WINSTONE AGGREGATES

Environmental Product Declaration

For Aggregate and Sand Products

In accordance with ISO 14025 and EN 15804+A1 for WINSTONE AGGREGATES

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Geographical scope of EPD:	New Zealand

EPD of construction products may not be comparable if they do not comply with EN 15804.

Contents

General Information

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

The EPD owner has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804.

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CEN standard EN15804 served as the core PCR	
PCR:	PCR 2012:01 Construction Products and Construction Services, Version 2.33, 2020-09-18
PCR review was conducted by:	The Technical Committee of the International EPD® System Chair: Massimo Marino info@environdec.com
Independent verification of the declaration and data, according to ISO 14025:2006	☐ EPD process certification (Internal) ✓ EPD verification (External)
Procedure for follow-up of data during EPD validity involves third-party verifier:	✓ Yes ☐ No

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Introduction to Winstone Aggregates

Winstone Aggregates is a leader in aggregate products and services in Aotearoa. Aggregate and sand from our sites have been used to shape New Zealand towns and cities.

Including iconic projects such as the Auckland Harbour Bridge, Wellington's Westpac Stadium and Auckland's Sky Tower. More recently the Peka Peka to Ōtaki Expressway (PP2Ō), Pūhoi to Warkworth (NX2) and City Edge Alliance, Hamilton.

We have been delivering aggregate and sand to New Zealanders for over a century. Our products contribute to the long-term infrastructure that support our communities. We do this with 11 quarries, 4 clean fill sites, 2 joint ventures, 4 laboratories and a distribution fleet across the country. Winstone Aggregates plays an important part in the growth of 6 regions throughout Aotearoa, providing employment to over 350 people.

We are the trusted aggregates solution partner for the concrete, roading, rail, and other infrastructure industries.

Our Sustainability Pathway

As one of New Zealand's largest aggregate suppliers, Winstone Aggregates is committed to further mitigating the potential adverse environmental impacts of our operations.

At Winstone Aggregates we recognise our role in reducing Greenhouse Gas (GHG) emissions and that integrating sustainability goals into our business operations is essential to delivering sustainable solutions for the construction industry.

Our sustainability framework incorporates the principles of sustainability with a focus on carbon reduction, biodiversity, social and water quality.

Winstone Aggregates is in a strong position to assist the construction industry in reducing its carbon footprint and achieve sustainability goals. Our data feeds into the Firth Industries EC^3 - Embodied Carbon Concrete Calculator. The EC^3 allows Firth to design concrete mixes based upon customers' requirements for strength, durability, and lower carbon footprints.

Winstone Aggregates has now developed carbon footprints of products for our quarries at Belmont, Flat Top, Hunua, Otaika, Otaki, Petone, Pukekawa, Whitehall.

Winstone Aggregates is proud to be the first New Zealand aggregates company to seek an EPD and expects industry peers to follow suit to promote a holistic approach in the construction materials industry.

What is an EPD?

An Environmental Product Declaration (EPD) is an independent, verified, and transparent declaration of the environmental impact of the life cycle of our products.

It is a comprehensive disclosure of our products' environmental impacts. An EPD covers the different stages of a product's life cycle, from creation to disposal.

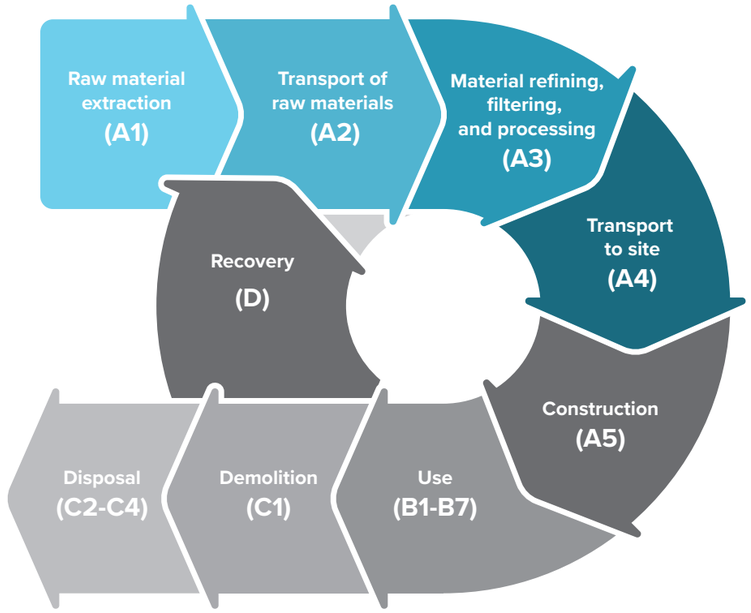
Our EPD quantifies the environmental impact of products through life cycle assessment (LCA), a science based approach. The Winstone Aggregates EPD covers the life cycle stages of raw material extraction (Module A1), internal transport (Module A2), processing (Module A3), and distribution to customer via Winstone Transport (Module A4).

EPD's are an important part of tendering for large infrastructure and building projects in New Zealand. The data in our EPD feeds into the Infrastructure Sustainability Council of Australia (ISC) IS Rating tool and the New Zealand Green Building Council Green Star tool.

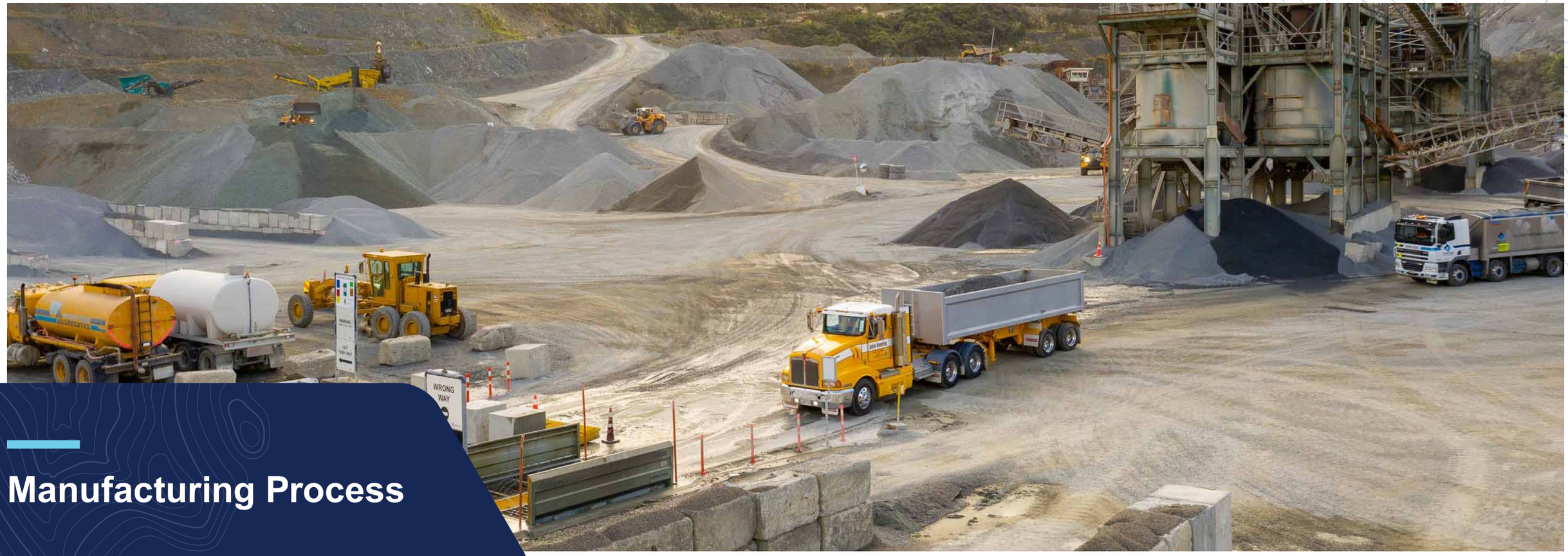
In 2015 the COP21 Paris Agreement marked the ambitious pursuit by all nations to combat climate change and its effects. Here in New Zealand the demand for construction materials continues to grow due to increased urbanisation and population growth.

Environmental impact data from eight sites are quantified using life cycle assessment in compliance with ISO 14044 (ISO, 2006c) by thinkstep-anz, specialist practitioners in generating EPDs, which are independently reviewed by a third-party verifier. EPDs are defined by international standards, relying on objective and scientifically accepted approaches.

The development of a raw aggregates EPD is a first in Aotearoa. Our EPD provides vital information that can support our customers in delivering sustainable solutions. The EPD also offers the opportunity to broaden knowledge and give greater confidence to environmental statements.



Aggregate and Sand Products

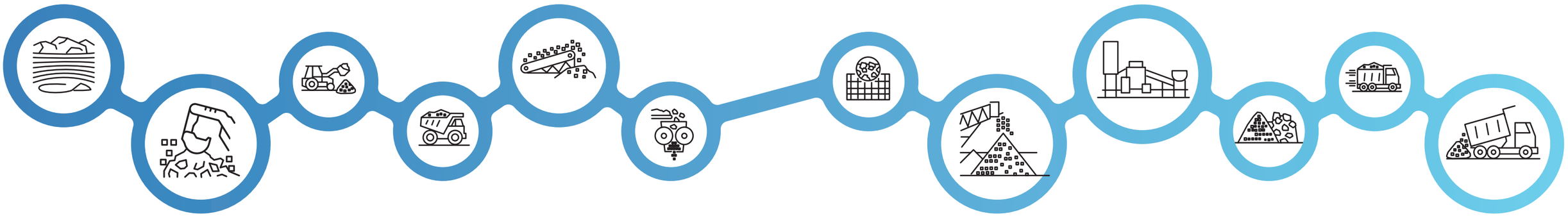


Manufacturing Process

Aggregates include crushed stone, gravel and sand. These are used in the construction of roads, the manufacturing of concrete, concrete products and asphalt. Aggregates are generally quarried from hard rock extraction sites or from alluvial deposits, as in the case of natural sand and gravel.

Quarrying of hard rock sites often starts with blasting material within the extraction zone to loosen rock, the blasted material is then loaded into dump trucks by excavators and carted to the plant for processing.

The extracted materials are then processed by crushing, screening, and washing into final products depending on size and rock quality. The processed aggregates can then be combined with other materials in the manufacturing of concrete or asphalt. Processed rock from the plant is transported to the relevant product stockpile by dump truck, loader or automated belt depending on the site. Different products are then loaded out from the stockpile and into trucks which transport products to customer sites.



Quarry **Load and Cart** **Crushing** **Screening** **Stockpiling and Distribution**

Aggregate and Sand Applications

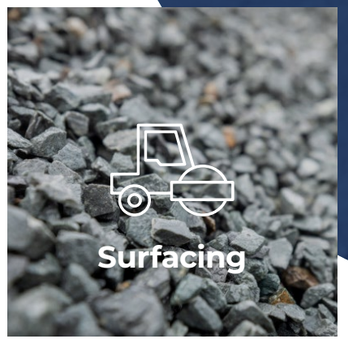
Winstone Aggregates produce aggregate and sand products for a wide range of applications, presented below. Note that products are not grouped by application, but rather, by processing requirements. For more information, see page 13 for product groups, page 14-16 for full product group categorisation, and page 21 for an explanation of processing requirements.

- **Premium All passing 7**
- **Premium All passing 5**
- **Concrete Sand**
- **Concrete Aggregate 14-5/ Graded Chip 14-8**
- **Concrete Aggregate 20-10/ Graded Chip 22-14**

High quality graded rock or sand, generally used in concrete mixes. Products conform to New Zealand aggregate standards and can be tailored to customer requirements

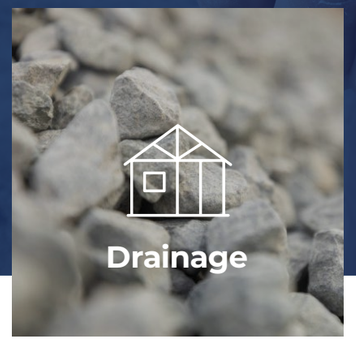
- **Cement Stabilised Basecourse**
- **General All Passing 100**
- **General All Passing 20**
- **General All Passing 25**
- **General All Passing 40**
- **General All Passing 65**
- **Hunua 40**
- **Hunua 65**
- **RM65**
- **TNZ AP 40 M/4**

Sub Basecourse well graded slightly weathered aggregate, generally used in local roads. Production can be tailored to customer requirements.



- **Graded Sealing Chip**
- **Asphalt Aggregate**

High Quality crushed and graded aggregate used in road surfacing. Products either conform to Waka Kotahi standards or are tailored to customer requirements.



- **Drainage 150/40**
- **Drainage 25**
- **Drainage 40**
- **Drainage 40-20**
- **Drainage 65-19**
- **Drainage 65-40**

Drainage material is an optimised blend of aggregates based on shape, size and strength. Drainage material includes a wide range of products already listed.

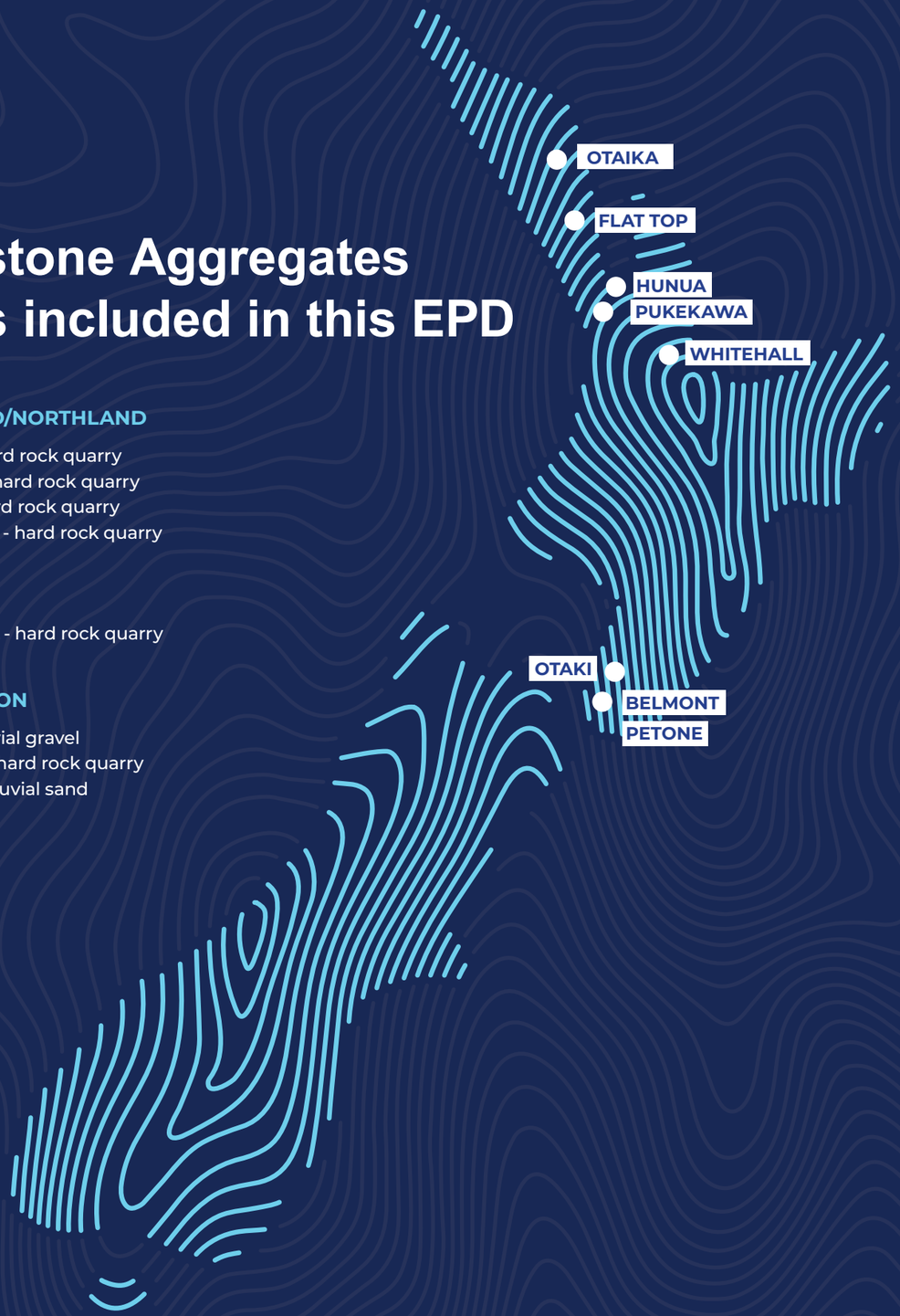
- **Filter Sand**
- **Block Sand**
- **Manufactured Sand**
- **Pumice Overs**
- **No 1 Sand**
- **No 3 Sand**
- **Sand**

High quality natural and manufactured sand aggregates used for a range of applications.

- **Breaker Rock**
- **Brown Rock**
- **Face Rock**
- **Stripping**
- **River Run**

Specialised product tailored to customer requirements.

Winstone Aggregates Sites included in this EPD



AUCKLAND/NORTHLAND

OTAIKA - hard rock quarry
FLAT TOP - hard rock quarry
HUNUA - hard rock quarry
PUKEKAWA - hard rock quarry

WAIKATO

WHITEHALL - hard rock quarry

WELLINGTON

OTAKI - alluvial gravel
BELMONT - hard rock quarry
PETONE - alluvial sand

Product Groups

Product(s) Covered by EPD

This EPD covers aggregate and sand products manufactured by Winstone Aggregates across 3 regions of the North Island, New Zealand. These sites account for approximately 80% of Winstone Aggregates production.

Aggregate and sand products that are used for similar applications can vary significantly in how they are processed.

For this reason, it is not deemed appropriate to group products by application. Instead, product groups are based on processing requirements. Product groups are characterised by crushing, screening, washing, and cement stabilising requirements. A list of each of these product groups is presented in table 1. For more information on grouping can be found in the 'LCA information' section of this document.

Table 1: Summary of established product groups

PRODUCT GROUP	ACRONYM
Aggregate – no processing	**ANP**
Aggregate – primary screening only	**APS**
Aggregate – primary screening and crushing	**APSC**
Aggregate – secondary screening and crushing	**ASSC**
Aggregate – tertiary screening and crushing, unwashed	**ATSC**
Aggregate – tertiary screening and crushing, washed	**ATSCW**
Manufactured sand	**MS**
Natural sand	**NS**
Aggregate – cement stabilised 1.5%	**AC1.5**
Aggregate – cement stabilised 3%	**AC3**
Aggregate – cement stabilised 5%	**AC5**

Full Product List

A full list of products, and their relevant group are presented in table 2.

Table 2: Full product names and product groups

Full product name	Product abbreviated name	Product group
Cyclone Sand	CYCL	Manufactured Sand
Concrete Sand	SANDC	Manufactured Sand
Filter F/2	F2	Natural Sand
Gravel 5mm	GRAVEL	Natural Sand
Pumice Overs	PUMOVERS	Natural Sand
No 1 Sand	SAND1	Natural Sand
No 3 Sand	SAND3	Natural Sand
SAND - 5MM	SAND5MM	Natural Sand
General Purpose Sand	SANDGP	Natural Sand
Rapid Sand	SANDR	Natural Sand
Breaker	BREAKER	Aggregate - No Processing
Brown Rock	BRR	Aggregate - No Processing
Face Metal	FACE	Aggregate - No Processing
Filling	FILL	Aggregate - No Processing
Face Rock	FROCK	Aggregate - No Processing
Gabion 300-400	GAB400	Aggregate - No Processing
Hardfill ex Face	HFF	Aggregate - No Processing
Over Run	OR	Aggregate - No Processing
RipRap	RIPRAP	Aggregate - No Processing
River Run	RR	Aggregate - No Processing
Spalls ex Face	SPF	Aggregate - No Processing
Spalls Selected	SPS	Aggregate - No Processing
Self Selected Rocks 800-500	SPS500	Aggregate - No Processing
Self Selected Rocks >800	SPS800	Aggregate - No Processing
Stripping	STRIP	Aggregate - No Processing
TOPSOIL	TOP	Aggregate - No Processing
Basecourse Domestic 40mm	BCD40	Aggregate - Primary Crushing & Screening
Basecourse Standard 40mm	BCS40	Aggregate - Primary Crushing & Screening
All Passing 100 Crushed Brown	BROWN100	Aggregate - Primary Crushing & Screening
All Passing 65 Crushed Brown	BROWN65	Aggregate - Primary Crushing & Screening
General All Passing 100	GAP100	Aggregate - Primary Crushing & Screening
General All Passing 100 Face	GAP100F	Aggregate - Primary Crushing & Screening
General All Passing 150	GAP150	Aggregate - Primary Crushing & Screening
Road Metal 65mm	RM65	Aggregate - Primary Crushing & Screening
Scalpings	SCALP	Aggregate - Primary Crushing & Screening
TG Metal 65mm	TGM65	Aggregate - Primary Crushing & Screening
TGTopcourse 20mm Standard	TGS20	Aggregate - Primary Crushing & Screening
TGS40mm	TGS40	Aggregate - Primary Crushing & Screening
Topcourse Domestic 20mm	TOP20D	Aggregate - Primary Crushing & Screening
Topcourse 20mm Standard	TOP20S	Aggregate - Primary Crushing & Screening
Scalped 40mm	SCALP40	Aggregate - Primary Screening Only
Scalped 65mm	SCALP65	Aggregate - Primary Screening Only
TGFILL 65mm+	TGFILL65+	Aggregate - Primary Screening Only
Basecourse 40mm R	BC40R	Aggregate - Secondary Crushing & Screening
Bedding Mix	BEDM	Aggregate - Secondary Crushing & Screening
Cribwall Backfill 40-20	CRIB40	Aggregate - Secondary Crushing & Screening
Cribwall Backfill 80-20	CRIB80	Aggregate - Secondary Crushing & Screening
Drainage 150/40	DRAIN15040	Aggregate - Secondary Crushing & Screening
Drainage 25	DRAIN25	Aggregate - Secondary Crushing & Screening
Drainage 40	DRAIN40	Aggregate - Secondary Crushing & Screening
Drainage 40-20	DRAIN4020	Aggregate - Secondary Crushing & Screening
Drainage 65-19	DRAIN65	Aggregate - Secondary Crushing & Screening
Drainage 65-40	DRAIN6540	Aggregate - Secondary Crushing & Screening
Filter B	FILB	Aggregate - Secondary Crushing & Screening
Gabion Stone	GABION	Aggregate - Secondary Crushing & Screening
Gabion 100-250	GABION100	Aggregate - Secondary Crushing & Screening
General All Passing 10	GAP10	Aggregate - Secondary Crushing & Screening
General All Passing 20	GAP20	Aggregate - Secondary Crushing & Screening
General All Passing 25	GAP25	Aggregate - Secondary Crushing & Screening
General All Passing 40	GAP40	Aggregate - Secondary Crushing & Screening
General All Passing 65	GAP65	Aggregate - Secondary Crushing & Screening
Hardfill 150-65	HF150-65	Aggregate - Secondary Crushing & Screening
Local Roads AP40	LR40	Aggregate - Secondary Crushing & Screening
Local Roads AP40 PP	LR40PP	Aggregate - Secondary Crushing & Screening
Local Roads AP65	LR65	Aggregate - Secondary Crushing & Screening
Local Roads AP65 PP	LR65PP	Aggregate - Secondary Crushing & Screening
Main Alignment AP65	PP65	Aggregate - Secondary Crushing & Screening
TGAP65	TGAP65	Aggregate - Secondary Crushing & Screening
WHAP65	WHAP65	Aggregate - Secondary Crushing & Screening
Asphaltic Sand	AS	Aggregate - Tertiary Crushing & Screening, Unwashed
Pap 7 ASP	ASP PAP7	Aggregate - Tertiary Crushing & Screening, Unwashed
Builders Mix 20	BM20	Aggregate - Tertiary Crushing & Screening, Unwashed
Crusher Fines	CRF	Aggregate - Tertiary Crushing & Screening, Unwashed
General All Passing 7	GAP7	Aggregate - Tertiary Crushing & Screening, Unwashed
Premium All Passing 7	PAP7	Aggregate - Tertiary Crushing & Screening, Unwashed
TGAP40	TGAP40	Aggregate - Tertiary Crushing & Screening, Unwashed

Full product name	Product abbreviated name	Product group
TNZ AP 40 M/4	TNZ40	Aggregate - Tertiary Crushing & Screening, Unwashed
Whitehall Topcourse 20 Premium	W20P	Aggregate - Tertiary Crushing & Screening, Unwashed
ASP Grade 4 Sealing Chip	ASP SC4	Aggregate - Tertiary Crushing & Screening, Washed
Bedding Material 10mm	BED10	Aggregate - Tertiary Crushing & Screening, Washed
Bedding Material 20mm	BED20	Aggregate - Tertiary Crushing & Screening, Washed
Bedding Material 7mm	BED7	Aggregate - Tertiary Crushing & Screening, Washed
Builders Mix	BUILD	Aggregate - Tertiary Crushing & Screening, Washed
Concrete Aggregate 14-5	CA145	Aggregate - Tertiary Crushing & Screening, Washed
Concrete Aggregate 14-7	CA147	Aggregate - Tertiary Crushing & Screening, Washed
Concrete Aggregate 20-10	CA20	Aggregate - Tertiary Crushing & Screening, Washed
Concrete Aggregate 20-10R	CA20R	Aggregate - Tertiary Crushing & Screening, Washed
Concrete Aggregate 22-14	CA22	Aggregate - Tertiary Crushing & Screening, Washed
Drainage 15	DRAIN15	Aggregate - Tertiary Crushing & Screening, Washed
Drainage 25-5	DRAIN25/5	Aggregate - Tertiary Crushing & Screening, Washed
Dricon	DRICON	Aggregate - Tertiary Crushing & Screening, Washed
Excelgrit	EXGRIT	Aggregate - Tertiary Crushing & Screening, Washed
Grade 2 Sealing Chip.	GRADE2	Aggregate - Tertiary Crushing & Screening, Washed
Grade 3 Sealing Chip.	GRADE3	Aggregate - Tertiary Crushing & Screening, Washed
Grade 4 Sealing Chip.	GRADE4	Aggregate - Tertiary Crushing & Screening, Washed
Grade 5 Sealing Chip.	GRADE5	Aggregate - Tertiary Crushing & Screening, Washed
Grade 6 Sealing Chip.	GRADE6	Aggregate - Tertiary Crushing & Screening, Washed
Grit 7-4mm	GRIT	Aggregate - Tertiary Crushing & Screening, Washed
Pap Sand	PAPS	Aggregate - Tertiary Crushing & Screening, Washed
Blinding Sand	SANDB	Aggregate - Tertiary Crushing & Screening, Washed
Grade 2 Sealing Chip	SC2	Aggregate - Tertiary Crushing & Screening, Washed
Grade 3 Sealing Chip	SC3	Aggregate - Tertiary Crushing & Screening, Washed
Grade 4 Sealing Chip	SC4	Aggregate - Tertiary Crushing & Screening, Washed
Grade 5 Sealing Chip	SC5	Aggregate - Tertiary Crushing & Screening, Washed
Grade 6 Sealing Chip	SC6	Aggregate - Tertiary Crushing & Screening, Washed
Winstone Permeable BC12mm	WPB12	Aggregate - Tertiary Crushing & Screening, Washed
GAP 40 Cement Stabilised 1.5%	GAP40CS1.5%	Aggregate – 1.5% cement stabilised
TNZ AP 40 M/4 Cement Stabilised 1.5%	TNZ40CS1.5%,	Aggregate – 1.5% cement stabilised
No 3 Sand Cement Treated 1.5%	SAND3CS1.5%	Aggregate – 1.5% cement stabilised
GAP 20 Cement Stabilised 3%	GAP20CS3%	Aggregate – 3% cement stabilised
GAP 40 Cement Stabilised 3%	GAP40CS3%	Aggregate – 3% cement stabilised
GAP 65 Cement Stabilised 3%	GAP65CS3%	Aggregate – 3% cement stabilised
TNZ AP 40 M/4 Cement Stabilised 3%	TNZ40CS3%	Aggregate – 3% cement stabilised
No 3 Sand Cement Treated 3%	SAND3CS3%	Aggregate – 3% cement stabilised
GAP 40 Cement Stabilised 5%	GAP40CS5%	Aggregate – 5% cement stabilised
GAP 65 Cement Stabilised 5%	GAP65CS5%	Aggregate – 5% cement stabilised
TNZ AP 40 M/4 Cement Stabilised 5%	TNZ40CS5%	Aggregate – 5% cement stabilised
No 3 Sand Cement Treated 5%	SAND3CS5%	Aggregate – 5% cement stabilised

Industry Classification

Table 3: Industry classification of products included in the EPD

PRODUCT	CLASSIFICATION	CODE	CATEGORY
Aggregate and sand products	UN CPC Ver.2	15320	Pebbles, gravel, broken, or crushed stone, macadam, granules, chippings, and powder of stone
	ANZSIC 2006	0911	Gravel and Sand Quarrying

Content Declaration

Table 4 provides a declaration of typical material contents in Winstone Aggregates' sand and aggregate products per unit mass. None of the materials identified in the European Chemicals Agency's Candidate List of Substances of Very High Concern are present in products at a concentration greater than 0.1% (ECHA, 2022).

Table 4: Content declaration

MATERIALS	WT%
Aggregate/sand raw material	95-100%
Cement	0-5%

Recycled Materials

No pre-consumer or post-consumer recycled materials are currently used in the declared products.

Packaging

Aggregate and sand products are delivered in bulk, therefore don't require any packaging.

System Boundaries

This EPD is of the 'cradle-to-gate' type with options. The life cycle of a building product is divided into three process modules according to the General Program Instructions (GPI) of the Australasian EPD Programme (EPD Australasia, 2018) and one module for transport during product distribution according to EN 15804.

Other life cycle stages (Modules A5, B1-B7, C1-C4, and D) are dependent on particular scenarios and best modelled at the building level.

Table 5: Modules declared in the scope of the EPD

PRODUCT STAGE			CONSTR. PROCESS STAGE	USE STAGE								END-OF-LIFE STAGE				RECOVERY STAGE
Raw material supply	Transport	Manufacturing	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport	Waste processing	Disposal	Future reuse, recycling or energy recovery potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

(X = declared module; MND = module not declared)

Life Cycle Assessment (LCA) Methodology

Declared Unit

The products covered in this study include 118 variations of regular aggregates, cement stabilised aggregates, and sand products used in a variety of applications across the building and construction industry. The declared unit for each product group is indicated in table 6.

Table 6: Details of LCA

PRODUCT CHARACTERISTICS	
Declared unit	1 tonne of product, delivered to site
Geographical coverage	New Zealand
LCA scope	Cradle to gate with options

This EPD has been produced in conformance with the requirements of the standards listed below:

Product Category Rules 2012:01 v2.33 Construction Products and Construction Services (EPD International, 2019)

European Standard 15804:2012+A1:2013 (CEN, 2013)

ISO 14025 Environmental labels and declarations (ISO, 2006a)

ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines (ISO, 2006c)

Instructions of the Australasian EPD Programme V3.0 (EPD Australasia, 2018)

General Programme Instructions for the International EPD® System v3.01 (EPD International, 2019)

Reference Service Life

The reference service life is not declared because the scope of the study excludes use phase modules, and high variation in service life is expected depending on product application.

Data Sources

Primary data was provided by Winstone Aggregates. Resource use (fuels, electricity, consumables) for material extraction and processing was provided at a quarry site level. Logged fuel use data from tracked trucks was provided for use in distribution calculations. Primary data is representative of the 2019 financial year, from 1st July 2018 through to 30 June 2019.

Where no primary data was available, background data was utilised; primarily used to model the upstream impacts of materials and resources used at quarry sites. Upstream impact of cement was modelled using environmental performance results from the environmental product declaration owned by Winstone Aggregates' cement supplier, Golden Bay Cement (Golden Bay Cement, 2019). All other data in the background system were from the GaBi Life Cycle Inventory Database 2021 (Sphera, 2021). Datasets have a reference year between 2017 and 2020 and all fall within the 10-year limit allowable for generic data under EN 15804 (CEN, 2013). Critical datasets for the study are presented in table 7 below.

Table 7: Critical datasets from Life Cycle Inventory Database 2021

Life cycle component	Sphera dataset	Geographical acronym
Diesel production	Diesel mix at refinery	AU
Diesel burning	Diesel combustion in construction machine	AU
Electricity grid supply	Electricity grid mix 1kV-60kV	NZ
Explosives (production and detonation)	Explosives (ANFO)	EU28

Explanation of Average/ Representative Products and Variation

Product groups that are representative of products with similar processing paths have been established. Fine aggregates tend to require more filtering and crushing to achieve a consistent product compared to larger aggregate products. Product groups are therefore characterised by the number of 'passes' made through crushers and screens. Some refined aggregate products, along with sand, requires washing to remove loose clay, which has been accounted for. Cement stabilised products require an extra processing step where cement is mixed with aggregate to enhance material durability. Table 8 presents information on processing for each product group established as part of the study.

Table 8: Characterising processing for product categories

PRODUCT GROUP	ACRONYM	SCREENING PASSES	CRUSHING PASSES	WASHING (YES/NO)	CEMENT STABILISING (YES/NO)
Aggregate – no processing	ANP	0	0	No	No
Aggregate – primary screening only	APS	1	0	No	No
Aggregate – primary screening and crushing	APSC	1	1	No	No
Aggregate – secondary screening and crushing	ASSC	2	2	No	No
Aggregate – tertiary screening and crushing, unwashed	ATSC	3+	3+	No	No
Aggregate – tertiary screening and crushing, washed	ATSCW	3+	3+	Yes	No
Manufactured sand	MS	1	0	Yes	No
Natural sand	NS	1	0	Yes	No
Aggregate – cement stabilised 1.5%	AC1.5	3+	3+	Yes	Yes
Aggregate – cement stabilised 3%	AC3	3+	3+	Yes	Yes
Aggregate – cement stabilised 5%	AC5	3+	3+	Yes	Yes

Product category results are presented as regional averages for Northland and Auckland (combined region), Waikato, and Wellington. These averages are weighted based on the annual mass output of products within each product category for each of the sites within each region.

Variation in global warming potential (GWP100) of Module A1-A3 for sites within each region and for each product group where variation exceeds the 10% variation threshold is presented in table 9.

Table 9: GWP100 regional site variations (Module A1-A3) from product groups in excess of 10%

Region	ANP	APS	APSC	ASSC	ATSC	ATSCW	NS
Auckland/Northland	22%	17%	12%	52%	13%	42%	22%

Cut off Criteria

Environmental impacts relating to personnel, infrastructure, and production equipment not directly consumed in the process are excluded from the system boundary as per the PCR (EPD International, 2019). Consumable parts replaced during equipment maintenance was excluded as preliminary calculations found that the associated flows contribute to less than 1% of mass and energy flows, as per PCR (EPD International, 2019). All other reported data were incorporated and modelled using the best available life cycle inventory data.

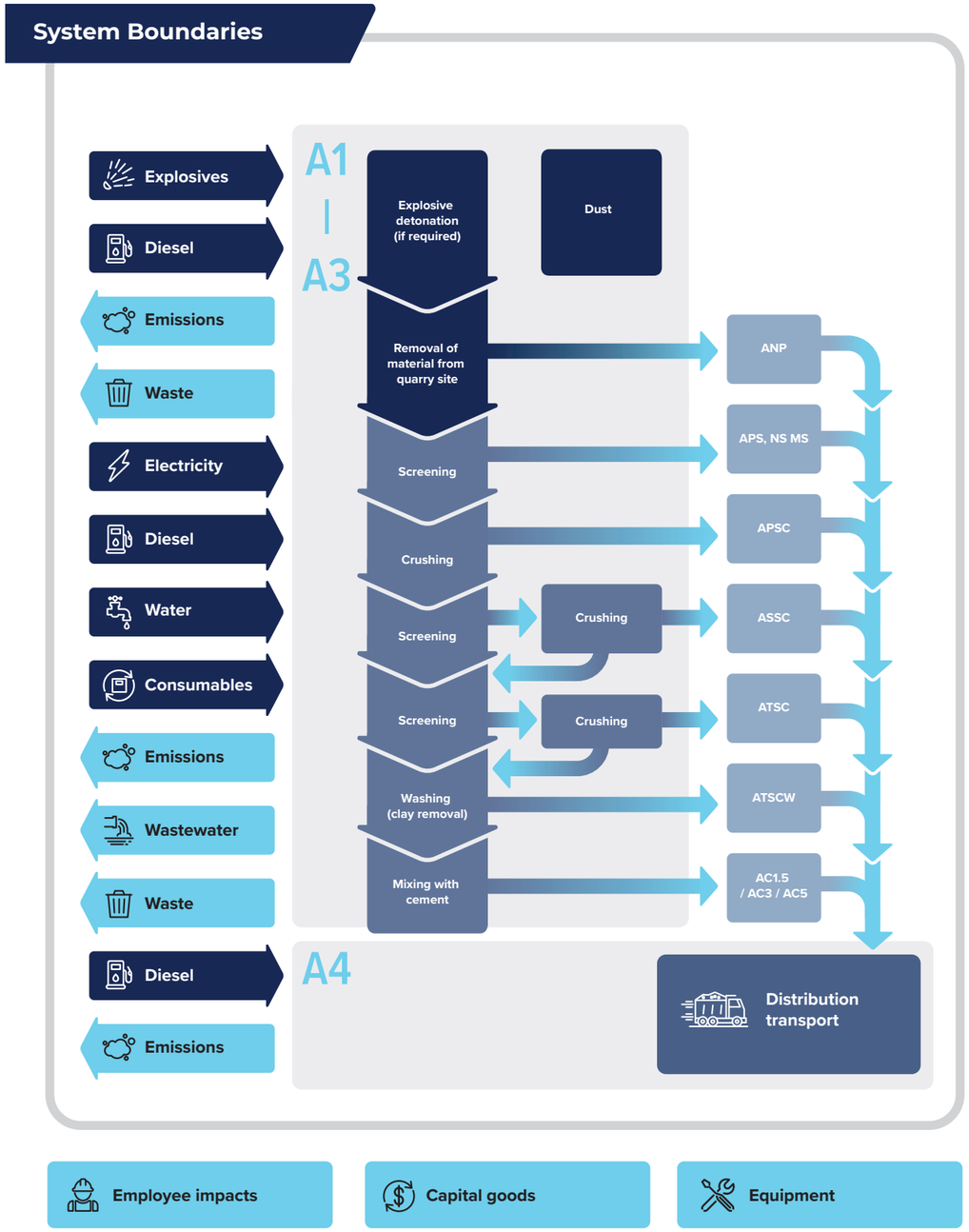
Allocation

Allocation of flows used in post extraction processing at the quarry site level is tailored to represent the degree of processing for each product category. The allocation of flows at a given quarry is scaled by the production mass output and passes during production as a proportion of the total output. An assumption is made that screening uses 25% of resources of a pass through a crusher. This assumption has been verified via scenario analysis to have negligible influence on results.

All electricity use is assumed to be used for processing at all quarries. Some equipment used for processing are diesel fuelled, which varies at each quarry. The proportion of bulk diesel consumed during extraction, and for processing, was divided using economic allocation of annual spend on diesel between processing and extraction equipment, taken from Winston Aggregate's equipment accounting system.

System Diagram

The processes included in scope of the LCA study are presented below:



Assumptions and Limitations

Key modelling assumptions used in the life cycle assessment of this EPD are detailed in table 10 below so that the results can be interpreted correctly.

Table 10: Key modelling assumptions

ASSUMPTION/LIMITATION	INFLUENCE ON RESULTS (LOW/ MEDIUM/ HIGH)	DISCUSSION
Energy use per unit mass between the same type of equipment (i.e., crushers or screens) is assumed to be the same for all different sizes and age of equipment.	Low	Equipment that is designed for larger production quantities may be slightly more efficient per unit mass than smaller models. Similarly, newer pieces of equipment may be more efficient than older models due to technological advances. Given the large scope of the assessment, it was not viable to investigate these differences.
Screening uses 25% of resources of a pass through a crusher.	Low	A scenario analysis was carried out in the background report for this document that investigated the influence of this assumption. The analysis found that for a 100% change in that percentage used, the maximum change across all environmental impact indicators, product groups and regions was 3.4%.
The allocation of diesel to raw material extraction and to processing is calculated using the annual spend on diesel per piece of equipment, taken from Winstone Aggregates' resource accounting system. Equipment is then categorised as being used for either extraction or processing to find the proportion of diesel spend between each stage for each site.	Low	Some discrepancies may exist in the accounting data due to logging errors, although these are not expected to influence the total annual spend per piece of equipment significantly.

Assessment Indicators

An introduction to each environmental impact indicator is provided in table 11 below. The best-known effect of each indicator is listed.

Table 11: Environmental impact indicators descriptions

Impact Indictor	Description	Unit	Reference
Global Warming Potential (GWP100)	A measure of greenhouse gas emissions, such as CO2 and methane. These emissions are causing an increase in the absorption of radiation emitted by the earth, increasing the natural greenhouse effect. This may in turn have adverse impacts on ecosystem health, human health and material welfare.	kg CO_2 equivalent	(IPCC, 2013)
Abiotic Resource Depletion (ADP elements, ADP fossil)	The consumption of non-renewable resources leads to a decrease in the future availability of the functions supplied by these resources. Depletion of mineral resources and non-renewable energy resources are reported separately. Depletion of mineral resources is assessed based on ultimate reserves.	kg Sb equivalent, MJ (net calorific value)	(van Oers, de Koning, Guinée, & Huppes, 2002)
Eutrophication Potential	Eutrophication covers all potential impacts of excessively high levels of macronutrients, the most important of which nitrogen (N) and phosphorus (P). Nutrient enrichment may cause an undesirable shift in species composition and elevated biomass production in both aquatic and terrestrial ecosystems. In aquatic ecosystems increased biomass production may lead to depressed oxygen levels, because of the additional consumption of oxygen in biomass decomposition.	kg PO_4^{3-} equivalent	(Guinée, et al., 2002)

Impact Indictor	Description	Unit	Reference
Acidification Potential	A measure of emissions that cause acidifying effects to the environment. The acidification potential is a measure of a molecule's capacity to increase the hydrogen ion (H+) concentration in the presence of water, thus decreasing the pH value. Potential effects include fish mortality, forest decline and the deterioration of building materials.	kg SO_2 equivalent	(Guinée, et al., 2002)
Photochemical Ozone Creation Potential (POCP)	A measure of emissions of precursors that contribute to ground level smog formation (mainly ozone O3), produced by the reaction of VOC and carbon monoxide in the presence of nitrogen oxides under the influence of UV light. Ground level ozone may be injurious to human health and ecosystems and may also damage crops.	kg C_2H_2 equivalent	(Guinée, et al., 2002)
Ozone Depletion Potential (ODP)	A measure of air emissions that contribute to the depletion of the stratospheric ozone layer. Depletion of the ozone leads to higher levels of UVB ultraviolet rays reaching the earth's surface with detrimental effects on humans and plants.	kg CFC 11 equivalent	(Guinée, et al., 2002)

The results tables describe the different environmental indicators for each product per declared unit. The first section of each table contains the environmental impact indicators, describing the potential environmental impacts of the product as shown in table 12. The second section shows the resource indicators, describing the use of renewable and non-renewable material resources, renewable and non- renewable primary energy and water, as shown in table 13. The final section of each table displays the waste and other outputs, as shown in table 14.

Table 12: Indicators for life cycle impact assessment

Abbreviation	Unit	Indicator
GWP	kg CO_2 eq.	Global warming potential
ODP	kg CFC 11 eq.	Ozone depletion potential
AP	kg SO_2 eq.	Acidification potential
EP	kg PO_4^{3-} eq.	Eutrophication potential
POCP	kg C_2H_2 eq.	Photochemical ozone creation potential
ADPE	kg Sb eq.	Abiotic depletion potential for non-fossil resources
ADPF	MJ	Abiotic depletion potential for fossil resources

Table 13: Life cycle inventory indicators on use of resources

Abbreviation	Unit	Indicator
PERE	MJ, net calorific value	Use of renewable primary energy excluding renewable primary energy resources used as raw materials
PERM	MJ, net calorific value	Use of renewable primary energy resources used as raw materials
PERT	MJ, net calorific value	Total use of renewable primary energy resources
PENRE	MJ, net calorific value	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials
PENRM	MJ, net calorific value	Use of non-renewable primary energy resources used as raw materials
PENRT	MJ, net calorific value	Total use of non-renewable primary energy resources
SM	kg	Use of secondary material;
RSF	MJ, net calorific value	Use of renewable secondary fuels
NRSF	MJ, net calorific value	Use of non-renewable secondary fuels
FWT	m^3	Total use of net fresh water

Table 14: Life cycle inventory indicators on waste categories and output flows

Abbreviation	Unit	Indicator
HWD	kg	Hazardous waste disposed
NHWD	kg	Non-hazardous waste disposed
RWD	kg	Radioactive waste disposed
CRU	kg	Components for reuse
MER	kg	Materials for energy recovery
MFR	kg	Materials for recycling
EEE	MJ	Exported electrical energy
EET	MJ	Exported thermal energy

Environmental Performance

Auckland/ Northland – non-stabilised products – Module A1-A3

Indicator	Unit	ANP	APS	APSC	ASSC	ATSC	ATSCW	NS	MS
Environmental impacts									
GWP	kg CO_2 eq.	3.31	3.24	3.61	4.12	3.65	3.59	3.00	3.57
ODP	kg CFC 11 eq.	2.34E-15	2.19E-15	2.94E-15	2.86E-15	3.87E-15	3.89E-15	1.44E-15	3.20E-15
AP	kg SO_2 eq.	0.0245	0.0240	0.0265	0.0303	0.0254	0.0250	0.0223	0.0262
EP	kg PO_4^{3-} eq.	0.00625	0.00611	0.00677	0.00770	0.00643	0.00636	0.00566	0.00670
POCP	kg C_2H_2 eq.	0.00248	0.00245	0.00267	0.00310	0.00258	0.00253	0.00233	0.00260
ADPE	kg Sb eq.	8.26E-08	8.12E-08	9.86E-08	1.09E-07	1.36E-07	1.33E-07	6.72E-08	1.00E-07
ADPF	MJ	44.5	43.7	48.5	55.5	48.8	48.0	40.7	47.7
Resource use									
PERE	MJ	0.694	1.53	2.30	4.28	14.6	13.5	1.71	1.49
PERM	MJ								
PERT	MJ	0.694	1.53	2.30	4.28	14.6	13.5	1.71	1.49
PENRE	MJ	44.8	44.0	48.9	55.9	49.2	48.4	40.9	48.2
PENRM	MJ	0	0	0	0	0	0	0	0
PENRT	MJ	44.8	44.0	48.9	55.9	49.2	48.4	40.9	48.2
SM	kg	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0
FW	m^3	0.0108	0.0136	0.0117	0.0180	0.0483	0.986	0.960	0.595
Waste categories and output flows									
HWD	kg	1.48E-09	1.36E-09	1.87E-09	1.74E-09	2.34E-09	2.38E-09	8.12E-10	2.08E-09
NHWD	kg	0.00621	0.00602	0.00698	0.00688	0.00810	0.00813	0.00503	0.00732
RWD	kg	1.31E-04	1.13E-04	1.58E-04	1.29E-04	1.15E-04	1.27E-04	5.81E-05	1.85E-04
CRU	kg	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	0	0
MER	kg	0	0	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0	0	0

Waikato – non-stabilised products – Module A1-A3

Indicator	Unit	ANP	APSC	ASSC	ATSC	ATSCW	MS
Environmental impact							
GWP	kg CO_2 eq.	4.37	4.50	4.68	4.92	4.92	4.39
ODP	kg CFC 11 eq.	1.87E-15	2.44E-15	3.02E-15	3.60E-15	3.60E-15	1.98E-15
AP	kg SO_2 eq.	0.0329	0.0333	0.0341	0.0353	0.0353	0.0330
EP	kg PO_4^{3-} eq.	0.00835	0.00844	0.00864	0.00893	0.00893	0.00836
POCP	kg C_2H_2 eq.	0.00344	0.00348	0.00356	0.00368	0.00368	0.00344
ADPE	kg Sb eq.	9.10E-08	1.10E-07	1.29E-07	1.49E-07	1.49E-07	9.47E-08
ADPF	MJ	59.3	60.9	63.3	66.3	66.3	59.6
Resource use							
PERE	MJ	0.582	5.05	9.54	14.0	14.0	1.48
PERM	MJ	0	0	0	0	0	0
PERT	MJ	0.582	5.05	9.54	14.0	14.0	1.48
PENRE	MJ	59.6	61.2	63.6	66.6	66.6	59.9
PENRM	MJ	0	0	0	0	0	0
PENRT	MJ	59.6	61.2	63.6	66.6	66.6	59.9
SM	kg	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0
FW	m^3	0.00909	0.0204	0.0317	0.0429	0.587	0.556
Waste categories and output flows							
HWD	kg	1.05E-09	1.39E-09	1.73E-09	2.07E-09	2.07E-09	1.12E-09
NHWD	kg	0.00428	0.00498	0.00571	0.00644	0.00644	0.00442
RWD	kg	8.61E-05	8.66E-05	8.71E-05	8.77E-05	8.77E-05	8.62E-05
CRU	kg	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0
MER	kg	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0

Wellington - non-stabilised products – Module A1-A3

Indicator	Unit	ANP	APS	APSC	ASSC	ATSC	ATSCW	NS	MS
Environmental impact									
GWP	kg CO_2 eq.	4.79	4.87	4.94	4.85	5.11	5.05	4.75	4.85
ODP	kg CFC 11 eq.	1.06E-15	1.35E-15	1.76E-15	1.54E-15	2.74E-15	2.49E-15	1.04E-15	1.28E-15
AP	kg SO_2 eq.	0.0363	0.0367	0.0368	0.0360	0.0371	0.0368	0.0357	0.0366
EP	kg PO_4^{3-} eq.	0.00917	0.00928	0.00931	0.00909	0.00936	0.00929	0.00902	0.00924
POCP	kg C_2H_2 eq.	0.00387	0.00390	0.00392	0.00386	0.00394	0.00392	0.00384	0.00389
ADPE	kg Sb eq.	8.52E-08	9.21E-08	1.05E-07	1.03E-07	1.37E-07	1.30E-07	8.82E-08	9.06E-08
ADPF	MJ	65.4	66.4	67.3	66.1	69.4	68.7	64.9	66.1
Resource use									
PERE	MJ	0.364	1.24	4.52	5.80	12.4	11.3	2.45	1.17
PERM	MJ	0	0	0	0	0	0	0	0
PERT	MJ	0.364	1.24	4.52	5.80	12.4	11.3	2.45	1.17
PENRE	MJ	65.6	66.5	67.5	66.2	69.6	68.8	65.0	66.3
PENRM	MJ	0	0	0	0	0	0	0	0
PENRT	MJ	65.6	66.5	67.5	66.2	69.6	68.8	65.0	66.3
SM	kg	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0
FW	m^3	0.00841	0.00804	0.0163	0.0251	0.0367	0.588	0.643	0.514
Waste categories and output flows									
HWD	kg	4.24E-10	6.16E-10	8.62E-10	6.80E-10	1.44E-09	1.27E-09	3.75E-10	5.67E-10
NHWD	kg	0.00548	0.00584	0.00636	0.00606	0.00757	0.00725	0.00543	0.00575
RWD	kg	2.28E-05	3.54E-05	3.58E-05	8.61E-06	3.50E-05	2.73E-05	2.85E-06	3.11E-05
CRU	kg	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	0	0
MER	kg	0	0	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0	0	0

Auckland/ Northland – cement stabilised products – Module A1-A3

Abb.	Unit	AC1.5	AC3	AC5
Environmental impacts				
GWP	kg CO_2 eq.	14.8	25.9	40.7
ODP	kg CFC 11 eq.	8.39E-14	1.63E-13	2.69E-13
AP	kg SO_2 eq.	0.0373	0.0495	0.0656
EP	kg PO_4^{3-} eq.	0.00949	0.0125	0.0166
POCP	kg C_2H_2 eq.	0.00353	0.00452	0.00583
ADPE	kg Sb eq.	2.93E-07	4.43E-07	6.44E-07
ADPF	MJ	93.7	138	198
Resource use				
PERE	MJ	34.4	55.2	82.8
PERM	MJ	0	0	0
PERT	MJ	23.9	34.2	47.9
PENRE	MJ	137	224	341
PENRM	MJ	0	0	0
PENRT	MJ	94.1	139	198
SM	kg	135	271	451
RSF	MJ	10.7	21.4	35.7
NRSF	MJ	0	0	0
FW	m^3	1.00	1.02	1.04
Waste categories and output flows				
HWD	kg	2.13E-08	4.00E-08	6.50E-08
NHWD	kg	0.276	0.274	0.271
RWD	kg	1.49E-04	1.54E-04	1.61E-04
CRU	kg	4.07E-04	8.13E-04	0.00136
MFR	kg	0	0	0
MER	kg	0	0	0
EEE	MJ	0	0	0
EET	MJ	0	0	0

Distribution – All Products and Regions – Module A4

Results for distribution is presented in table 15. These results represent indicator results based on the average fuel consumed per trip nationwide, equivalent to a 47km two-way trip.

Table 15: Environmental impact results for Module A4 - all regions and product groups

Abb.	Unit	AC1.5
Environmental impacts		
GWP	kg CO_2 eq.	3.38
ODP	kg CFC 11 eq.	6.70E-16
AP	kg SO_2 eq.	0.00313
EP	kg PO_4^{3-} eq.	5.31E-04
POCP	kg C_2H_2 eq.	-5.32E-05
ADPE	kg Sb eq.	5.28E-08
ADPF	MJ	45.2
Resource use		
PERE	MJ	0.221
PERM	MJ	0
PERT	MJ	0.221
PENRE	MJ	45.3
PENRM	MJ	0
PENRT	MJ	45.3
SM	kg	0
RSF	MJ	0
NRSF	MJ	0
FW	m^3	4.39E-04
Waste categories and output flows		
HWD	kg	1.63E-10
NHWD	kg	0.00108
RWD	kg	6.24E-06
CRU	kg	0
MFR	kg	0
MER	kg	0
EEE	MJ	0
EET	MJ	0

The results presented in table 15 are encouraged to be scaled by the EPD user to fit to the actual distance travelled in each specific application. An exemplar calculation for a 100-kilometre quarry-to-site is provided below, intended for inclusion in the EPD document itself. This calculation process can be applied to estimate the environmental performance of any impact category included in the study.

GWP calculation for distribution of 1 tonne of product for 100km (quarry-to-site):
Transport by truck: 47km (default) = Read from table 15 = 3.38 kg CO_2 eq.
Transport by truck: 100km = 3.38 x 100/47 = **7.19 kg CO_2 eq.**

References

CEN. (2013). *EN 15804:2012+A1:2013, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.* Brussels: European Committee for Standardization.

ECHA (2022). *Candidate List of Substances of Very High Concern for Authorisation.* Helsinki: European Chemicals Agency.

EPD Australasia. (2018). *Instructions of the Australasian EPD Programme v3.0.* www.epd-australasia.com.

EPD International. (2019). *General Programme Instructions for the International EPD(r) System. Version 3.01, dated 2019-09-18.* www.environdec.com.

EPD International. (2020). *PCR 2012:01 Construction products and construction services, version 2.33.* EPD International.

Golden Bay Cement. (2019). *Environmental Product Declaration: Eversure GP cement and Everfast HE cement.*

Guinée, J. B., Gorrée, M., Heijungs, R., Huppes, G., Kleijn, R., de Koning, A., . . . Huijbregts, M. (2002). *Handbook on life cycle assessment. Operational guide to the ISO standards.* Dordrecht: Kluwer.

IPCC. (2013). *Climate Change 2013: The Physical Science Basis.* Geneva, Switzerland: IPCC.

ISO. (2006a). *ISO 14025: Environmental labels and declarations — Type III environmental declarations — Principles and procedures.* Geneva: International Organization for Standardization.

ISO. (2006b). *ISO 14040: Environmental management – Life cycle assessment – Principles and framework.* Geneva: International Organization for Standardization.

ISO. (2006c). *ISO 14044: Environmental management – Life cycle assessment – Requirements and guidelines.* Geneva: International Organization for Standardization.

Sphera. (2021). *GaBi LCA Database Documentation.* Retrieved from GaBi Life Cycle Inventory Database Documentation: https://gabi.sphera.com/international/support/gabi/gabi-database-2021-lci-documentation/

van Oers, L., de Koning, A., Guinée, J. B., & Huppes, G. (2002). *Abiotic resource depletion in LCA*. The Hague: Ministry of Transport, Public Works and Water Management.

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