14E+01	3.99E+01	1.66E+01	3.75E+01	9.80E+00	1.04E+01
PENRT	MJ_{NCV}	2.06E+03	2.51E+03	2.22E+03	2.59E+03	2.33E+03	2.68E+03
SM	kg	1.58E+02	1.91E+02	2.87E+02	2.00E+02	3.12E+02	2.20E+02
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	3.19E+00	3.17E+00	3.10E+00	3.16E+00	3.09E+00	3.15E+00
HWD	kg	2.09E-05	1.06E-04	2.93E-05	9.87E-05	2.91E-05	3.08E-05
NHWD	kg	8.94E-01	1.30E+00	1.14E+00	1.59E+00	1.65E+00	1.77E+00
RWD	kg	2.64E-03	5.84E-03	3.79E-03	6.01E-03	2.94E-03	3.11E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

PERTH REGION

Table 21. Environmental profiles (A1-A3), concrete for special applications, Perth, per m^3

Indicator	Unit	S50/120 GB	S40 DIAPHRAGM WALL MIX	TRACK SLAB S40 GB	ENVISIA TRACK SLAB S32	ENVISIA 40MPa INDUSTRIAL
GWP	**kg CO_2 eq**	**384**	**232**	**247**	**263**	**279**
ODP	kg CFC11 eq	5.90E-06	6.50E-06	5.13E-06	5.85E-06	6.08E-06
AP	kg SO_2 eq	1.22	1.04	0.906	0.971	1.03
EP	kg PO_4^{3-} eq	0.200	0.145	0.141	0.151	0.160
POCP	kg C_2H_4 eq	0.0778	0.0747	0.0592	0.0662	0.0682
ADPE	kg Sb eq	7.61E-06	1.79E-05	9.18E-06	1.76E-05	1.35E-05
ADPF	MJ_{NCV}	2720	2140	1930	2150	2210

Table 22. Environmental parameters (A1-A3), concrete for special applications, Perth, per m^3

Parameter	Unit	S50/120 GB	S40 DIAPHRAGM WALL MIX	TRACK SLAB S40 GB	ENVISIA TRACK SLAB S32	ENVISIA 40MPa INDUSTRIAL
PERE	MJ_{NCV}	4.45E+01	7.64E+01	3.34E+01	4.40E+01	4.65E+01
PERM	MJ_{NCV}	4.81E-02	1.50E-01	5.85E-02	1.81E-01	4.26E-01
PERT	MJ_{NCV}	4.45E+01	7.65E+01	3.34E+01	4.42E+01	4.70E+01
PENRE	MJ_{NCV}	2.77E+03	2.16E+03	1.97E+03	2.19E+03	2.26E+03
PENRM	MJ_{NCV}	1.72E+01	1.90E+01	1.26E+01	2.14E+01	9.81E+00
PENRT	MJ_{NCV}	2.79E+03	2.18E+03	1.98E+03	2.22E+03	2.27E+03
SM	kg	2.29E+02	2.63E+02	1.98E+02	1.98E+02	2.18E+02
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	3.14E+00	1.95E+01	3.13E+00	3.23E+00	3.26E+00
HWD	kg	2.52E-05	4.64E-05	2.41E-05	5.12E-05	4.70E-05
NHWD	kg	8.52E-01	3.35E+00	1.55E+00	3.07E+00	1.84E+00
RWD	kg	3.62E-03	5.98E-03	3.39E-03	6.19E-03	3.02E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

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Table 23. Environmental profiles (A1-A3), concrete for special applications, Perth, per m^3

Indicator	Unit	STABILISED SAND 6%	KERB MACHINE 25MPa	KERB MACHINE 32MPa	SHOTCRETE 40MPa	NO FINES 6:1
GWP	**kg CO_2 eq**	**88**	**306**	**322**	**349**	**259**
ODP	kg CFC11 eq	2.62E-06	4.45E-06	4.41E-06	5.15E-06	2.80E-06
AP	kg SO_2 eq	0.284	0.808	0.822	0.958	0.573
EP	kg PO_4^{3-} eq	0.053	0.150	0.155	0.170	0.118
POCP	kg C_2H_4 eq	0.0265	0.0572	0.0578	0.0684	0.0393
ADPE	kg Sb eq	1.00E-06	2.71E-06	2.60E-06	3.30E-06	2.67E-06
ADPF	MJ_{NCV}	710	2020	2090	2380	1570

Table 24. Environmental parameters (A1-A3), concrete for special applications, Perth, per m^3

Parameter	Unit	STABILISED SAND 6%	KERB MACHINE 25MPa	KERB MACHINE 32MPa	SHOTCRETE 40MPa	NO FINES 6:1
PERE	MJ_{NCV}	1.10E+01	2.98E+01	3.05E+01	6.32E+01	2.38E+01
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.45E-02
PERT	MJ_{NCV}	1.10E+01	2.98E+01	3.05E+01	6.32E+01	2.39E+01
PENRE	MJ_{NCV}	7.31E+02	2.06E+03	2.13E+03	2.40E+03	1.59E+03
PENRM	MJ_{NCV}	1.72E+00	7.27E+00	6.69E+00	8.03E+00	1.82E+00
PENRT	MJ_{NCV}	7.33E+02	2.07E+03	2.13E+03	2.41E+03	1.59E+03
SM	kg	2.81E+01	7.28E+01	6.24E+01	9.36E+01	2.27E-03
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	2.64E+00	3.04E+00	3.06E+00	1.62E+01	2.58E+00
HWD	kg	2.11E-06	7.87E-06	7.17E-06	8.87E-06	5.39E-06
NHWD	kg	6.88E-02	2.25E-01	2.28E-01	2.51E-01	4.12E-01
RWD	kg	3.60E-04	1.37E-03	1.25E-03	1.54E-03	5.45E-04
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

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Table 25. Environmental profiles (A1-A3), concrete for special applications, Perth, per m^3

Indicator	Unit	HIGH STRENGTH 50MPa	HIGH STRENGTH 65MPa	HIGH STRENGTH 80MPa	40MPa 10mm TREMIE LH	40MPa 14mm TREMIE LH	40MPa 10mm TREMIE GB
GWP	**kg CO_2 eq**	**339**	**370**	**433**	**228**	**228**	**294**
ODP	kg CFC11 eq	5.49E-06	5.83E-06	6.47E-06	5.96E-06	5.97E-06	5.07E-06
AP	kg SO_2 eq	1.09	1.19	1.38	1.02	1.02	0.955
EP	kg PO_4^{3-} eq	0.178	0.194	0.224	0.144	0.144	0.157
POCP	kg C_2H_4 eq	0.0708	0.0760	0.0872	0.0698	0.0699	0.0646
ADPE	kg Sb eq	7.50E-06	6.94E-06	1.49E-05	2.09E-05	2.09E-05	1.62E-05
ADPF	MJ_{NCV}	2430	2630	3060	2040	2040	2170

Table 26. Environmental parameters (A1-A3), concrete for special applications, Perth, per m^3

Parameter	Unit	HIGH STRENGTH 50MPa	HIGH STRENGTH 65MPa	HIGH STRENGTH 80MPa	40MPa 10mm TREMIE LH	40MPa 14mm TREMIE LH	40MPa 10mm TREMIE GB
PERE	MJ_{NCV}	4.01E+01	4.24E+01	5.41E+01	4.21E+01	4.22E+01	4.02E+01
PERM	MJ_{NCV}	5.77E-02	5.10E-02	2.10E-01	1.80E-01	1.80E-01	1.17E-01
PERT	MJ_{NCV}	4.02E+01	4.24E+01	5.43E+01	4.23E+01	4.23E+01	4.03E+01
PENRE	MJ_{NCV}	2.47E+03	2.68E+03	3.12E+03	2.08E+03	2.08E+03	2.21E+03
PENRM	MJ_{NCV}	1.53E+01	1.39E+01	1.56E+01	2.13E+01	2.13E+01	1.64E+01
PENRT	MJ_{NCV}	2.49E+03	2.69E+03	3.13E+03	2.10E+03	2.11E+03	2.22E+03
SM	kg	2.00E+02	2.20E+02	2.60E+02	2.81E+02	2.81E+02	1.68E+02
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	3.13E+00	3.14E+00	3.12E+00	3.14E+00	3.15E+00	3.13E+00
HWD	kg	2.45E-05	2.21E-05	4.62E-05	5.43E-05	5.43E-05	3.95E-05
NHWD	kg	9.12E-01	8.56E-01	2.57E+00	4.05E+00	4.05E+00	3.15E+00
RWD	kg	3.34E-03	3.02E-03	4.67E-03	6.94E-03	6.94E-03	5.33E-03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01	9.60E+01
MER	kg	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

OTHER ENVIRONMENTAL INFORMATION

WATER MANAGEMENT

Water is a valuable resource and good quality fresh water is essential to our concrete, construction material and plasterboard operations. We use water in manufacturing, and for dust suppression, cleaning and sanitation. Our quarry and asphalt operations are able to use recycled, brackish and/or process water.

At our larger sites, including quarries, we also capture rainfall or stream flow that is largely used for dust control purposes. We are developing systems that will enable us to collect data on captured rainfall and are developing plans that will underpin an overall improvement in water efficiency.

When developing or purchasing new facilities, our due diligence assessment includes scenario analysis of the quantity and quality of water, assessment of the risks of potential water discharges, and, where relevant, river catchment assessments to ensure sufficient water availability and supply.

WASTE AND RECYCLING

Throughout Boral's operations, some materials are commonly re-used back into our production processes. Returned concrete is used to make concrete blocks at some plants. This beneficially uses materials that would otherwise require disposal. A large proportion of Boral's recycled and lower carbon products revenue, totalling nine per cent of Boral Limited revenue, is derived from external waste products.

This includes our fly ash and recycling businesses. Opportunities for the re-use of production by-products or waste material continues to grow and are actively being pursued.

BIODIVERSITY MANAGEMENT

Protecting the diversity of plant and animal species at and around our operational sites is a core component of our land management efforts. Some examples of the many initiatives to protect biodiversity at our own sites include:

- Boral in WA has completed a number of community projects at Orange Grove Primary School including a Heritage Garden space, installation of garden pathways and cockatoo nesting boxes.
- Collaborating with the Royal Botanic Garden Sydney NSW in research on the endangered Illawarra Socketwood population at our Dunmore Quarry in New South Wales.
- Partnering with Sleepy Burrows Wombat Sanctuary to capture and relocate wombats found at our Peppertree Quarry in New South Wales.
- Maintaining koala fodder plantations at Narangba and Petrie quarries in Queensland.
- Conservation work to provide habitat for the threatened legless lizard and spiny rice-flower at Deer Park Quarry in Victoria.
- Construction of a bird island habitat as part of our rehabilitation of wetlands at our Dunmore Quarry in New South Wales.
- Through our community partnership with Conservation Volunteers Australia, we support conservation and education initiatives in our local communities, including native vegetation initiatives in local reserves and schools.

OUR APPROACH TO CLIMATE RELATED RISKS

OUR APPROACH

Boral recognises that climate related physical risks and a global transition to a lower-carbon future are expected to impact our operations, customers and suppliers.

We support the Paris Agreement and mechanisms to achieve its objective of limiting future average global temperature rises to well below 2°C, as well as Australia's 2030 target of a 26–28% reduction in carbon emissions below 2005 levels.

Looking at how Boral's carbon emissions are tracking relative to 2005 levels, in Australia we have reduced emissions by around 40% since FY2005. We achieved about half of this decrease largely by realigning our portfolio away from emissions-intensive businesses. The remainder of the decrease is due to reducing clinker manufacturing in Australia in favour of importing it from more efficient and larger scale operations in Asia. Including Boral North America, our Scope 1 and 2 emissions decreased by 43% since FY2005. We continue to progressively adopt the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD). In FY2019, we enhanced our climate-related governance and risk management, completed scenario analysis of Boral Cement's business and continued to strengthen our resilience to a 2°C scenario. We also broadened our reporting of physical climate-related risks and Scope 3 emissions.

We completed a Group-wide review of our climate-related risks and opportunities using the TCFD framework. This review informed a two-year roadmap to undertake further scenario analysis of key climate related business risks. We transparently and constructively engaged with Climate Action 100+ investor representatives and other stakeholders during the year, sharing our progress in aligning our efforts with the TCFD recommendations and building greater resilience to climate-related impacts.

ENERGY AND CLIMATE POLICY

Boral has not identified any major positions on energy and climate policy held by our industry associations that are materially inconsistent with Boral's position.
We support:

- A national approach to climate and energy policy to ensure that least-cost carbon emissions abatement is targeted while ensuring reliable and competitive energy can be delivered.
- Climate and energy policies that do not unduly erode the competitiveness of domestic-based businesses.

Through our community partnership with Conservation Volunteers Australia, we support conservation and education initiatives in our local communities, including native vegetation initiatives in local reserves and schools.

In Australia, we are a member of the Cement Industry Federation (CIF). The CIF policy is to support the Federal Government's national target to reduce emissions by 26–28 per cent by 2030, and the CIF has been working with the World Business Council for Sustainable Development and its current roadmap to reduce emissions.

Boral acknowledges the Paris Agreement and supports mechanisms to achieve its objectives, including a national approach to climate and energy policy. Boral's major industry associations are:

- Green Building Council of Australia (GBCA)
- Infrastructure Sustainability Council of Australia (ISCA)
- Concrete Institute of Australia (CIA)
- Australian Pozzolan Association (APozA)
- Business Council of Australia
- Cement Industry Federation
- Cement, Concrete & Aggregates Australia
- Australian Mines and Metals Association's Australian Resources and Energy Group
- American Coal Ash Association.

For more information visit boral.com/industry associations

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