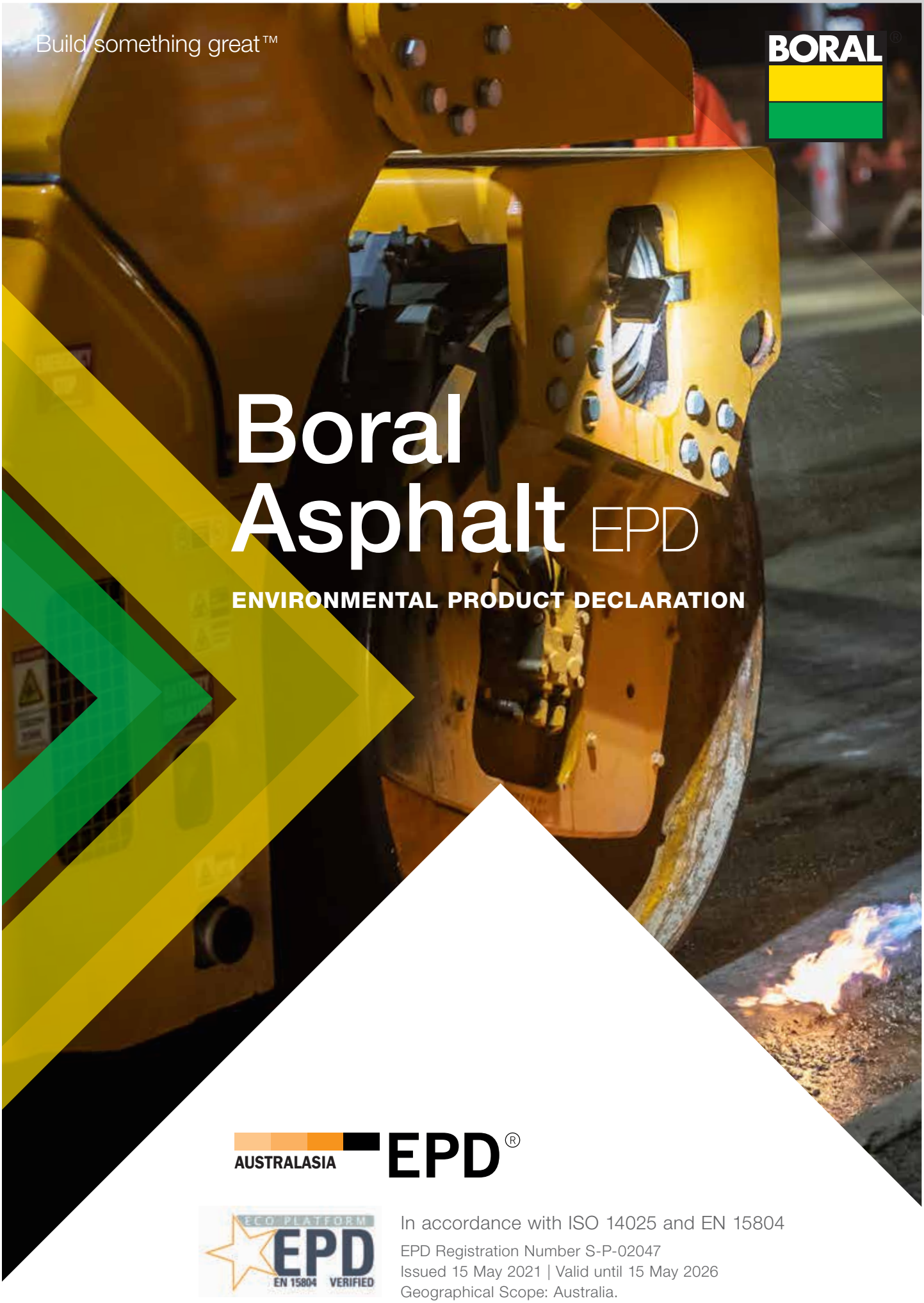
Build something great™



Boral Asphalt EPD

ENVIRONMENTAL PRODUCT DECLARATION

AUSTRALASIA EPD®

In accordance with ISO 14025 and EN 15804

EPD Registration Number S-P-02047
Issued 15 May 2021 | Valid until 15 May 2026
Geographical Scope: Australia.

CONTENTS

Left image: 2017 - Bolte Bridge

Cover image: 2019 - Asphalt Nightworks - Croydon VIC.

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 the EPD ecosystem, together with ISO 14025, ISO 14040 and ISO 14044, as they enable transparency and comparability between EPDs. This EPD provides environmental indicators for Boral Asphalt products.

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.

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EPD Produced by	START2SEE LIFE CYCLE ASSESSMENTS	**Rob Rouwette, start2see**	Address: 309 / 2a Montrose Place Hawthorn East Vic 3123, Australia Web: www.start2see.com.au Phone: +61 403 834 470 Email: Rob.Rouwette@start2see.com.au
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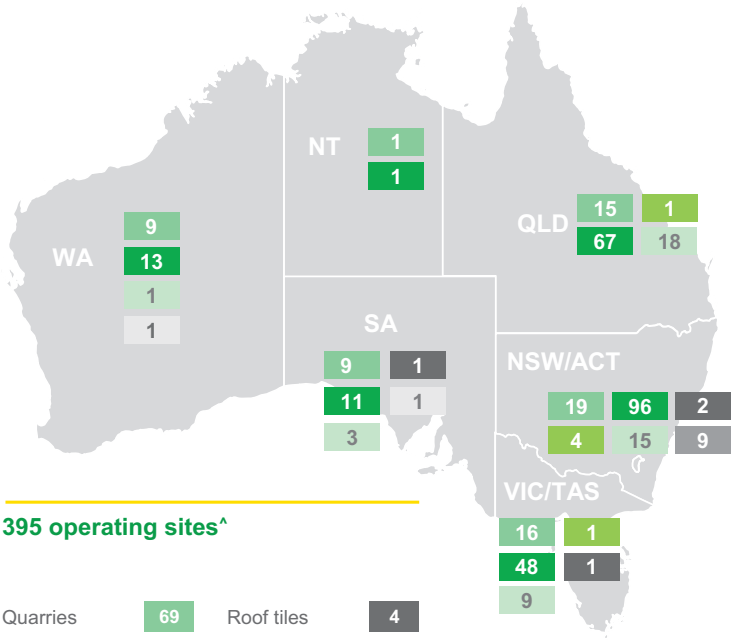
CEN standard EN 15804 served as the core PCR	
PCR:	PCR 2012:01 Construction Products and Construction Services, Version 2.33, 2020-09-18 PCR 2018:04 Asphalt Mixtures, Version 1.03, 2019-09-06 Appendix to product category rules for asphalt mixtures – Australia, Australasian EPD Programme, 2019-01-22
PCR 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 Asphalt has a footprint of over 40 plants and depots located across Australia. We operate in all states and territories with facilities in Queensland, New South Wales, Victoria, South Australia, Western Australia and ACT. The adaptability of our people and mobility of our technology allows us access to the far reaches of the continent, offshore territories and even neighbouring countries. In addition to our presence in capital cities, Boral Asphalt has successfully worked in locations as far ranging as rural Tasmania, Papua New Guinea and Cocos Island. Inland projects span the northern regions of Western Australia, mining towns in central Queensland and remote parts of the Northern Territory.

This asphalt EPD covers the suite of standard Boral asphalt products that subscribe to regulating authority standards and can often include reclaimed asphalt. Innovative alternatives are also incorporated and include Boral Asphalt INNOVO which is a product system that allows multiple recycled materials like plastic, slag, rubber, toner and glass.



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.

ABOUT BORAL

INNOVATION & TECHNICAL CAPABILITY

Boral is a leader in innovative asphalt technology having developed an extensive range of high performance and unique bituminous road products. The company partners with academia, clients and industry or product agencies to continuously improve the performance properties of products in increasingly demanding user loading conditions. Collaboration extends internationally where possible through associations with counterparts, suppliers and road agencies in other countries, in order to advance technologies, which more recently has included intensively increased use of recycled materials and reduction in cradle-to-grave energy consumption and natural resources.

Where possible, we transfer proven technology from overseas by regularly scanning the market and adapting it to suit local conditions and materials. As the demand for durable roads increases, part of our focus has been on the development of “perpetual pavements” that use advanced materials for superior strength and flexibility. These pavements and materials are more resilient to loadings and can reduce the amount of maintenance intervention required. This can minimise disruptions to road users, reduce downtime for operations and increase amenity for our communities. Our latest innovations have been applied in the form of long life surfacings with reduced thickness on major roads in capital cities while other asphalt products with high deformation resistance have been placed in ports and industrial precincts. We have also applied innovative treatments in low traffic rural environments so that communities can save money while transitioning to better pavement structures and the improved amenity they bring.

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 road 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 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.

ABOUT BORAL

Boral Asphalt has over the decades, installed a variety of sustainable measures at manufacturing plants like carbon filtration of emissions from the production line, optimised fuel type and usage for burners, dust control through enclosed systems and baghouses that allows for re-use of the collected dust.

As major asphalt producer, Boral pro-actively uses reclaimed asphalt from old road pavements in its new products and adamantly supports that parent industries must provide for the repurposing of asphalt materials at the end of each product life cycle. Reclaimed Asphalt Pavement (RAP) is used in accordance with regulator specifications so that valid independent governance is applied to sustainable assessment.

Boral continues to recycle steel slag, left as a by-product of steel and iron manufacturing processes. Slag mixes are included in this EPD as a mature innovation. Slag improves skid resistance and deformation resistance which also improves pavement life, thereby reducing the consumption of vital natural resources.

Boral has introduced an innovative product system named INNOVO to describe the many variants of sustainable products it produces that contain multiple recycled materials including glass, plastic, rubber, slag, toner and RAP. INNOVO mixes are included in the EPD.

Warm mix asphalt is another innovative technology covered by this EPD. Warm mix asphalt uses warm mix additives or processes to reduce temperature and so, the possibility of fugitive emissions.

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.

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 at and around our facilities.
- Openly and constructively engaging with communities surrounding our operations.

GEOGRAPHICAL SCOPE

ASPHALT
The asphalt plants considered for this Environmental Product Declaration comprise:

ACT/NSW
Canberra (ACT), batch
Enfield/Western Sydney (NSW), batch

QUEENSLAND
Allen's Asphalt Caboolture (QLD), continuous
Charlton/Toowoomba (QLD), batch
Ipswich/Brisbane (QLD), batch
West Burleigh/Gold Coast (QLD), batch

SOUTHERN REGION
Gepps Cross/Adelaide (SA), batch
Ballarat (Vic), batch
Deer Park/Western Melbourne (Vic), batch
Montrose/Eastern Melbourne (Vic), batch

WESTERN AUSTRALIA
Welshpool/Perth (WA), batch

Red pins = plants that are being modelled in this EPD

DECLARED PRODUCTS

PRODUCTS COVERED BY THIS ENVIRONMENTAL PRODUCT DECLARATION

The EPD covers a range of asphalt products that are relevant in their local markets. In the near future, we expect that the environmental impacts of products not referenced in the EPD can be provided on request. The Australian flexible Pavement Association (AfPA), of which Boral is a leading member, is developing an environmental impact calculator allowing us to provide environmental profiles for virtually any mix design from all of the plants which are in scope in this EPD.

Table 1. Boral Asphalt products included in the EPD

Plant	Processes	Products in EPD
Canberra (ACT)	**Batch**	DG10 10% RAP DG10 INNOVO DG14
Enfield/Western Sydney (NSW)	**Batch**	DG14 C450 AUSP 30% RAP DG14 HD A15E HFA
Allen's Asphalt Caboolture (QLD)	**Continuous**	AC10, AC14, AC20 Council specific mix EME2
Charlton/Toowoomba (QLD)	**Batch**	2232.20.AC14H 2235.20.AC20H EME2
Ipswich/Brisbane (QLD)	**Batch**	2143.19.EME2 2179.19.AC14H 2187.19.AC20H
West Burleigh/Gold Coast (QLD)	**Batch**	10mm Cold Mix 2008.15.AC14H 2009.15.AC20H 2120.19.EME2
Gepps Cross/Adelaide (SA)	**Batch**	A10E RAP10% DG10 RAP10% DG14 RAP15% Cold Mix INNOVO 2 INNOVO 3
Ballarat (Vic)	**Batch**	BCRA* C320 20Si C320 20Si 10% RAP
Deer Park/Western Melbourne (Vic)	**Batch**	BCRA* C320 20Si C320 20Si 10% RAP
Montrose/Eastern Melbourne (Vic)	**Batch**	BCRA* C320 20Si C320 20Si 10% RAP
Welshpool/Perth (WA)	**Batch**	Bitupack®DG14 JM45 DG14 JM50 DG20 JM49

INNOVO

Innovo is a Boral asphalt product system that offers an opportunity to combine multiple alternative recycled materials such as glass, rubber, plastic, slag, toner and RAP so that environmental and sustainability objectives can be met with the option to customise to requirements and local conditions. Both soft and hard plastic may be used, depending on local availability.

INNOVO can be used wherever asphalt is currently used and mix designs are primarily based on road authority specifications or performance qualified to meet client expectations. Performance is expected to meet or exceed these specifications or relevant high value proposition parameters set by the application.

INNOVO Benefits

INNOVO is an asphalt system that replaces some natural raw materials with recyclable materials such as glass, plastic, rubber and and used printer cartridge toners. It will be available to customers where these recyclable materials are available and based on local operational capabilities. INNOVO asphalt can be:

- A mixture of coarse and fine graded aggregates and bitumen with or without mineral filler.
- Laid and compacted hot for a dense smooth surface.
- Common and versatile paving product.
- Used for wearing courses and structural layers, roads and pavement surfacing.
- Designed to meet a variety of applications.

ASPHALT PRODUCTION

Asphalt is produced by mixing stones of various sizes with bitumen or modified bitumen in a mixer. Sand is often added and sometimes special additives are included to achieve desirable properties in the asphalt mix. Used asphalt is one of the most recycled materials in the world and can be used at many production facilities. Some production facilities also incorporate recycled glass, plastic, printer toner, steel slag and rubber to produce sustainable mixes designed to meet client performance requirements. When required, oxides to colour asphalt, cellulose fibre and several other additives can be fed into the production process to achieve structural, functional or architectural attributes.

Most asphalt is produced at high temperature so that the bitumen is in a liquid state and readily coats all solid components thereby acting as the glue that holds the mix together. While still pliable, the asphalt is placed in flat layers on the road through specialised paving machines. Upon cooling to ambient temperature the bitumen becomes a semi-solid and holds the stone in a formed shape. Stones that are appropriately packed together provide further resistance to deformation when external force is applied.

Mixers used in contemporary production are part of a complex facility called a mixing plant. There are two main types of mixing plant: batch plants and continuous or drum mixing plants.

In batch plants, the aggregates are taken from storage in controlled amounts and passed through a rotary dryer where they are dried and heated. The aggregates then pass over a screening unit that separates them into different sized fractions and deposits them into bins for hot storage. The aggregates, mineral filler and binder are then proportioned by mass on a set of scales on a batch basis and thoroughly mixed in a twin shaft pug mill. Batch plants are designed around flexibility – they can be operated intermittently and can change from one mix to another quite readily. Most Boral plants are Batch Plants.

Continuous plants produce asphalt in a non-stop, continuous process from ingredient input to final product. A commonly used continuous plant is Drum Plant. In these plants, the aggregates must be dried, heated and mixed with the binder in the drum in a single, non-stop process. Batch Plants are different because the process can be stopped between a dry phase which involves aggregates only and a wet phase when bitumen is injected for blending with hot aggregates and other dry components in a separate pug-mill type mixer. The continuous process of a Drum Plant is more suited to non-stop production of larger quantities of a single product.

In both Batch and Drum Plants, the end product is transferred to a hot surge or storage bin for subsequent loading into trucks. Batch Plants have the extra option of discharging mix directly from the pug mill into trucks for transport to the paving site.

Plant sizes range from small mixers for preparation of small quantities of asphalt or coldmix up to large plants capable of several hundred tonnes per hour. They may be mobile, portable or permanently located plants. All plants must be capable of uniformly mixing coarse and fine aggregate, filler, and binder to meet the specified requirements at all times guided by AS 2150.

Boral's asphalt products are designed to meet client requirements and generally in accordance with the following Australian standards and respective state road authority-based specifications:

- AS 2150 Asphalt - A guide to good practice
- AS/NZS 2891 Methods of sampling and testing asphalt
- MRT Qld – MRT S30 - Transport and Main Roads Specifications MRTS30 Asphalt Pavements
- TfNSW – IC-QA-R116 - Transport for NSW (TfNSW) QA Specification R116 Heavy duty dense graded asphalt
- VDoT – 407 - Department of Transport (VIC) Standard Section 407 Hot mix asphalt
- DIT SA – R27 - Department for Infrastructure and Transport (SA) Specification: Part R27 Supply of Asphalt
- MRWA – 504 - Main Roads Western Australia Specification 504 Asphalt Wearing Course

INNOVO® CASE STUDY

CITY OF MITCHAM - SOUTH AUSTRALIA

INNOVO2 - EPD

CASE STUDY

Location Carlisle Road, Westbourne Park, SA

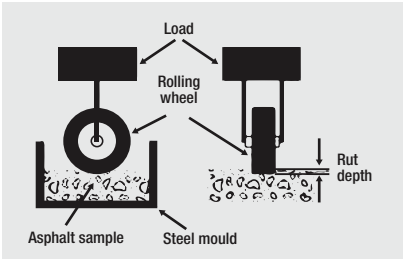
Owner City Of Mitcham

To celebrate Earth Day 2020, the City of Mitcham asked Boral to assist its community achieve a cleaner environment by taking used plastic, rubber and glass out of waste and using them in council roads. Avoiding landfill reduces hefty disposal fees paid by councils and levied on residents; while repurposing these high value materials can save energy and preserves natural resources used for new products.

Product Performance

The proportions of repurposed materials in the asphalt mix are given in the table below.

Asphalt component	%w/w Asphalt Mix
Bitumen	6
PET Plastic	1
RAP	10
Other components	83



Rut resistance and fatigue life measurements on production samples of the sustainable Fine AC mix with high binder content resulted in performance levels equal to or higher than standard Fine AC mix typically used on local streets around Adelaide. It confirms that that recycled material alternatives deliver exceptional value for money.

Outcomes

The equivalent of 450,000 used plastic bottles and 150 tonnes of reclaimed asphalt pavement (RAP) were redirected from landfill and recycled in the asphalt surfacing laid on Carlisle Road.

PET plastic was sourced directly from municipal waste collection, processed through a material recycling facility, while the RAP was extracted from Adelaide Streets.

A road made from more than 450,000 plastic bottles was laid in the City of Mitcham to coincide with Earth Day on Wednesday April 22.

Carlisle Street, Westbourne Park, is one of two 'recycled road' demonstration sites rolled out by City of Mitcham and its contractor Boral using recycled materials.

City of Mitcham Mayor Dr Heather Holmes-Ross said the use of the plastic bottles in an asphalt mix road was a first for South Australia. The 450,000 bottles that were recycled into the asphalt would reach a height of 60 kilometres if stacked on top of each other. This plastic mix is stronger and lasts longer than traditional asphalt.

What they said...

> "The current projects are part of a new initiative that was based around an open 'expression of interest' we put out to the state to attract new innovations of incorporating recyclables into asphalt and encouraging private industry to push the boundaries of what is achievable"
>
> **Dr Holmes-Ross**

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.

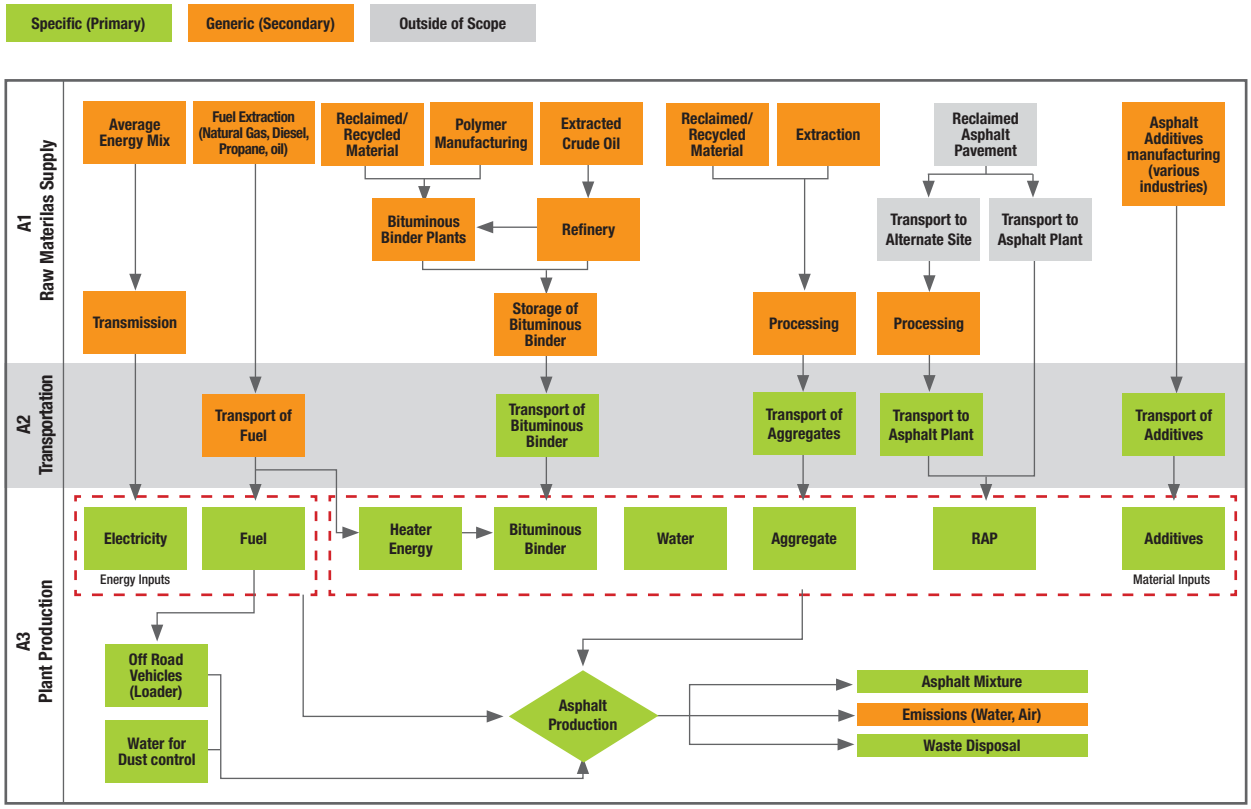


Figure 3. Flow diagram of asphalt production process (life cycle stages A1 to A3), data types and system boundaries (AEPDP 2019)

CRADLE-TO-GATE LIFE CYCLE

RAW MATERIAL STAGE A1

Asphalt products are typically made using a bitumen binder (sometimes modified using polymers, such as styrene-butadiene-styrene (SBS) or crumb rubber, coarse aggregates (crushed rock), fine aggregates (natural sand, manufactured sand, crushed glass) and fillers (e.g. bag house filter dust, fly ash, limestone). Other additives may be used to achieve desired material properties. The exact composition of each asphalt product is designed to create the characteristics that make the product fit-for-purpose. Raw materials used in the production of Boral's asphalt products comply with the standard AS 2150 or can be customised to client requirements if requested.

TRANSPORTATION STAGE A2

Raw materials are typically transported to our sites by road or rail freighters. Coarse aggregates, manufactured sands and natural sands are sourced from our network of quarries. Bituminous binders are supplied by a range of binder suppliers from various Australian terminals. Transport of raw materials to Boral Asphalt's plants has been included based upon actual transport modes and distances relevant to each plant.

MANUFACTURING STAGE A3

The typical manufacturing process of Boral's normal asphalt and INNOVO asphalt is via either continuous drum plants or batch plants as explained in the section "Asphalt Production". The entire process is verified by a third party under ISO 9001.

This manufacturing stage (A3) includes activities associated with mixing of constituents at the asphalt plant, but not including delivery and placement of asphalt at the project location.

Table 2: 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).

LIFE CYCLE ASSESSMENT (LCA) METHODOLOGY

BACKGROUND DATA

Boral has supplied primary data from key quarries and eleven asphalt production sites. Background data (e.g. for energy and transport processes, bitumen and additives) have predominantly been sourced from AusLCI and the AusLCI shadow database (v1.35), in line with the Australian PCR Appendix for asphalt mixtures (AEPDP 2019).

The prescribed Life Cycle Inventory (LCI) data for bitumen, rubber crumb and vegetable oil bio-equivalent (used in Bitupack® asphalt) have a significant effect on the results of the LCA. When comparing asphalt EPDs, it is therefore important to understand which background LCI data are used.

The quarry data has been collected for calendar year 2018. The asphalt production data has been collected for FY2019 or FY2020. Environmental profiles of our products are based on life cycle data that are less than five years old. Background data used are less than 10 years old.

Methodological choices have been applied in line with EN 15804; deviations have been recorded.

Table 3. Electricity grid composition*

Plant Location	Brown Coal	Black Coal	Natural Gas/CSG	Hydro	Wind	Solar	Other	GHG (kg CO_2e/kWh)
ACT/NSW	–	84.0%	3.4%	4.4%	2.7%	3.7%	1.7%	0.88
QLD	–	79.5%	13.5%	1.0%	–	4.1%	1.9%	0.91
SA	–	–	46.0%	–	36.0%	9.0%	9.0%**	0.50
VIC	83.0%	–	0.6%	6.5%	6.5%	2.6%	0.8%	1.07
WA	–	50.3%	34.9%	–	8.1%	5.7%	1.0%	0.68

* Source: AusLCI v1.35 (2021)

** This includes 8.3% electricity imported from Victoria into South Australia

LIFE CYCLE ASSESSMENT (LCA) METHODOLOGY

ALLOCATION

The key material production processes that require allocation are:

- **Asphalt**: Boral Asphalt manufactures a range of asphalt products at most sites. Products can be produced at different temperatures (e.g. hot mix, warm mix or cold mix) and the composition of the asphalt mix also affects the energy required to drive off moisture and heat up the raw materials to the required temperature. To determine the energy requirements for each mix design, start2see has applied Method A (AEPDP 2019; section 2.5): Determine the energy use for each mix design based on the composition, specific heat capacity of components, moisture content of raw materials and the plant's overall efficiency.
- **RAP**: Reclaimed Asphalt Pavement reaches the end-of-waste state when the reclaimed, milled material has been collected in a truck and transported to a storage pile, ready to be processed for further use. Boral typically processes RAP at its quarries, using a power screen with a front-end loader to feed material and then move processed material to a nearby stockpile. No electricity or water is being used for the RAP reprocessing. Diesel use (0.267 L/tonne) is included in the LCA.

  The main asphalt PCR (Environdec 2019) and ISO 21930 state that recycled content of products should only cover recycled materials from post-industrial and post-consumer scraps, but not made from internal scrap. Boral has indicated that up to 10% of RAP used originates from production waste. Therefore, each 1.0 kg of RAP used in our asphalt amounts to 0.9 kg of Secondary Material (parameter: SM).
- **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.
- **Slag aggregates**: Steel furnace slag is a by-product from steel production. Economic allocation is used to attribute a portion of the steel furnace process to the slag as per AusLCI data.
- **Crumb rubber**: End-of-life tyres reach the end-of-waste state after they have been collected and shredded into tyre-derived-fuel (TDF). Further processing of this rubber can involve grinding the material into crumb rubber, a fine powder. The energy required for the grinding process is attributed to the crumb rubber and PET.
- **Recycled plastic**: Post-industrial recycled PE plastic is used at some sites. The plastic reaches the end-of-waste state after it is cleaned and ready for use by Boral. Transport of plastic from supplier to the asphalt plant is included in the life cycle of asphalt.

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).
- Of the raw materials used by Boral Asphalt, only vegetable-based oil (reusable drums) and crumb rubber (reusable bulk-bags) are supplied in packaged format. As the packaging used for these products is reusable, it is well below the materiality cut-off and packaging materials have therefore been omitted.

LIFE CYCLE ASSESSMENT (LCA) METHODOLOGY

KEY ASSUMPTIONS

The key material production processes that require allocation are:

- **Asphalt composition:** The asphalt composition of each product is taken from Boral Asphalt's internal operating systems. These data are considered to be of high accuracy.
- **Water consumption:** Water consumption data were not available for plants at Ipswich and Gepps Cross. We have used the unweighted average water consumption from the other nine plants to estimate water use at Ipswich and Gepps Cross.
- **Vegetable oil:** The Bitupack® product manufactured in Welshpool contains vegetable-based oil. We have used canola oil as a proxy, based on discussions with the supplier and in line with AEPDP 2019. The choice for type of oil can have a significant impact on the environmental profile of Bitupack®.
- **Transport of raw materials to Boral Asphalt:** Boral Asphalt has supplied details of supplier locations, transport modes and distances. For minor raw materials at some sites, the exact supply locations are not known. We have assumed that these materials are supplied by 16-28t truck over a one-way distance of 100 km.

  This assumption has no material impact on the LCA results.

PRODUCT COMPOSITION

Table 4A.

	Canberra ACT			Enfield (Sydney) NSW		Caboolture QLD Allen's Asphalt			Charlton Toowoomba QLD			Ipswich Brisbane QLD			West Burleigh Gold Coast QLD			
Product	**DG14**	**DG10 10%RAP**	**DG10 INNOVO**	**DG14 C450 AUSP 30%RAP**	**DG14 HD A15E HFA**	**COUNCIL SPEC MIX**	**AC10, AC14, AC20**	**EME2**	**2232.20.AC14H**	**2235.20.AC20H**	**EME2**	**2179.19.AC14H**	**2187.19.AC20H**	**2143.19.EME2**	**2008.15.AC14H**	**2009.15.AC20H**	**2120.19.EME2**	**10mm COLD MIX**
Components - kg/t																		
Bitumen	50	51	50	38	53	50	45	52	48	46	53	49	46	59	48	45	54	38
Natural sand	130	130	80			153	85		119	105		266	248		119	115		114
Manufactured sand	260	260	260	310	423	300	247	430	267	248	426	124	95	335	243	224	478	322
Crushed rock	520	419	330	179	121	487	608	483	557	592	521	551	601	607	571	597	468	512
Bag house dust	40	40	30	15	5	10		35							10	10		
Reclaimed Asphalt (RAP)*		100	200	300														
Crushed glass sand#			50															
Slag aggregate^				160	383													
Hydrated lime					15		15		9	9		10	10		10	10		
Cold Mix add. - Diesel																		14

Table 4B.

	Gepps Cross Adelaide SA						Ballarat VIC			Deer Park (West Melb) VIC			Montrose (East Melb) VIC			Welshpool (Perth) WA			
Product	**DG10 RAP10%**	**DG14 RAP15%**	**A10E RAP10%**	**COLD MIX**	**INNOVO 2**	**INNOVO 3**	**C320 20SI**	**BCRA**	**C320 20Si 10%RAP**	**C320 20SI**	**BCRA**	**C320 20Si 10%RAP**	**C320 20SI**	**BCRA**	**C320 20Si 10%RAP**	**DG20 JM49**	**DG14 JM45**	**DG14 JM50**	**BITUPACK®**
Components - kg/t																			
Bitumen	53	49	50	50	56	60	44	73	36	47	50	40	43	42	45	46	46	50	43
Natural sand	174	132	174	98	187	185	220		200	90		58	77		86	66		75	
Manufactured sand	174	143	174	195	206	203	143	155	105		150		206	160	172	320	480	411	713
Crushed rock	479	511	479	650	448	443	593	740	563	814	765	763	665	700	602	452	442	346	217
Bag house dust	9	15	9							39		29				10	20	10	15
Reclaimed Asphalt (RAP)*	100	150	100		93	92			95			100			96	93		93	
Hydrated lime	10		10					7			10					15	15	15	
Cold Mix add. - Diesel				7															
SBS polymer			3																
Rubber crumb#						10		24			25			23					
Recycled plastic^					10	10													
Vegetable based oil																			13
Milled limestone										10		10	10	75					

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).

* 90% post-consumer recycled material/10% production waste # Post-consumer recycled material ^ Post-industrial recycled material

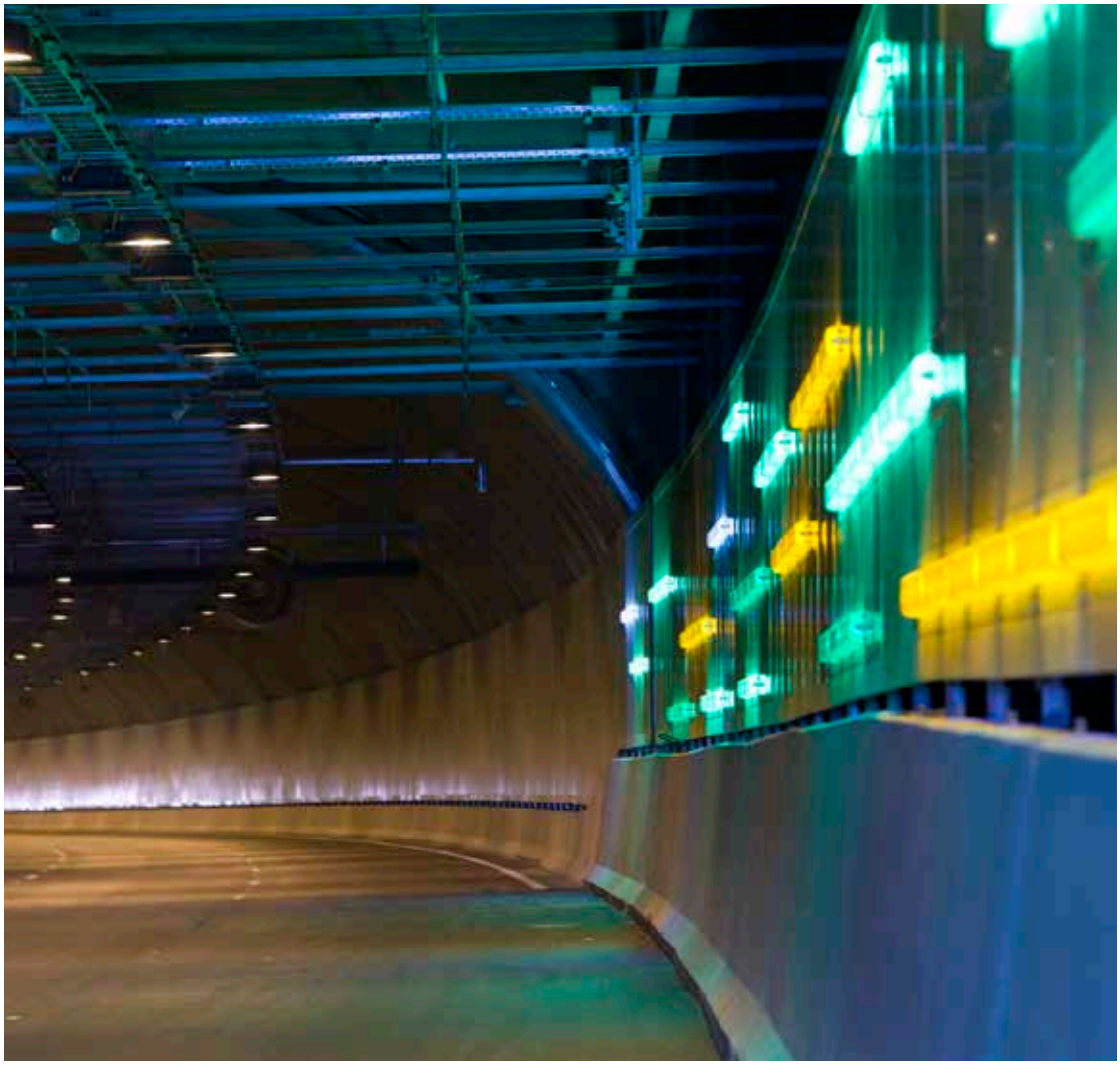
DECLARED UNIT

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.

Asphalt is available in various compositions and with characteristics that are specifically designed for each application. The declared unit that covers all of the products is: 1 metric tonne (t) of manufactured asphalt mixture (as ordered by client) with identifying characteristics. This declared unit has been selected in line with the Australian PCR Appendix (AEPDP 2019).

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

The product code for asphalt is UN CPC 1533 (Bitumen and asphalt, natural; asphaltites and asphaltic rock) & 3794 (Bituminous mixtures based on natural and artificial stone materials and bitumen, natural asphalt or related substances as a binder) and ANZSIC Class 1709 (Other Petroleum and Coal Product Manufacturing).



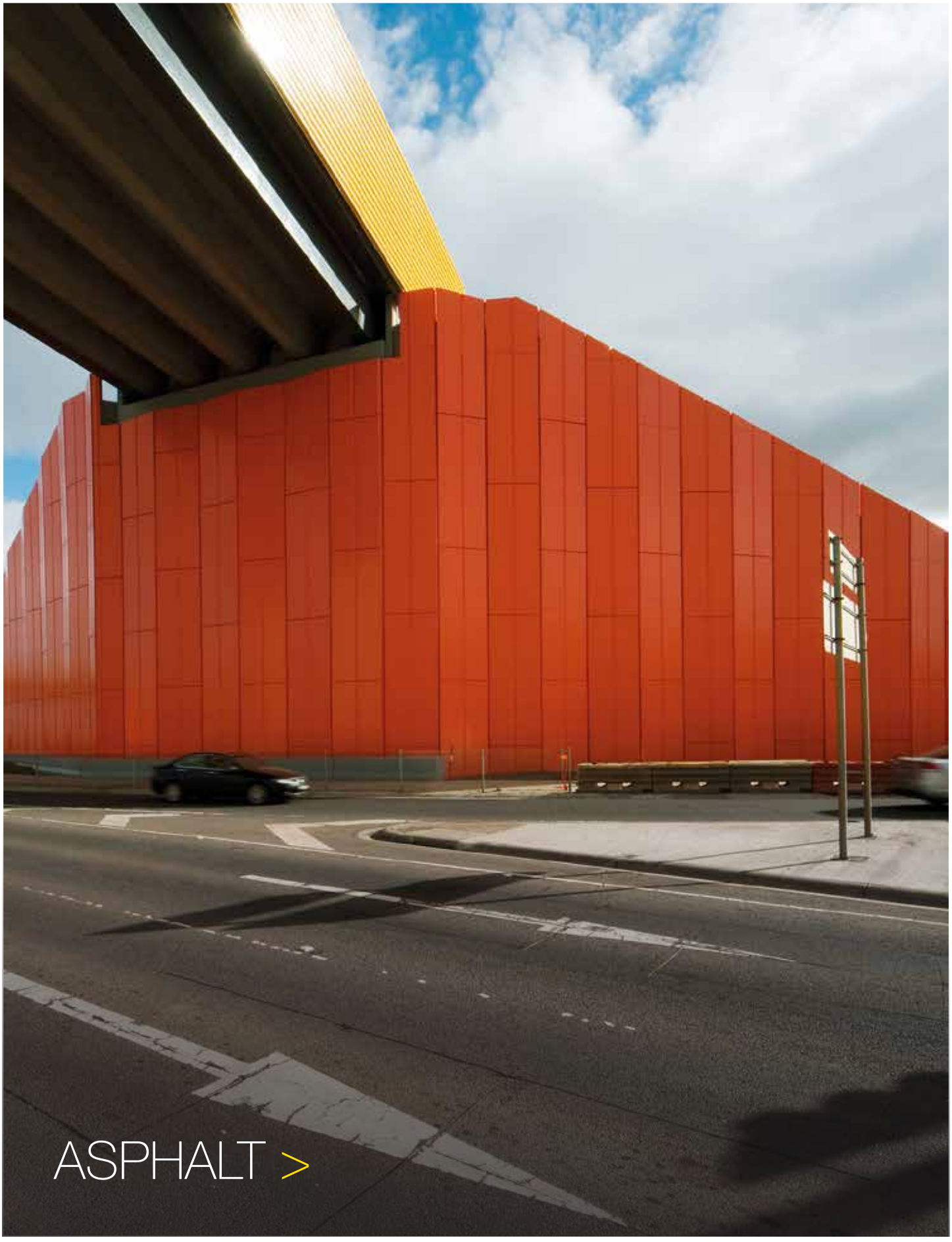
ENVIRONMENTAL INDICATORS

Table 5. 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 6: 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



ASPHALT >

Environmental profiles and parameters.

ENVIRONMENTAL PROFILES

The cradle-to-gate (module A1-A3) environmental profiles and environmental parameters of each product group are expressed per tonne of asphalt (volume as ordered by the client).

LIMITATIONS

The results of this study and the EPD are valid for Boral products only. Products from other manufacturers will likely have different impacts due to differences in mix designs, supply chains and manufacturing processes. LCI data as prescribed in the Australian PCR Appendix were used as background data for the materials and processes relevant to the life cycle of asphalt products. Key limitations of the LCI data are:

- The prescribed bitumen LCI data, SBS LCI data and crumb rubber LCI data have a significant impact on the results of the LCA. When comparing asphalt EPDs, it is therefore important that these are based on the same LCI data for bitumen, SBS and crumb rubber.
- The results of the Bitupack® product are highly dependent on the choice of vegetable oil data. We have used the AusLCI data for canola oil, as per the Australian PCR Appendix and based on discussions with the supplier. Due to confidentiality of the actual product ingredients, canola oil is considered the best available proxy.
- We don't have site-by-site data of the source of RAP (production waste or end-of-life (post-consumer) RAP). Boral has estimated that up to 10% of RAP used originates from production waste. Therefore, in the LCA each 1.0 kg of RAP used in asphalt amounts to 0.9 kg of Secondary Material (parameter: SM).

OVERVIEW OF RESULTS

Plant locations	Results tables
Canberra (ACT)	7 - 8
Enfield/Western Sydney (NSW)	9 - 10
Allen's Asphalt Caboolture (QLD)	11 - 12
Charlton/Toowoomba (QLD)	13 - 14
Ipswich/Brisbane (QLD)	15 - 16
West Burleigh/Gold Coast (QLD)	17 - 18
Gepps Cross/Adelaide (SA)	19 - 20
Ballarat (Vic)	23 - 24
Deer Park/Western Melbourne (Vic)	25 - 26
Montrose/Eastern Melbourne (Vic)	27 - 28
Welshpool/Perth (WA)	29 - 30

BORAL ASPHALT CANBERRA

Table 7. Environmental profiles, Boral Asphalt products, Canberra (ACT), stages A1-A3, per tonne

Indicator	Unit	DG10 10% RAP	DG10 INNOVO	DG14
GWP	**kg CO_2 eq**	**56.4**	**57.2**	**64.6**
ODP	kg CFC-11 eq	2.68E-05	2.65E-05	3.08E-05
AP	kg SO_2 eq	3.29E-01	3.23E-01	3.81E-01
EP	kg PO_4^{3-} eq	4.13E-02	4.05E-02	4.76E-02
POCP	kg C_2H_4 eq	0.0541	0.0544	0.0614
ADPE	kg Sb eq	4.78E-07	4.78E-07	5.11E-07
ADPF	MJ_{NCV}	2840	2810	3320

Table 8. Environmental parameters, Boral Asphalt products, Canberra (ACT), stages A1-A3, per tonne

Parameter	Unit	DG10 10% RAP	DG10 INNOVO	DG14
PERE	MJ_{NCV}	8.20E+00	8.08E+00	1.18E+01
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	8.20E+00	8.08E+00	1.18E+01
PENRE	MJ_{NCV}	6.24E+02	6.33E+02	7.02E+02
PENRM	MJ_{NCV}	2.46E+03	2.41E+03	2.89E+03
PENRT	MJ_{NCV}	3.08E+03	3.04E+03	3.60E+03
SM	kg	9.00E+01	2.30E+02	1.07E+02
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.89E+00	1.67E+00	1.97E+00
HW	kg	0.00E+00	0.00E+00	0.00E+00
NHW	kg	9.17E-02	9.09E-02	1.18E-01
RW	kg	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00

BORAL ASPHALT ENFIELD

Table 9. Environmental profiles, Boral Asphalt products, Enfield (NSW), stages A1-A3, per tonne

Indicator	Unit	DG14 C450 AUSP 30% RAP	DG14 HD A15E HFA
GWP	**kg CO_2 eq**	**56.4**	**81.0**
ODP	kg CFC-11 eq	1.78E-05	2.54E-05
AP	kg SO_2 eq	2.65E-01	3.72E-01
EP	kg PO_4^{3-} eq	3.52E-02	4.72E-02
POCP	kg C_2H_4 eq	0.0416	0.0612
ADPE	kg Sb eq	3.90E-07	6.49E-07
ADPF	MJ_{NCV}	2030	2870

Table 10. Environmental parameters, Boral Asphalt products, Enfield (NSW), stages A1-A3, per tonne

Parameter	Unit	DG14 C450 AUSP 30% RAP	DG14 HD A15E HFA
PERE	MJ_{NCV}	6.97E+00	1.13E+01
PERM	MJ_{NCV}	0.00E+00	0.00E+00
PERT	MJ_{NCV}	6.97E+00	1.13E+01
PENRE	MJ_{NCV}	3.64E+02	5.48E+02
PENRM	MJ_{NCV}	1.83E+03	2.56E+03
PENRT	MJ_{NCV}	2.20E+03	3.10E+03
SM	kg	2.70E+02	0.00E+00
RSF	MJ_{NCV}	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00
FW	m^3	1.02E+00	1.25E+00
HW	kg	0.00E+00	0.00E+00
NHW	kg	9.03E-02	1.05E-01
RW	kg	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00

ALLEN'S ASPHALT CABOOLTURE

Table 11. Environmental profiles, Allen's Asphalt products, Caboolture (QLD), stages A1-A3, per tonne

Indicator	Unit	AC10, AC14, AC20	COUNCIL SPECIFIC MIX	EME2
GWP	**kg CO_2 eq**	**63.8**	**54.4**	**54.4**
ODP	kg CFC-11 eq	2.56E-05	2.70E-05	2.78E-05
AP	kg SO_2 eq	3.04E-01	3.18E-01	3.27E-01
EP	kg PO_4^{3-} eq	3.81E-02	3.93E-02	4.02E-02
POCP	kg C_2H_4 eq	0.0533	0.0537	0.0547
ADPE	kg Sb eq	5.26E-07	5.30E-07	5.57E-07
ADPF	MJ_{NCV}	2610	2790	2870

Table 12. Environmental parameters, Allen's Asphalt products, Caboolture (QLD), stages A1-A3, per tonne

Parameter	Unit	AC10, AC14, AC20	COUNCIL SPECIFIC MIX	EME2
PERE	MJ_{NCV}	8.08E+00	5.42E+00	5.59E+00
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	8.08E+00	5.42E+00	5.59E+00
PENRE	MJ_{NCV}	6.60E+02	6.16E+02	6.08E+02
PENRM	MJ_{NCV}	2.17E+03	2.41E+03	2.51E+03
PENRT	MJ_{NCV}	2.83E+03	3.03E+03	3.12E+03
SM	kg	0.00E+00	0.00E+00	0.00E+00
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
FW	m^3	2.08E+00	2.09E+00	2.12E+00
HW	kg	0.00E+00	0.00E+00	0.00E+00
NHW	kg	4.46E-02	4.25E-02	4.41E-02
RW	kg	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00

BORAL ASPHALT CHARLTON

Table 13. Environmental profiles, Boral Asphalt products, Charlton (QLD), stages A1-A3, per tonne

Indicator	Unit	2232.20.AC14H	2235.20.AC20H	EME2
GWP	**kg CO_2 eq**	**70.5**	**69.4**	**62.7**
ODP	kg CFC-11 eq	2.48E-05	2.39E-05	2.62E-05
AP	kg SO_2 eq	4.21E-01	4.11E-01	4.34E-01
EP	kg PO_4^{3-} eq	6.18E-02	6.07E-02	6.25E-02
POCP	kg C_2H_4 eq	0.0500	0.0485	0.0508
ADPE	kg Sb eq	4.52E-07	4.47E-07	4.74E-07
ADPF	MJ_{NCV}	2790	2700	2960

Table 14. Environmental parameters, Boral Asphalt products, Charlton (QLD), stages A1-A3, per tonne

Parameter	Unit	2232.20.AC14H	2235.20.AC20H	EME2
PERE	MJ_{NCV}	9.29E+00	9.16E+00	7.72E+00
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	9.29E+00	9.16E+00	7.72E+00
PENRE	MJ_{NCV}	7.11E+02	7.02E+02	6.47E+02
PENRM	MJ_{NCV}	2.31E+03	2.22E+03	2.56E+03
PENRT	MJ_{NCV}	3.03E+03	2.92E+03	3.20E+03
SM	kg	0.00E+00	0.00E+00	0.00E+00
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.77E+00	1.76E+00	1.80E+00
HW	kg	0.00E+00	0.00E+00	0.00E+00
NHW	kg	1.24E-01	1.23E-01	1.23E-01
RW	kg	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00

BORAL ASPHALT IPSWICH

Table 15. Environmental profiles, Boral Asphalt products, Ipswich (QLD), stages A1-A3, per tonne

Indicator	Unit	2143.19.EME2	2179.19.AC14H	2187.19.AC20H
GWP	**kg CO_2 eq**	**72.5**	**79.4**	**77.6**
ODP	kg CFC-11 eq	3.04E-05	2.71E-05	2.56E-05
AP	kg SO_2 eq	4.38E-01	4.03E-01	3.87E-01
EP	kg PO_4^{3-} eq	5.71E-02	5.40E-02	5.23E-02
POCP	kg C_2H_4 eq	0.0639	0.0606	0.0581
ADPE	kg Sb eq	5.04E-07	4.02E-07	3.96E-07
ADPF	MJ_{NCV}	3340	2950	2800

Table 16. Environmental parameters, Boral Asphalt products, Ipswich (QLD), stages A1-A3, per tonne

Parameter	Unit	2143.19.EME2	2179.19.AC14H	2187.19.AC20H
PERE	MJ_{NCV}	7.07E+00	7.99E+00	7.73E+00
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	7.07E+00	7.99E+00	7.73E+00
PENRE	MJ_{NCV}	7.82E+02	8.41E+02	8.29E+02
PENRM	MJ_{NCV}	2.84E+03	2.36E+03	2.21E+03
PENRT	MJ_{NCV}	3.63E+03	3.20E+03	3.04E+03
SM	kg	0.00E+00	0.00E+00	0.00E+00
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
FW	m^3	2.24E+00	2.06E+00	2.05E+00
HW	kg	0.00E+00	0.00E+00	0.00E+00
NHW	kg	7.20E-02	6.73E-02	6.60E-02
RW	kg	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00

BORAL ASPHALT WEST BURLEIGH

Table 17. Environmental profiles, Boral Asphalt products, West Burleigh (QLD), stages A1-A3, per tonne

Indicator	Unit	10MM COLD MIX	2008.15. AC14H	2009.15. AC20H	2120.19. EME2
GWP	**kg CO_2 eq**	**55.8**	**67.9**	**66.7**	**68.7**
ODP	kg CFC-11 eq	2.37E-05	2.24E-05	2.11E-05	2.49E-05
AP	kg SO_2 eq	3.43E-01	3.28E-01	3.13E-01	3.52E-01
EP	kg PO_4^{3-} eq	4.49E-02	4.44E-02	4.29E-02	4.64E-02
POCP	kg C_2H_4 eq	0.0503	0.0505	0.0483	0.0538
ADPE	kg Sb eq	3.94E-07	3.67E-07	3.58E-07	4.05E-07
ADPF	MJ_{NCV}	2730	2570	2430	2840

Table 18. Environmental parameters, Boral Asphalt products, West Burleigh (QLD), stages A1-A3, per tonne

Parameter	Unit	10MM COLD MIX	2008.15. AC14H	2009.15. AC20H	2120.19. EME2
PERE	MJ_{NCV}	8.33E+00	1.00E+01	9.84E+00	1.03E+01
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	8.33E+00	1.00E+01	9.84E+00	1.03E+01
PENRE	MJ_{NCV}	4.83E+02	4.66E+02	4.58E+02	4.65E+02
PENRM	MJ_{NCV}	2.47E+03	2.31E+03	2.17E+03	2.60E+03
PENRT	MJ_{NCV}	2.95E+03	2.78E+03	2.63E+03	3.07E+03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.74E+00	1.69E+00	1.68E+00	1.75E+00
HW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHW	kg	1.41E-01	1.42E-01	1.40E-01	1.45E-01
RW	kg	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
MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	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

BORAL ASPHALT GEPPS CROSS

Table 19. Environmental profiles, Boral Asphalt products, Gepps Cross (SA), stages A1-A3, per tonne

Indicator	Unit	A10E RAP10%	DG10 RAP10%	DG14 RAP15%
GWP	**kg CO_2 eq**	**67.5**	**52.5**	**42.4**
ODP	kg CFC-11 eq	2.33E-05	2.45E-05	2.22E-05
AP	kg SO_2 eq	3.69E-01	3.14E-01	2.86E-01
EP	kg PO_4^{3-} eq	3.98E-02	3.70E-02	3.38E-02
POCP	kg C_2H_4 eq	0.0611	0.0508	0.0453
ADPE	kg Sb eq	7.49E-07	3.26E-07	3.01E-07
ADPF	MJ_{NCV}	2840	2640	2410

Table 20. Environmental parameters, Boral Asphalt products, Gepps Cross (SA), stages A1-A3, per tonne

Parameter	Unit	A10E RAP10%	DG10 RAP10%	DG14 RAP15%
PERE	MJ_{NCV}	1.35E+01	1.17E+01	9.24E+00
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	1.35E+01	1.17E+01	9.24E+00
PENRE	MJ_{NCV}	6.73E+02	3.17E+02	2.54E+02
PENRM	MJ_{NCV}	2.41E+03	2.56E+03	2.36E+03
PENRT	MJ_{NCV}	3.08E+03	2.87E+03	2.62E+03
SM	kg	9.00E+01	9.00E+01	1.35E+02
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
FW	m^3	2.24E+00	1.41E+00	1.28E+00
HW	kg	0.00E+00	0.00E+00	0.00E+00
NHW	kg	2.94E-02	2.91E-02	2.44E-02
RW	kg	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00

BORAL ASPHALT GEPPS CROSS

Table 21. Environmental profiles, Boral Asphalt products, Gepps Cross (SA), stages A1-A3, per tonne

Indicator	Unit	COLD MIX	INNOVO 2	INNOVO 3
GWP	**kg CO_2 eq**	**41.1**	**46.1**	**51.4**
ODP	kg CFC-11 eq	2.58E-05	2.53E-05	2.70E-05
AP	kg SO_2 eq	3.30E-01	3.24E-01	3.48E-01
EP	kg PO_4^{3-} eq	3.83E-02	3.80E-02	4.14E-02
POCP	kg C_2H_4 eq	0.0515	0.0508	0.0538
ADPE	kg Sb eq	3.70E-07	3.43E-07	3.60E-07
ADPF	MJ_{NCV}	2800	2750	2980

Table 22. Environmental parameters, Boral Asphalt products, Gepps Cross (SA), stages A1-A3, per tonne

Parameter	Unit	COLD MIX	INNOVO 2	INNOVO 3
PERE	MJ_{NCV}	1.07E+01	1.01E+01	1.33E+01
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	1.07E+01	1.01E+01	1.33E+01
PENRE	MJ_{NCV}	3.12E+02	2.86E+02	3.38E+02
PENRM	MJ_{NCV}	2.73E+03	2.70E+03	2.89E+03
PENRT	MJ_{NCV}	3.04E+03	2.99E+03	3.23E+03
SM	kg	0.00E+00	9.37E+01	1.07E+02
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.50E+00	1.49E+00	1.51E+00
HW	kg	0.00E+00	0.00E+00	0.00E+00
NHW	kg	2.83E-02	2.80E-02	5.24E-02
RW	kg	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00

BORAL ASPHALT BALLARAT

Table 23. Environmental profiles, Boral Asphalt products, Ballarat (VIC), stages A1-A3, per tonne

Indicator	Unit	BCRA	C320 20Si	C320 20Si 10% RAP
GWP	**kg CO_2 eq**	**81.9**	**59.0**	**56.6**
ODP	kg CFC-11 eq	3.31E-05	2.03E-05	1.70E-05
AP	kg SO_2 eq	4.39E-01	2.84E-01	2.46E-01
EP	kg PO_4^{3-} eq	5.36E-02	3.59E-02	3.19E-02
POCP	kg C_2H_4 eq	0.0657	0.0427	0.0370
ADPE	kg Sb eq	5.49E-07	4.05E-07	3.57E-07
ADPF	MJ_{NCV}	3780	2320	1960

Table 24. Environmental parameters, Boral Asphalt products, Ballarat (VIC), stages A1-A3, per tonne

Parameter	Unit	BCRA	C320 20Si	C320 20Si 10% RAP
PERE	MJ_{NCV}	2.10E+01	1.04E+01	9.84E+00
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	2.10E+01	1.04E+01	9.84E+00
PENRE	MJ_{NCV}	5.68E+02	3.86E+02	3.69E+02
PENRM	MJ_{NCV}	3.52E+03	2.12E+03	1.75E+03
PENRT	MJ_{NCV}	4.09E+03	2.51E+03	2.12E+03
SM	kg	3.53E+01	0.00E+00	8.59E+01
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.89E+00	1.75E+00	1.57E+00
HW	kg	0.00E+00	0.00E+00	0.00E+00
NHW	kg	1.22E-01	5.27E-02	4.87E-02
RW	kg	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00

BORAL ASPHALT DEER PARK

Table 25. Environmental profiles, Boral Asphalt products, Deer Park (VIC), stages A1-A3, per tonne

Indicator	Unit	BCRA	C320 20Si	C320 20Si 10% RAP
GWP	**kg CO_2 eq**	**67.4**	**49.5**	**46.9**
ODP	kg CFC-11 eq	2.31E-05	2.13E-05	1.83E-05
AP	kg SO_2 eq	3.14E-01	2.82E-01	2.46E-01
EP	kg PO_4^{3-} eq	3.95E-02	3.42E-02	3.03E-02
POCP	kg C_2H_4 eq	0.0492	0.0449	0.0396
ADPE	kg Sb eq	4.27E-07	3.83E-07	3.44E-07
ADPF	MJ_{NCV}	2620	2350	2020

Table 26. Environmental parameters, Boral Asphalt products, Deer Park (VIC), stages A1-A3, per tonne

Parameter	Unit	BCRA	C320 20Si	C320 20Si 10% RAP
PERE	MJ_{NCV}	1.58E+01	6.73E+00	6.18E+00
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	1.58E+01	6.73E+00	6.18E+00
PENRE	MJ_{NCV}	4.28E+02	2.81E+02	2.59E+02
PENRM	MJ_{NCV}	2.41E+03	2.27E+03	1.93E+03
PENRT	MJ_{NCV}	2.84E+03	2.55E+03	2.19E+03
SM	kg	3.62E+01	0.00E+00	9.00E+01
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.72E+00	1.66E+00	1.49E+00
HW	kg	0.00E+00	0.00E+00	0.00E+00
NHW	kg	9.55E-02	3.56E-02	3.19E-02
RW	kg	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00

BORAL ASPHALT MONTROSE

Table 27. Environmental profiles, Boral Asphalt products, Montrose (VIC), stages A1-A3, per tonne

Indicator	Unit	BCRA	C320 20Si	C320 20Si 10% RAP
GWP	**kg CO_2 eq**	**55.9**	**45.2**	**46.3**
ODP	kg CFC-11 eq	1.94E-05	1.95E-05	2.04E-05
AP	kg SO_2 eq	2.81E-01	2.63E-01	2.70E-01
EP	kg PO_4^{3-} eq	3.70E-02	3.20E-02	3.25E-02
POCP	kg C_2H_4 eq	0.0453	0.0435	0.0446
ADPE	kg Sb eq	4.00E-07	3.94E-07	3.74E-07
ADPF	MJ_{NCV}	2240	2150	2240

Table 28. Environmental parameters, Boral Asphalt products, Montrose (VIC), stages A1-A3, per tonne

Parameter	Unit	BCRA	C320 20Si	C320 20Si 10% RAP
PERE	MJ_{NCV}	1.79E+01	6.38E+00	5.60E+00
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	1.79E+01	6.38E+00	5.60E+00
PENRE	MJ_{NCV}	3.92E+02	2.57E+02	2.59E+02
PENRM	MJ_{NCV}	2.03E+03	2.07E+03	2.17E+03
PENRT	MJ_{NCV}	2.42E+03	2.33E+03	2.43E+03
SM	kg	3.33E+01	0.00E+00	8.64E+01
RSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.95E+00	2.06E+00	1.91E+00
HW	kg	0.00E+00	0.00E+00	0.00E+00
NHW	kg	9.53E-02	3.84E-02	3.72E-02
RW	kg	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00

BORAL ASPHALT WELSHPOOL

Table 29. Environmental profiles, Boral Asphalt products, Welshpool (WA), stages A1-A3, per tonne

Indicator	Unit	BITUPACK	DG14 JM45	DG14 JM50	DG20 JM49
GWP	**kg CO_2 eq**	**11.3**	**58.3**	**74.8**	**58.2**
GWP – fossil	kg CO_2 eq	56.8	58.3	74.8	58.2
GWP – biogenic	kg CO_2 eq	-45.4	0.0255	0.0810	0.0249
GWP – LULUC	kg CO_2 eq	3.02E-03	8.69E-05	1.70E-04	8.68E-05
ODP	kg CFC-11 eq	2.29E-05	2.30E-05	2.35E-05	2.29E-05
AP	kg SO_2 eq	5.79E-01	3.47E-01	4.19E-01	3.45E-01
EP	kg PO_4^{3-} eq	2.29E-01	3.61E-02	4.03E-02	3.56E-02
POCP	kg C_2H_4 eq	0.0639	0.0469	0.0600	0.0467
ADPE	kg Sb eq	7.26E-05	4.80E-07	8.67E-07	4.35E-07
ADPF	MJ_{NCV}	2410	2490	2870	2480

Table 30. Environmental parameters, Boral Asphalt products, Welshpool (WA), stages A1-A3, per tonne

Parameter	Unit	BITUPACK	DG14 JM45	DG14 JM50	DG20 JM49
PERE	MJ_{NCV}	8.57E+00	9.13E+00	1.11E+01	9.01E+00
PERM	MJ_{NCV}	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ_{NCV}	8.57E+00	9.13E+00	1.11E+01	9.01E+00
PENRE	MJ_{NCV}	5.34E+02	4.81E+02	8.42E+02	4.76E+02
PENRM	MJ_{NCV}	2.07E+03	2.22E+03	2.27E+03	2.22E+03
PENRT	MJ_{NCV}	2.61E+03	2.70E+03	3.11E+03	2.69E+03
SM	kg	0.00E+00	0.00E+00	8.37E+01	8.37E+01
RSF	MJ_{NCV}	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
FW	m^3	1.75E+00	1.65E+00	2.38E+00	1.54E+00
HW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHW	kg	4.53E-02	3.53E-02	3.70E-02	3.50E-02
RW	kg	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
MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	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

OTHER ENVIRONMENTAL INFORMATION

WASTE & RECYCLING

All plant waste is processed into RAP stockpiles and re-used in the asphalt production process. Where possible we maximise the amount of RAP used in production which has been profiled from road repair works.

EMISSION MANAGEMENT

All asphalt plants are fitted with carbon filtration systems to filter and manage emissions from the production process. Our asphalt plants have a closed loop system where all the dust particles are collected and added back to the production process.

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:

- 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 low-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 AfPA Australian Flexible Pavement Association. Boral acknowledges the Paris Agreement and supports mechanisms to achieve its objectives, including a national approach to climate and energy policy. Boral Asphalt's major industry associations are:

- Green Building Council of Australia (GBCA)
- Infrastructure Sustainability Council of Australia (ISCA)
- Business Council of Australia
- Cement, Concrete & Aggregates Australia
- Australian flexible Pavement Association

For more information visit boral.com/industry associations

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CONTACT INFORMATION

To view our technical papers and find out more visit:

www.boral.com.au/asphalt