



Statement of Verification

BREG EN EPD No: 000832

Issue: 01

This is to verify that the Environmental Product Declaration provided by:

Thompson Quarries

are in accordance with the requirements of:

EN 15804:2012+A2:2019

and

BRE Global Scheme Document SD207

This declaration is for:

1 tonne of quarried stone.

Company Address

William Thompson & Son (Dumbarton) Ltd
Sheephill Quarry
Off A82 Dunglass Roundabout
Milton
Dumbarton
G60 5BP



Signed for BRE Global Limited

Hayley Thomson

Operator

24 July 2026

Date of this Issue

24 July 2026

Date of First Issue

23 July 2031

Expiry Date



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Environmental Product Declaration

EPD Number: 000832

General Information

EPD Programme Operator	Applicable Product Category Rules
BRE Global Watford, Herts WD25 9XX United Kingdom	BRE Environmental Profiles 2025 Product Category Rules for Type III environmental product declaration of construction products to EN 15804+A2 PN 514 Rev 3.2
Commissioner of LCA study	LCA consultant/Tool
William Thompson & Son (Dumbarton) Ltd Birch Road Dumbarton G82 2RN SCOTLAND	LCA Consultant: EcoReview LCA tool: Ecochain
Declared Unit	Applicability/Coverage
1 tonne of quarried stone	Product Specific
EPD Type	Background database
Cradle to Gate with options	Ecoinvent (version 3.11)
Demonstration of Verification	
CEN standard EN 15804 serves as the core PCR ^a	
Independent verification of the declaration and data according to EN ISO 14025:2010 ☐ Internal ☒ External	
(Where appropriate ^b) Third party verifier: Kim Allbury	
a: Product category rules b: Optional for business-to-business communication; mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4)	
Comparability	
Environmental product declarations from different programmes may not be comparable if not compliant with EN 15804:2012+A2:2019. Comparability is further dependent on the specific product category rules, system boundaries and allocations, and background data sources. See Clause 5.3 of EN 15804:2012+A2:2019 for further guidance	

Information modules covered

Product			Construction		Use stage							End-of-life				Benefits and loads beyond the system boundary
					Related to the building fabric					Related to the building						
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw materials supply	Transport	Manufacturing	Transport to site	Construction – Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, Recovery and/or Recycling potential
☒	☒	☒	☒	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒

Note: Ticks indicate the Information Modules declared.

Manufacturing site(s)

William Thompson & Son (Dumbarton) Ltd
Sheephill Quarry
Off A82 Dunglass Roundabout
Milton
Dumbarton
G60 5BP

Construction Product:

Product Description

Thompson Quarries (operated by William Thompson & Son) is a long-established quarry and aggregate supplier in Scotland, known for its focus on quality, sustainability, and service reliability. Based at the Sheephill quarry and landfill site near Glasgow, the company has supplied natural stone, sand, gravel, recycled aggregates and ready mixed concrete to the construction and civil engineering sectors for over 70 years. This EPD represents a typical 1000 kg of quarry aggregate and related products from Thompson Quarries, covering all key stages from extraction and processing to delivery.

The aggregate consists predominantly of andesitic basalt, which is a volcanic rock composed mainly of plagioclase feldspar (andesine–oligoclase) with minor chlorite and opaque minerals. The particles are angular with a holocrystalline, porphyritic texture, and the material shows low alkali–silica reactivity potential.

These materials are used across a range of applications, including road construction, concrete production, landscaping, drainage systems, and foundations, with a commitment to environmentally responsible practices through recycling and waste management.

The product designations of the four aggregate types produced at this site are:

1. Rock Armour and Non-Crushed Rock
2. Bulk Fill, 6F and Crusher Run
3. Sub-Base and Structural Fill
4. Graded Aggregates

The detailed specific product names of the four main product types are given in the table below:



Aggregate type designation	Specific aggregate name	Aggregate type designation	Specific aggregate name
Rock Armour and Non-Crushed Rock	Class 6A Class-1C Rock Armour Rock Armour 1.5-2T Rock Armour 2m x 2m Rock Armour 300-500mm Rock Armour 300-600mm Rock Armour 400-200mm Rock Armour 400-600mm Rock Armour 500-600mm Rock Armour 500-900mm Rock Armour 750-1000mm Rock Armour 900-1100mm Rock Armour 900-1200mm	Sub-Base and Structural Fill	Class 6N Type 1 Type 1 X Reduced Fines Type 2 Type 3
Bulk Fill, 6F and Crusher Run	100mm Crusher/Run 125mm Crusher Run 150mm Crusher/Run 6F5 75mm Crusher Run Class 1A	Graded Aggregates	100-200mm Clean 100-50mm-Clean 10-5mm Clean 14-5mm Clean 14mm-Dust 20-10mm Clean Whinstone 20-5mm Clean Drainfill 20-5mm Clean Drainfill Added Dust 20-5mm Con Agg 20-Dust 40-20mm Clean 40-5mm-clean 4x2" Cleanstone 63-10mm Clean 75-40mm Clean 8X4" Clean Class 6G Gabion Class-6I Modified 6B 225-125mm Type 3 No Fines Type A Type B Whin Dust

Technical Information

The technical data in the table below applies to all four aggregate types produced at the production site. The aggregate types are:

1. Rock Armour and Non-Crushed Rock
2. Bulk Fill, 6F and Crusher Run
3. Sub-Base and Structural Fill
4. Graded Aggregates

Property	Value, Unit
Micro-Deval coefficient (MDE)	10%
Los Angeles coefficient (LA)	15%
Water absorption	1.20%
Particle density (oven dried)	2.56 Mg/m ³
Particle density (SSD)	2.60 Mg/m ³
Particle density (apparent)	2.65 Mg/m ³
Water soluble sulfate (SO ₃)	0.001 % SO ₃
Water soluble sulfate (SO ₄)	0.001 % SO ₄
Acid soluble sulfate (SO ₃)	<0.1 %
Water soluble chloride content	<0.001 %
Drying shrinkage	0.04%
Magnesium sulfate soundness	4%

For more information, please contact the William Thompson & Son (Dumbarton) Ltd or visit:

[Quarry & Landfill Services | William Thompson & Son](#)

Dumbarton Quarry



Main Product Contents

Material/Chemical Input	%
Natural stone	100

Manufacturing Process

Rock Blasting and Excavation

The production process at Thompson Aggregates begins with controlled drilling and blasting at the quarry face to fragment the in-situ rock. Following blasting, excavators and loading shovels segregate material according to size and quality. From this, large dimension stone and armour stone products are selected. These include specialist materials such as:

- Class 6A / Class 1C
- Rock Armour

Material not selected for armour stone production is directed to the primary crushing stage for further processing.

The product type exiting the production process after this stage is the **Rock Armour and Non-Crushed Rock**



Rock Armour and Non-Crushed Rock

Primary Crushing

Blasted rock is fed into the primary crusher for initial size reduction. This stage produces large graded sub-base and crusher-run materials, which are screened and stockpiled separately. Products produced at this stage include:

- 150mm-75 mm Crusher Run
- 6F5
- Class 1A

The product type exiting the production process after this stage is the **Bulk Fill, 6F and Crusher Run**



Bulk Fill, 6F and Crusher Run

Secondary Crushing

Material requiring tighter grading is transferred to the secondary crushing plant, where it undergoes further size reduction. Screening ensures compliance with specification standards, and products are stockpiled individually. Products from this stage include:

- Type 1, Type 2, Type 3
- Class 6N

The product type exiting the production process after this stage is the **Sub-Base and Structural Fill**



Sub-Base and Structural Fill

Sort Classification (Final Screening and Grading)

Specialist products such as clean graded aggregates and single-sized materials go through a final stage consisting of screening, washing (where required), and precise classification. Products from this stage include:

- Clean graded stone
- Single sizes
- Clean Whinstone
- Clean Drainfill
- Cleanstone variants
- Concrete Aggregate
- Whin Dust and 14mm Dust
- 20-Dust
- Class 6I
- Gabion stone (Class 6G)
- Modified 6B (225–125mm)
- Type A and Type B

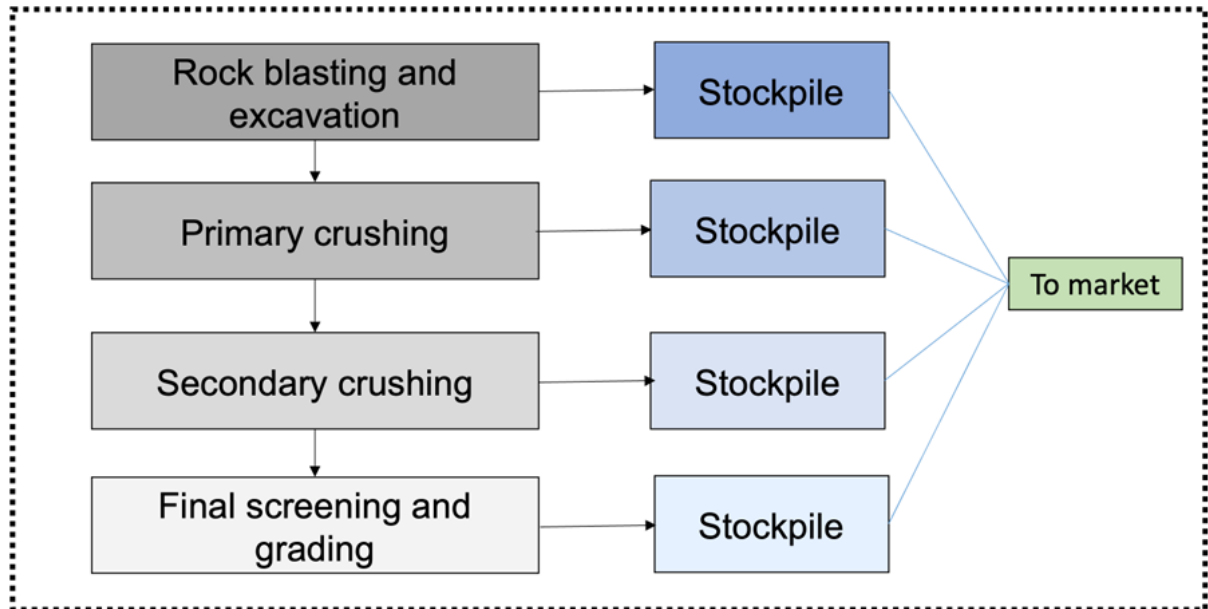
The product type exiting the production process after this stage is the **Graded Aggregates**



Graded Aggregates

Each product is stored in designated stock bays to prevent cross-contamination and is loaded directly into customer vehicles.

Process flow diagram



End of Life and Benefits/Loads Beyond the System Boundary

In the **Demolition and Deconstruction Phase C1** it is assumed that very little energy is required for re-excavation. Similarly in the bound application (such as concrete), it is assumed that the energy required for this process is negligible compared to the energy required for demolishing the structure, therefore, no data is included for this module.

In the **Transport Phase C2**, it is assumed that crushed material travels 31 miles to the point of processing for recycling or landfill.

in the **Processing Phase, C3**, it is assumed that 95% of the material is recycled. Based on prior data for aggregate recycling, it is estimated that diesel consumption for recycled aggregate is 0.55 litres of diesel per tonne of recycled aggregate.

In the **Disposal Phase, C4**, it is assumed that 5% of the material is landfilled.

In the **Benefit Beyond the System Boundary Phase, D**, a benefit arises from the use of the aggregates recovered by the recycling process in end-of-life stage. This is modelled in the LCA calculations as a negative 0.95 tonnes of 'market for crushed gravel', RoW



Life Cycle Assessment Calculation Rules

Declared unit description

1 tonne of quarried stone

System boundary

This cradle-to-gate with options EPD has been assessed in accordance with the modular approach as defined in EN15804:2012+A2:2019 and BRE 2025 Product Category Rules (PN 514 Rev 3.1) which includes the processes covered in the manufacturing site i.e., product stage A1 to A3, transport to site A4 end of life stages C1-C4 and Module D.

Data sources, quality and allocation

Time Representativeness

In this LCA the data relating to the manufacturing of the aggregates, and the data relating to the background processes for environmental impacts are recent (<2 years). Time Representativeness is considered to be Very good.

Geographical Representativeness

The processes used in the production of the aggregates are geographically representative, insofar as the production location of the aggregates lies within the region for which the relevant Ecoinvent (version 3.11) environmental records have been selected. Geographical Representativeness is considered to be Very good.

Technical Representativeness

Processes and energies used in the process have been modelled exactly as described by Thompson Quarries and are based directly on the production data supplied by Thompsons, in relation to processes, fuels used, and without any significant need for improvement. Technical Representativeness is considered to be Very good.

Allocation:

The source of default unit processes or activities is the Ecoinvent database version 3.11, system model "Allocation, cut-off by classification". The measurement of environmental impacts in this EPD uses the LCIA methodologies recommended for PEF 3.1. In this EPD, the waste processes are allocated in the relevant module. In the case of the use of secondary materials or energy recovered from secondary fuels, the system boundary between the system under study and the previous system (providing the secondary materials) is set where outputs of the previous system, e.g. materials, products, building elements or energy, reach the end-of-waste state. The modularity and the polluter payer principles have been followed.

Cut-off criteria

All relevant inputs and outputs - like emissions, energy and materials - have been taken into account in this LCA, and in accordance with EN15804+A2:2019. The study covers at least 95% of the materials and energy per module and at least 99% of the total use of materials and energy of each unit process. Long term emissions have been excluded from the study.



LCA Results for Rock Armour and Non-Crushed Rock

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO ₂ eq	kg CO ₂ eq	kg CO ₂ eq	kg CO ₂ eq	kg CFC11 eq	mol H ⁺ eq	kg (PO ₄) ³⁻ eq
Product stage	Raw material supply	A1	1.98E+00	2.00E+00	-2.25E-02	2.32E-03	1.49E-08	1.07E-02	5.09E-05
	Transport	A2	1.05E-02	1.05E-02	8.13E-06	4.83E-06	2.29E-10	2.17E-05	8.30E-08
	Manufacturing	A3	1.87E-01	1.87E-01	3.78E-05	1.91E-05	2.77E-09	1.67E-03	6.53E-07
	Total	A1-3	2.18E+00	2.20E+00	-2.25E-02	2.35E-03	1.79E-08	1.24E-02	5.16E-05
Construction process stage	Transport	A4	1.11E+00	1.11E+00	1.02E-03	5.47E-04	2.41E-08	2.42E-03	9.01E-06
	Construction	A5	MND	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	9.25E+00	9.24E+00	8.46E-03	4.56E-03	2.01E-07	2.02E-02	7.50E-05
	Waste processing	C3	3.62E+00	3.62E+00	7.34E-04	3.71E-04	5.38E-08	3.24E-02	1.27E-05
	Disposal	C4	5.90E-01	5.86E-01	3.73E-03	4.26E-04	1.38E-08	4.17E-03	8.42E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.75E+01	-1.75E+01	-3.77E-02	-1.37E-02	-1.87E-07	-1.10E-01	-4.73E-04

GWP-total = Global warming potential, total;
 GWP-fossil = Global warming potential, fossil;
 GWP-biogenic = Global warming potential, biogenic;
 GWP-luluc = Global warming potential, land use and land use change;

ODP = Depletion potential of the stratospheric ozone layer;
 AP = Acidification potential, accumulated exceedance; and
 EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment

LCA Results for Rock Armour and Non-Crushed Rock (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			EP-marine	EP-terrestrial	POCP	ADP-mineral&metals	ADP-fossil	WDP	PM
			kg N eq	mol N eq	kg NMVOC eq	kg Sb eq	MJ, net calorific value	m ³ world eq deprived	disease incidence
Product stage	Raw material supply	A1	1.66E-03	2.84E-02	5.51E-03	1.64E-05	1.71E+01	1.09E+00	1.16E-07
	Transport	A2	5.26E-06	5.46E-05	3.39E-05	3.37E-08	1.48E-01	5.64E-04	6.55E-10
	Manufacturing	A3	7.76E-04	8.50E-03	2.54E-03	6.66E-08	2.41E+00	6.83E-03	4.76E-08
	Total	A1-3	2.44E-03	3.69E-02	8.09E-03	1.65E-05	1.97E+01	1.10E+00	1.65E-07
Construction process stage	Transport	A4	5.97E-04	6.21E-03	3.76E-03	3.62E-06	1.57E+01	6.52E-02	8.23E-08
	Construction	A5	MND	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	4.97E-03	5.18E-02	3.13E-02	3.02E-05	1.31E+02	5.43E-01	6.86E-07
	Waste processing	C3	1.51E-02	1.65E-01	4.94E-02	1.29E-06	4.69E+01	1.32E-01	9.24E-07
	Disposal	C4	1.54E-03	1.67E-02	5.64E-03	1.19E-06	1.27E+01	5.38E-01	8.94E-08
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-3.00E-02	-3.52E-01	-1.08E-01	-8.84E-05	-2.28E+02	-1.49E+01	-1.66E-06

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
 EP-terrestrial = Eutrophication potential, accumulated exceedance;
 POCP = Formation potential of tropospheric ozone;
 ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;

ADP-fossil = Depletion potential of the stratospheric ozone layer;
 WDP = Water (user) deprivation potential, deprivation-weighted water consumption; and
 PM = Particulate matter.

LCA Results for Rock Armour and Non-Crushed Rock (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U ²³⁵ eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	1.31E-02	6.42E+00	6.66E-10	1.68E-08	INA
	Transport	A2	8.71E-05	7.51E-02	4.36E-12	9.79E-11	INA
	Manufacturing	A3	4.04E-04	1.32E-01	1.88E-11	2.99E-10	INA
	Total	A1-3	1.36E-02	6.63E+00	6.90E-10	1.72E-08	INA
Construction process stage	Transport	A4	7.98E-03	7.78E+00	5.05E-10	1.12E-08	INA
	Construction	A5	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	INA
	Transport	C2	6.65E-02	6.49E+01	4.21E-09	9.31E-08	INA
	Waste processing	C3	7.84E-03	2.56E+00	3.65E-10	5.79E-09	INA
	Disposal	C4	6.57E-03	5.56E+00	3.27E-10	3.67E-09	INA
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-4.02E-01	-4.92E+01	-6.16E-09	-1.46E-07	INA

IRP = Potential human exposure efficiency relative to U235;
ETP-fw = Potential comparative toxic unit for ecosystems;
HTP-c = Potential comparative toxic unit for humans;

HTP-nc = Potential comparative toxic unit for humans; and
SQP = Potential soil quality index.

LCA Results for Rock Armour and Non-Crushed Rock (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing resource use, primary energy			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	1.52E+00	0.00E+00	1.52E+00	1.84E+01	0.00E+00	1.84E+01
	Transport	A2	2.59E-03	0.00E+00	2.59E-03	1.57E-01	0.00E+00	1.57E-01
	Manufacturing	A3	1.53E-02	0.00E+00	1.53E-02	2.57E+00	0.00E+00	2.57E+00
	Total	A1-3	1.54E+00	0.00E+00	1.54E+00	2.12E+01	0.00E+00	2.12E+01
Construction process stage	Transport	A4	2.47E-01	0.00E+00	2.47E-01	1.67E+01	0.00E+00	1.67E+01
	Construction	A5	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	2.06E+00	0.00E+00	2.06E+00	1.39E+02	0.00E+00	1.39E+02
	Waste processing	C3	2.97E-01	0.00E+00	2.97E-01	4.98E+01	0.00E+00	4.98E+01
	Disposal	C4	2.18E-01	0.00E+00	2.18E-01	1.35E+01	0.00E+00	1.35E+01
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.38E+01	0.00E+00	-1.38E+01	-2.43E+02	0.00E+00	-2.43E+02

PERE = Use of renewable primary energy excluding renewable primary energy used as raw materials;
 PERM = Use of renewable primary energy resources used as raw materials;
 PERT = Total use of renewable primary energy resources;

PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
 PENRM = Use of non-renewable primary energy resources used as raw materials;
 PENRT = Total use of non-renewable primary energy resource

LCA Results for Rock Armour and Non-Crushed Rock (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing resource use, secondary materials and fuels, use of water						
			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m ³
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	2.81E-02
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	2.03E-05
	Manufacturing	A3	0.00E+00	0.00E+00	0.00E+00	2.10E-04
	Total	A1-3	0.00E+00	0.00E+00	0.00E+00	2.84E-02
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	2.11E-03
	Construction	A5	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	1.76E-02
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	4.07E-03
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	1.28E-02
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	-3.65E-01

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;

NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water

LCA Results for Rock Armour and Non-Crushed Rock (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	1.24E-04	1.42E-01	8.22E-06
	Transport	A2	9.42E-07	6.12E-03	5.88E-08
	Manufacturing	A3	1.69E-05	1.64E-03	2.54E-07
	Total	A1-3	1.41E-04	1.50E-01	8.53E-06
Construction process stage	Transport	A4	1.00E-04	7.82E-01	5.18E-06
	Construction	A5	MND	MND	MND
Use stage	Use	B1	MND	MND	MND
	Maintenance	B2	MND	MND	MND
	Repair	B3	MND	MND	MND
	Replacement	B4	MND	MND	MND
	Refurbishment	B5	MND	MND	MND
	Operational energy use	B6	MND	MND	MND
	Operational water use	B7	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	8.35E-04	6.52E+00	4.31E-05
	Waste processing	C3	3.28E-04	3.18E-02	4.94E-06
	Disposal	C4	6.31E-05	5.01E+01	4.03E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.73E-03	-6.84E+00	-2.61E-04

HWD = Hazardous waste disposed;
 NHWD = Non-hazardous waste disposed;
 RWD = Radioactive waste disposed

LCA Results for Rock Armour and Non-Crushed Rock (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing output flows – at end of life								
			CRU	MFR	MER	EE	Biogenic carbon (product)	Biogenic carbon (packaging)
			kg	kg	kg	MJ per energy carrier	kg C	kg C
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Manufacturing	A3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total	A1-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Construction	A5	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CRU = Components for reuse;
MFR = Materials for recycling

MER = Materials for energy recovery;
EE = Exported Energy



LCA Results for Bulk Fill, 6F and Crusher Run

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO ₂ eq	kg CO ₂ eq	kg CO ₂ eq	kg CO ₂ eq	kg CFC11 eq	mol H ⁺ eq	kg (PO ₄) ³⁻ eq
Product stage	Raw material supply	A1	1.98E+00	2.00E+00	-2.25E-02	2.32E-03	1.49E-08	1.07E-02	5.09E-05
	Transport	A2	1.05E-02	1.05E-02	8.13E-06	4.83E-06	2.29E-10	2.17E-05	8.30E-08
	Manufacturing	A3	1.22E+00	1.22E+00	2.46E-04	1.24E-04	1.81E-08	1.09E-02	4.25E-06
	Total	A1-3	3.21E+00	3.23E+00	-2.22E-02	2.45E-03	3.31E-08	2.16E-02	5.52E-05
Construction process stage	Transport	A4	3.15E+00	3.14E+00	2.88E-03	1.55E-03	6.84E-08	6.87E-03	2.55E-05
	Construction	A5	MND	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	9.25E+00	9.24E+00	8.46E-03	4.56E-03	2.01E-07	2.02E-02	7.50E-05
	Waste processing	C3	3.62E+00	3.62E+00	7.34E-04	3.71E-04	5.38E-08	3.24E-02	1.27E-05
	Disposal	C4	5.90E-01	5.86E-01	3.73E-03	4.26E-04	1.38E-08	4.17E-03	8.42E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.75E+01	-1.75E+01	-3.77E-02	-1.37E-02	-1.87E-07	-1.10E-01	-4.73E-04

GWP-total = Global warming potential, total;
 GWP-fossil = Global warming potential, fossil;
 GWP-biogenic = Global warming potential, biogenic;
 GWP-luluc = Global warming potential, land use and land use change;

ODP = Depletion potential of the stratospheric ozone layer;
 AP = Acidification potential, accumulated exceedance; and
 EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment

LCA Results for Bulk Fill, 6F and Crusher Run (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			EP-marine	EP-terrestrial	POCP	ADP-mineral&metals	ADP-fossil	WDP	PM
			kg N eq	mol N eq	kg NMVOC eq	kg Sb eq	MJ, net calorific value	m ³ world eq deprived	disease incidence
Product stage	Raw material supply	A1	1.66E-03	2.84E-02	5.51E-03	1.64E-05	1.71E+01	1.09E+00	1.16E-07
	Transport	A2	5.26E-06	5.46E-05	3.39E-05	3.37E-08	1.48E-01	5.64E-04	6.55E-10
	Manufacturing	A3	5.05E-03	5.54E-02	1.66E-02	4.34E-07	1.57E+01	4.44E-02	3.10E-07
	Total	A1-3	6.71E-03	8.38E-02	2.21E-02	1.68E-05	3.30E+01	1.13E+00	4.27E-07
Construction process stage	Transport	A4	1.69E-03	1.76E-02	1.07E-02	1.03E-05	4.46E+01	1.85E-01	2.33E-07
	Construction	A5	MND	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	4.97E-03	5.18E-02	3.13E-02	3.02E-05	1.31E+02	5.43E-01	6.86E-07
	Waste processing	C3	1.51E-02	1.65E-01	4.94E-02	1.29E-06	4.69E+01	1.32E-01	9.24E-07
	Disposal	C4	1.54E-03	1.67E-02	5.64E-03	1.19E-06	1.27E+01	5.38E-01	8.94E-08
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-3.00E-02	-3.52E-01	-1.08E-01	-8.84E-05	2.28E+02	-1.49E+01	-1.66E-06

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
 EP-terrestrial = Eutrophication potential, accumulated exceedance;
 POCP = Formation potential of tropospheric ozone;
 ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;

ADP-fossil = Depletion potential of the stratospheric ozone layer;
 WDP = Water (user) deprivation potential, deprivation-weighted water consumption; and
 PM = Particulate matter.

LCA Results for Bulk Fill, 6F and Crusher Run (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U ²³⁵ eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	1.31E-02	6.42E+00	6.66E-10	1.68E-08	INA
	Transport	A2	8.71E-05	7.51E-02	4.36E-12	9.79E-11	INA
	Manufacturing	A3	2.63E-03	8.58E-01	1.23E-10	1.94E-09	INA
	Total	A1-3	1.58E-02	7.35E+00	7.93E-10	1.88E-08	INA
Construction process stage	Transport	A4	2.26E-02	2.21E+01	1.43E-09	3.17E-08	INA
	Construction	A5	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	INA
	Transport	C2	6.65E-02	6.49E+01	4.21E-09	9.31E-08	INA
	Waste processing	C3	7.84E-03	2.56E+00	3.65E-10	5.79E-09	INA
	Disposal	C4	6.57E-03	5.56E+00	3.27E-10	3.67E-09	INA
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-4.02E-01	-4.92E+01	-6.16E-09	-1.46E-07	INA

IRP = Potential human exposure efficiency relative to U235;
ETP-fw = Potential comparative toxic unit for ecosystems;
HTP-c = Potential comparative toxic unit for humans;

HTP-nc = Potential comparative toxic unit for humans; and
SQP = Potential soil quality index.

LCA Results for Bulk Fill, 6F and Crusher Run (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing resource use, primary energy			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	1.52E+00	0.00E+00	1.52E+00	1.84E+01	0.00E+00	1.84E+01
	Transport	A2	2.59E-03	0.00E+00	2.59E-03	1.57E-01	0.00E+00	1.57E-01
	Manufacturing	A3	9.96E-02	0.00E+00	9.96E-02	1.67E+01	0.00E+00	1.67E+01
	Total	A1-3	1.62E+00	0.00E+00	1.62E+00	3.53E+01	0.00E+00	3.53E+01
Construction process stage	Transport	A4	7.01E-01	0.00E+00	7.01E-01	4.74E+01	0.00E+00	4.74E+01
	Construction	A5	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	2.06E+00	0.00E+00	2.06E+00	1.39E+02	0.00E+00	1.39E+02
	Waste processing	C3	2.97E-01	0.00E+00	2.97E-01	4.98E+01	0.00E+00	4.98E+01
	Disposal	C4	2.18E-01	0.00E+00	2.18E-01	1.35E+01	0.00E+00	1.35E+01
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.38E+01	0.00E+00	-1.38E+01	-2.43E+02	0.00E+00	-2.43E+02

PERE = Use of renewable primary energy excluding renewable primary energy used as raw materials;
 PERM = Use of renewable primary energy resources used as raw materials;
 PERT = Total use of renewable primary energy resources;

PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
 PENRM = Use of non-renewable primary energy resources used as raw materials;
 PENRT = Total use of non-renewable primary energy resource

LCA Results for Bulk Fill, 6F and Crusher Run (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing resource use, secondary materials and fuels, use of water						
			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m ³
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	2.81E-02
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	2.03E-05
	Manufacturing	A3	0.00E+00	0.00E+00	0.00E+00	1.36E-03
	Total	A1-3	0.00E+00	0.00E+00	0.00E+00	2.95E-02
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	5.99E-03
	Construction	A5	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	1.76E-02
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	4.07E-03
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	1.28E-02
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	-3.65E-01

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;

NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water

LCA Results for Bulk Fill, 6F and Crusher Run (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	1.24E-04	1.42E-01	8.22E-06
	Transport	A2	9.42E-07	6.12E-03	5.88E-08
	Manufacturing	A3	1.10E-04	1.07E-02	1.66E-06
	Total	A1-3	2.35E-04	1.59E-01	9.94E-06
Construction process stage	Transport	A4	2.84E-04	2.22E+00	1.47E-05
	Construction	A5	MND	MND	MND
Use stage	Use	B1	MND	MND	MND
	Maintenance	B2	MND	MND	MND
	Repair	B3	MND	MND	MND
	Replacement	B4	MND	MND	MND
	Refurbishment	B5	MND	MND	MND
	Operational energy use	B6	MND	MND	MND
	Operational water use	B7	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	8.35E-04	6.52E+00	4.31E-05
	Waste processing	C3	3.28E-04	3.18E-02	4.94E-06
	Disposal	C4	6.31E-05	5.01E+01	4.03E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.73E-03	-6.84E+00	-2.61E-04

HWD = Hazardous waste disposed;
 NHWD = Non-hazardous waste disposed;
 RWD = Radioactive waste disposed

LCA Results for Bulk Fill, 6F and Crusher Run (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing output flows – at end of life								
			CRU	MFR	MER	EE	Biogenic carbon (product)	Biogenic carbon (packaging)
			kg	kg	kg	MJ per energy carrier	kg C	kg C
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Manufacturing	A3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total	A1-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Construction	A5	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CRU = Components for reuse;
MFR = Materials for recycling

MER = Materials for energy recovery;
EE = Exported Energy

LCA Results for Sub-Base and Structural Fill

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO ₂ eq	kg CO ₂ eq	kg CO ₂ eq	kg CO ₂ eq	kg CFC11 eq	mol H ⁺ eq	kg (PO ₄) ³⁻ eq
Product stage	Raw material supply	A1	1.98E+00	2.00E+00	-2.25E-02	2.32E-03	1.49E-08	1.07E-02	5.09E-05
	Transport	A2	1.05E-02	1.05E-02	8.13E-06	4.83E-06	2.29E-10	2.17E-05	8.30E-08
	Manufacturing	A3	4.03E+00	4.03E+00	8.15E-04	4.12E-04	5.98E-08	3.60E-02	1.41E-05
	Total	A1-3	6.02E+00	6.04E+00	-2.17E-02	2.74E-03	7.49E-08	4.68E-02	6.51E-05
Construction process stage	Transport	A4	2.59E+00	2.59E+00	2.37E-03	1.28E-03	5.63E-08	5.65E-03	2.10E-05
	Construction	A5	MND	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	9.25E+00	9.24E+00	8.46E-03	4.56E-03	2.01E-07	2.02E-02	7.50E-05
	Waste processing	C3	3.62E+00	3.62E+00	7.34E-04	3.71E-04	5.38E-08	3.24E-02	1.27E-05
	Disposal	C4	5.90E-01	5.86E-01	3.73E-03	4.26E-04	1.38E-08	4.17E-03	8.42E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.75E+01	-1.75E+01	-3.77E-02	-1.37E-02	-1.87E-07	-1.10E-01	-4.73E-04

GWP-total = Global warming potential, total;
 GWP-fossil = Global warming potential, fossil;
 GWP-biogenic = Global warming potential, biogenic;
 GWP-luluc = Global warming potential, land use and land use change;

ODP = Depletion potential of the stratospheric ozone layer;
 AP = Acidification potential, accumulated exceedance; and
 EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment

LCA Results for Sub-Base and Structural Fill (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			EP-marine	EP-terrestrial	POCP	ADP-mineral&metals	ADP-fossil	WDP	PM
			kg N eq	mol N eq	kg NMVOC eq	kg Sb eq	MJ, net calorific value	m ³ world eq deprived	disease incidence
Product stage	Raw material supply	A1	1.66E-03	2.84E-02	5.51E-03	1.64E-05	1.71E+01	1.09E+00	1.16E-07
	Transport	A2	5.26E-06	5.46E-05	3.39E-05	3.37E-08	1.48E-01	5.64E-04	6.55E-10
	Manufacturing	A3	1.67E-02	1.83E-01	5.49E-02	1.44E-06	5.21E+01	1.47E-01	1.03E-06
	Total	A1-3	1.84E-02	2.12E-01	6.04E-02	1.78E-05	6.93E+01	1.24E+00	1.14E-06
Construction process stage	Transport	A4	1.39E-03	1.45E-02	8.78E-03	8.46E-06	3.67E+01	1.52E-01	1.92E-07
	Construction	A5	MND	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	4.97E-03	5.18E-02	3.13E-02	3.02E-05	1.31E+02	5.43E-01	6.86E-07
	Waste processing	C3	1.51E-02	1.65E-01	4.94E-02	1.29E-06	4.69E+01	1.32E-01	9.24E-07
	Disposal	C4	1.54E-03	1.67E-02	5.64E-03	1.19E-06	1.27E+01	5.38E-01	8.94E-08
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-3.00E-02	-3.52E-01	-1.08E-01	-8.84E-05	2.28E+02	-1.49E+01	-1.66E-06

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
 EP-terrestrial = Eutrophication potential, accumulated exceedance;
 POCP = Formation potential of tropospheric ozone;
 ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;

ADP-fossil = Depletion potential of the stratospheric ozone layer;
 WDP = Water (user) deprivation potential, deprivation-weighted water consumption; and
 PM = Particulate matter.

LCA Results for Sub-Base and Structural Fill (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U ²³⁵ eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	1.31E-02	6.42E+00	6.66E-10	1.68E-08	INA
	Transport	A2	8.71E-05	7.51E-02	4.36E-12	9.79E-11	INA
	Manufacturing	A3	8.72E-03	2.84E+00	4.06E-10	6.44E-09	INA
	Total	A1-3	2.19E-02	9.34E+00	1.08E-09	2.33E-08	INA
Construction process stage	Transport	A4	1.86E-02	1.82E+01	1.18E-09	2.61E-08	INA
	Construction	A5	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	INA
	Transport	C2	6.65E-02	6.49E+01	4.21E-09	9.31E-08	INA
	Waste processing	C3	7.84E-03	2.56E+00	3.65E-10	5.79E-09	INA
	Disposal	C4	6.57E-03	5.56E+00	3.27E-10	3.67E-09	INA
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-4.02E-01	-4.92E+01	-6.16E-09	-1.46E-07	INA

IRP = Potential human exposure efficiency relative to U235;
ETP-fw = Potential comparative toxic unit for ecosystems;
HTP-c = Potential comparative toxic unit for humans;

HTP-nc = Potential comparative toxic unit for humans; and
SQP = Potential soil quality index.

LCA Results for Sub-Base and Structural Fill (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing resource use, primary energy			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	1.52E+00	0.00E+00	1.52E+00	1.84E+01	0.00E+00	1.84E+01
	Transport	A2	2.59E-03	0.00E+00	2.59E-03	1.57E-01	0.00E+00	1.57E-01
	Manufacturing	A3	3.30E-01	0.00E+00	3.30E-01	5.54E+01	0.00E+00	5.54E+01
	Total	A1-3	1.85E+00	0.00E+00	1.85E+00	7.40E+01	0.00E+00	7.40E+01
Construction process stage	Transport	A4	5.77E-01	0.00E+00	5.77E-01	3.91E+01	0.00E+00	3.91E+01
	Construction	A5	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	2.06E+00	0.00E+00	2.06E+00	1.39E+02	0.00E+00	1.39E+02
	Waste processing	C3	2.97E-01	0.00E+00	2.97E-01	4.98E+01	0.00E+00	4.98E+01
	Disposal	C4	2.18E-01	0.00E+00	2.18E-01	1.35E+01	0.00E+00	1.35E+01
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.38E+01	0.00E+00	-1.38E+01	-2.43E+02	0.00E+00	-2.43E+02

PERE = Use of renewable primary energy excluding renewable primary energy used as raw materials;
 PERM = Use of renewable primary energy resources used as raw materials;
 PERT = Total use of renewable primary energy resources;

PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
 PENRM = Use of non-renewable primary energy resources used as raw materials;
 PENRT = Total use of non-renewable primary energy resource

LCA Results for Sub-Base and Structural Fill (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing resource use, secondary materials and fuels, use of water						
			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m ³
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	2.81E-02
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	2.03E-05
	Manufacturing	A3	0.00E+00	0.00E+00	0.00E+00	4.52E-03
	Total	A1-3	0.00E+00	0.00E+00	0.00E+00	3.27E-02
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	4.93E-03
	Construction	A5	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	1.76E-02
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	4.07E-03
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	1.28E-02
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	-3.65E-01

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;

NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water

LCA Results for Sub-Base and Structural Fill (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	1.24E-04	1.42E-01	8.22E-06
	Transport	A2	9.42E-07	6.12E-03	5.88E-08
	Manufacturing	A3	3.65E-04	3.54E-02	5.49E-06
	Total	A1-3	4.90E-04	1.84E-01	1.38E-05
Construction process stage	Transport	A4	2.34E-04	1.83E+00	1.21E-05
	Construction	A5	MND	MND	MND
Use stage	Use	B1	MND	MND	MND
	Maintenance	B2	MND	MND	MND
	Repair	B3	MND	MND	MND
	Replacement	B4	MND	MND	MND
	Refurbishment	B5	MND	MND	MND
	Operational energy use	B6	MND	MND	MND
	Operational water use	B7	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	8.35E-04	6.52E+00	4.31E-05
	Waste processing	C3	3.28E-04	3.18E-02	4.94E-06
	Disposal	C4	6.31E-05	5.01E+01	4.03E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.73E-03	-6.84E+00	-2.61E-04

HWD = Hazardous waste disposed;
 NHWD = Non-hazardous waste disposed;
 RWD = Radioactive waste disposed

LCA Results for Sub-Base and Structural Fill (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing output flows – at end of life								
			CRU	MFR	MER	EE	Biogenic carbon (product)	Biogenic carbon (packaging)
			kg	kg	kg	MJ per energy carrier	kg C	kg C
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Manufacturing	A3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total	A1-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Construction	A5	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CRU = Components for reuse;
MFR = Materials for recycling

MER = Materials for energy recovery;
EE = Exported Energy

LCA Results for Graded Aggregates

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO ₂ eq	kg CO ₂ eq	kg CO ₂ eq	kg CO ₂ eq	kg CFC11 eq	mol H ⁺ eq	kg (PO ₄) ³⁻ eq
Product stage	Raw material supply	A1	1.98E+00	2.00E+00	-2.25E-02	2.32E-03	1.49E-08	1.07E-02	5.09E-05
	Transport	A2	1.05E-02	1.05E-02	8.13E-06	4.83E-06	2.29E-10	2.17E-05	8.30E-08
	Manufacturing	A3	8.32E+00	8.32E+00	1.68E-03	8.51E-04	1.24E-07	7.43E-02	2.91E-05
	Total	A1-3	1.03E+01	1.03E+01	-2.08E-02	3.18E-03	1.39E-07	8.51E-02	8.01E-05
Construction process stage	Transport	A4	3.70E+00	3.70E+00	3.39E-03	1.82E-03	8.04E-08	8.08E-03	3.00E-05
	Construction	A5	MND	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	9.25E+00	9.24E+00	8.46E-03	4.56E-03	2.01E-07	2.02E-02	7.50E-05
	Waste processing	C3	3.62E+00	3.62E+00	7.34E-04	3.71E-04	5.38E-08	3.24E-02	1.27E-05
	Disposal	C4	5.90E-01	5.86E-01	3.73E-03	4.26E-04	1.38E-08	4.17E-03	8.42E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.75E+01	-1.75E+01	-3.77E-02	-1.37E-02	-1.87E-07	-1.10E-01	-4.73E-04

GWP-total = Global warming potential, total;
 GWP-fossil = Global warming potential, fossil;
 GWP-biogenic = Global warming potential, biogenic;
 GWP-luluc = Global warming potential, land use and land use change;

ODP = Depletion potential of the stratospheric ozone layer;
 AP = Acidification potential, accumulated exceedance; and
 EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment

LCA Results for Graded Aggregates (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			EP-marine	EP-terrestrial	POCP	ADP-mineral&metals	ADP-fossil	WDP	PM
			kg N eq	mol N eq	kg NMVOC eq	kg Sb eq	MJ, net calorific value	m ³ world eq deprived	disease incidence
Product stage	Raw material supply	A1	1.66E-03	2.84E-02	5.51E-03	1.64E-05	1.71E+01	1.09E+00	1.16E-07
	Transport	A2	5.26E-06	5.46E-05	3.39E-05	3.37E-08	1.48E-01	5.64E-04	6.55E-10
	Manufacturing	A3	3.46E-02	3.79E-01	1.13E-01	2.97E-06	1.08E+02	3.04E-01	2.12E-06
	Total	A1-3	3.62E-02	4.07E-01	1.19E-01	1.94E-05	1.25E+02	1.39E+00	2.24E-06
Construction process stage	Transport	A4	1.99E-03	2.07E-02	1.25E-02	1.21E-05	5.25E+01	2.17E-01	2.74E-07
	Construction	A5	MND	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	4.97E-03	5.18E-02	3.13E-02	3.02E-05	1.31E+02	5.43E-01	6.86E-07
	Waste processing	C3	1.51E-02	1.65E-01	4.94E-02	1.29E-06	4.69E+01	1.32E-01	9.24E-07
	Disposal	C4	1.54E-03	1.67E-02	5.64E-03	1.19E-06	1.27E+01	5.38E-01	8.94E-08
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-3.00E-02	-3.52E-01	-1.08E-01	-8.84E-05	2.28E+02	-1.49E+01	-1.66E-06

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
 EP-terrestrial = Eutrophication potential, accumulated exceedance;
 POCP = Formation potential of tropospheric ozone;
 ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;

ADP-fossil = Depletion potential of the stratospheric ozone layer;
 WDP = Water (user) deprivation potential, deprivation-weighted water consumption; and
 PM = Particulate matter.

LCA Results for Graded Aggregates (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U ²³⁵ eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	1.31E-02	6.42E+00	6.66E-10	1.68E-08	INA
	Transport	A2	8.71E-05	7.51E-02	4.36E-12	9.79E-11	INA
	Manufacturing	A3	1.80E-02	5.87E+00	8.38E-10	1.33E-08	INA
	Total	A1-3	3.12E-02	1.24E+01	1.51E-09	3.02E-08	INA
Construction process stage	Transport	A4	2.66E-02	2.59E+01	1.68E-09	3.72E-08	INA
	Construction	A5	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	INA
	Transport	C2	6.65E-02	6.49E+01	4.21E-09	9.31E-08	INA
	Waste processing	C3	7.84E-03	2.56E+00	3.65E-10	5.79E-09	INA
	Disposal	C4	6.57E-03	5.56E+00	3.27E-10	3.67E-09	INA
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-4.02E-01	-4.92E+01	-6.16E-09	-1.46E-07	INA

IRP = Potential human exposure efficiency relative to U235;
ETP-fw = Potential comparative toxic unit for ecosystems;
HTP-c = Potential comparative toxic unit for humans;

HTP-nc = Potential comparative toxic unit for humans; and
SQP = Potential soil quality index.



LCA Results for Graded Aggregates (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing resource use, primary energy			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	1.52E+00	0.00E+00	1.52E+00	1.84E+01	0.00E+00	1.84E+01
	Transport	A2	2.59E-03	0.00E+00	2.59E-03	1.57E-01	0.00E+00	1.57E-01
	Manufacturing	A3	6.82E-01	0.00E+00	6.82E-01	1.14E+02	0.00E+00	1.14E+02
	Total	A1-3	2.20E+00	0.00E+00	2.20E+00	1.33E+02	0.00E+00	1.33E+02
Construction process stage	Transport	A4	8.25E-01	0.00E+00	8.25E-01	5.58E+01	0.00E+00	5.58E+01
	Construction	A5	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	2.06E+00	0.00E+00	2.06E+00	1.39E+02	0.00E+00	1.39E+02
	Waste processing	C3	2.97E-01	0.00E+00	2.97E-01	4.98E+01	0.00E+00	4.98E+01
	Disposal	C4	2.18E-01	0.00E+00	2.18E-01	1.35E+01	0.00E+00	1.35E+01
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.38E+01	0.00E+00	-1.38E+01	-2.43E+02	0.00E+00	-2.43E+02

PERE = Use of renewable primary energy excluding renewable primary energy used as raw materials;
 PERM = Use of renewable primary energy resources used as raw materials;
 PERT = Total use of renewable primary energy resources;

PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
 PENRM = Use of non-renewable primary energy resources used as raw materials;
 PENRT = Total use of non-renewable primary energy resource

LCA Results for Graded Aggregates (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing resource use, secondary materials and fuels, use of water						
			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m ³
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	2.81E-02
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	2.03E-05
	Manufacturing	A3	0.00E+00	0.00E+00	0.00E+00	9.34E-03
	Total	A1-3	0.00E+00	0.00E+00	0.00E+00	3.75E-02
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	7.05E-03
	Construction	A5	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	1.76E-02
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	4.07E-03
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	1.28E-02
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	-3.65E-01

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;

NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water

LCA Results for Graded Aggregates (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	1.24E-04	1.42E-01	8.22E-06
	Transport	A2	9.42E-07	6.12E-03	5.88E-08
	Manufacturing	A3	7.54E-04	7.31E-02	1.13E-05
	Total	A1-3	8.78E-04	2.21E-01	1.96E-05
Construction process stage	Transport	A4	3.34E-04	2.61E+00	1.73E-05
	Construction	A5	MND	MND	MND
Use stage	Use	B1	MND	MND	MND
	Maintenance	B2	MND	MND	MND
	Repair	B3	MND	MND	MND
	Replacement	B4	MND	MND	MND
	Refurbishment	B5	MND	MND	MND
	Operational energy use	B6	MND	MND	MND
	Operational water use	B7	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	8.35E-04	6.52E+00	4.31E-05
	Waste processing	C3	3.28E-04	3.18E-02	4.94E-06
	Disposal	C4	6.31E-05	5.01E+01	4.03E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.73E-03	-6.84E+00	-2.61E-04

HWD = Hazardous waste disposed;
 NHWD = Non-hazardous waste disposed;
 RWD = Radioactive waste disposed

LCA Results for Graded Aggregates (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing output flows – at end of life								
			CRU	MFR	MER	EE	Biogenic carbon (product)	Biogenic carbon (packaging)
			kg	kg	kg	MJ per energy carrier	kg C	kg C
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Manufacturing	A3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total	A1-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Construction	A5	MND	MND	MND	MND	MND	MND
Use stage	Use	B1	MND	MND	MND	MND	MND	MND
	Maintenance	B2	MND	MND	MND	MND	MND	MND
	Repair	B3	MND	MND	MND	MND	MND	MND
	Replacement	B4	MND	MND	MND	MND	MND	MND
	Refurbishment	B5	MND	MND	MND	MND	MND	MND
	Operational energy use	B6	MND	MND	MND	MND	MND	MND
	Operational water use	B7	MND	MND	MND	MND	MND	MND
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CRU = Components for reuse;
MFR = Materials for recycling

MER = Materials for energy recovery;
EE = Exported Energy

Scenarios and additional technical information

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
A4 – Transport to the building site	The A4 stage considers transport to a customer in the local market supplied by the manufacturer.		
	Fuel type / Vehicle type	Litre of fuel type per distance or vehicle type	freight, lorry 16-32 metric ton, EURO6 engine
	Distance:	Rock Armour & Non-Crushed Rock	6km
		Bulk Fill, 6F and Crusher Run	17km
		Sub-Base and Structural Fill	14km
		Graded Aggregates	20km
	Capacity utilisation (incl. empty returns)	%	15 % of trucks delivering stones are used for back-loads
	Bulk density of transported products	kg/m ³	variable
C1 – Deconstruction demolition	The basaltic aggregate is used in both bound and unbound applications. In the C1 phase, in the unbound application it is assumed that very little energy is required for re-excavation. Similarly in the bound application (such as concrete), it is assumed that the energy required for this process is negligible compared to the energy required for demolishing the structure, therefore, no data is included for this module.		
C2 - Transport	In the transport phase C2, it is assumed that crushed material travels 50km to the point of processing for recycling or landfill.		
C3 – Waste Processing	It is assumed that 95% of the material is recycled. Based on a previous study carried out by EcoReview for Thompson's aggregate recycling operation in Dumbarton, it is estimated that diesel consumption for recycled aggregate is 0.55 litres of diesel per tonne of recycled aggregate. This metric is used in the LCA calculations for the C3 impacts.		
	Recycling	tonne	0.95
C4 – Landfill	It is assumed that 5% of the material is landfilled.		
	Landfill	tonne	0.05
Module D	The benefit beyond the system boundary arises from the use of the sand and aggregates recovered from the recycling process in end-of-life stage. This is modelled in the LCA calculations as a negative 0.95 tonnes of 'market for crushed gravel', RoW.		
	During the life cycle of the product, no use has been made of any hazardous substance listed in the "Candidate List of Substances of Very High Concern (SVHC) for authorization" in a percentage higher than 0,1% of the weight of the product.		



Interpretation of results

The bulk of the product stage (A1 to A3) environmental impacts are attributed to the diesel that provides all the quarrying energy. The minor element of the product stage impacts is from the impacts of the consumables, being mostly explosives. The products that go through the most quarrying, crushing and sorting processes have the higher impacts, which in terms of CO₂-eq per tonne are in the order of 10 kg CO₂-eq per tonne.

In the end-of-life stages, the main impacts are from the transport to reprocessing/disposal stage (C2) and the recycling stage (C3).

In the benefits beyond the system boundary stage (D) the benefit derives from the recycled aggregated replacing the manufacture of aggregates from primary raw materials.

Biogenic Carbon

There is no biogenic carbon in the product system.

About Sheephill Quarry

Thompson Quarries are a fourth-generation business founded in 1947 and operating from our base in Dumbarton, Scotland. Our Sheephill Quarry has been in operation since the 1980's. Thompson Group deliver in excess of 500,000 tonnes of aggregate to the construction sector in West Central Scotland each year.

We operate in construction sectors including but not limited to; Housebuilding, Industrial Buildings, Commercial Property Construction, MOD Works, Energy, Road, Rail and Utilities.

Our Basalt Rock is highly robust and durable. It is used not only for construction projects but also for manufacture of Readymix Concrete at our in-house batching plant, and also for marine applications such as coastal works, scour protection and revetments. The rock has a density of 2.60 tonnes/m³ with a consistent LA Coefficient of sub 20%.

We operate four mobile crushing trains made up of Primary Jaw Crushers, Secondary Cone Crushers and Triple Deck Screens. The mobile equipment allows us to take the processing kit to the quarry face being developed. This minimises internal haulage used when transporting blasted rock to a fixed crushing and screening plant.

We own and operate a fleet of thirty modern Euro 6 Standard 8-wheeled tippers plus seven 8m³ capacity concrete mixer trucks. Operating our own fleet gives us optimum control and flexibility which reduces empty vehicle movements thus reducing our carbon footprint.

Thompson Group also operates a Landfill Site, Recycling Wash-plant and two Readymix Batching Plants at Sheephill Quarry.



References

BSI. Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products. BS EN 15804:2012+A2:2019. London, BSI, 2019.

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ISO 14040: Environmental management - Life cycle assessment – Principles and Framework', International Organization for Standardization, ISO14040:2006.

ISO 14044: Environmental management - Life cycle assessment - Requirements and guidelines', International Organization for Standardization, ISO14044:2006.

ISO 14025: Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures', International Organization for Standardization, ISO14025:2006.

BS EN 12620 'Aggregates for Concrete' and Specification for Highway Works, Series 500, 600 and 800.

BS EN 13242 Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction.

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