ENVIRONMENTAL PRODUCT DECLARATION (EPD)

General Information

EPD Holder

Holliday Rock
1401 N. Benson Ave.
Upland, CA 91786 USA

Date of Issue – April 24, 2023

Period of Validity – 10/27/2027

Program Operator

National Ready Mix Concrete Association
66 Canal Center Plaza, Suite 250,
Alexandria, VA 22314

NRMCA EPD #20068

LCA and EPD Developer

WAP Sustainability Consulting
1701 Market Street
Chattanooga, TN 37408
www.wapsustainability.com

Core PCR - ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products

Sub-category PCR - NSF International Product Category Rule (PCR) for Concrete Version 2.1 (August 2021), Reviewed by Thomas P. Gloria, Bill Stough, and Michael Overcash.

Independent LCA Reviewer and EPD Verifier - Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025:2006 ☐ Internal ☒ External: Joseph Geibig EcoForm

Environmental Impacts

Declared Product: 3C35L000

Description: 3500psi 1"

Compressive Strength: 3500 psi @ 28 days

Declared Unit: 1 m^3 (yd^3) of ready mix concrete	**per m^3**	**per yd^3**
Global Warming Potential (kg CO2e)	303.94	232.38
Ozone Depletion (kg CFC11e)	2.40E-06	1.84E-06
Acidification (kg SO2e)	0.66	0.51
Eutrophication (kg Ne)	0.09	0.07
SFP (Smog) (kg O3e)	18.35	14.03
Abiotic Depletion, fossil (MJ, NCV)	1900.59	1453.10
Abiotic Depletion, non-fossil (kg Sbe)	1.37E-04	1.04E-04

Product Components:
Portland Cement (ASTM C150), BatchWater (ASTM C1602), Natural Fine Aggregate (ASTM C33), Natural Coarse Aggregate (ASTM C33), Water Reducer (ASTM C494)

The declared product meets the following product specifications:
• ACI 211: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete. • ACI 318: Building Code Requirements for Structural Concrete. • ASTM C94 Standard Specification for Ready-Mixed Concrete. • CSA A23.1/A23.2: Concrete Materials and Methods of Concrete Construction • CSI Masterformat Division 03-30-00: Cast-in-Place Concrete. • UNSPC Code 30111500: Ready Mix

Disclaimer: EPDs are comparable only if they comply with this document, use the same sub-category PCR where applicable, include all relevant information modules, use the same functional unit and are based on equivalent scenarios with respect to the context of construction works. This EPD is intended for business-to-business communications. This EPD was calculated using manufacturer specific cement data that represents 100% of the total cement used in this mix.

For Additional Explanatory Material

Manufacture Representative: Ignacio Valdivia (ivaldivia@hollidayrock.com)
Software Tool: THETA by WAP Sustainability Consulting V.1.0

Declared Unit

The declared unit is 1 cubic meter of ready mixed concrete product. The defined concrete mix is intended for commercial applications developed and produced by Holliday Rock. Key product variables include:

- Compressive strength - Compressive strengths are represented in the mix design and include the number of days after pouring as a part of the reference value: e.g. 3,000 psi @ 28 days; 4,000 psi @ 56 days; 6,000 psi @ 90 days; etc.
- Water to cementitious materials ratio (w/cm) – Varies but generally lower for a higher strength non-air entrained mix design (above 5,000 psi (34.5 MPa)) in accordance with ACI 211.1 recommendations.
- SCM use – various mix designs call for Portland cement displacement by incorporating fly ash (FA) and/or slag cement (SL).
- Admixtures use – Admixtures used was specified for the mix design that were modeled. These admixtures can include an air-entraining admixture, water reducing and accelerating admixtures, and high range water reducer admixtures

System Boundary

A summary of life cycle stages included in the EPD is identified in the figure below. This EPD covers A1-A3 life cycle stages (Cradle-to-Gate). A summary of activities excluded from the EPD is as follows:

- Production, manufacture, and construction of manufacturing capital goods and infrastructure.
- Production and manufacture of production equipment, delivery vehicles, and laboratory equipment.
- Personnel-related activities (travel, furniture, and office supplies)
- Energy and water use related to company management and sales activities.

BUILDING LIFE CYCLE INFORMATION MODULES (X: Included in LCA; MND: Module Not Declared)

Production State			Construction Stage		Use Stage							End-Of-Life Stage			
Extraction Production	Transport to Facility	Manufacturing	Transport to Site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction /Demolition	Transport to Disposal	Waste Processing	Disposal of Waste
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Cut-off Rules

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO 21930: 2017 Section 7.1.8. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty (e.g., portland cement and admixtures) are included.
- The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the life cycle inventory.
- Proxy data was used for admixtures used that did not align with any of the admixture categories published in the European Federation of Concrete Admixtures Associations (EFCA) EPDs. In those cases, the Water Reducing Admixture data was selected as a conservative assumption as per the NSF PCR Appendix A.

Allocation

The allocation of co-products or secondary flows cross the system boundary conforms with the ISO 21930: 2017 Section 7.2.4. Specifically, the allocation criteria were applied as follows:

- Allocation was not applied to any of the gate-to-gate production facilities.
- For Secondary Data sources, the NSF PCR default allocation selection (i.e. “Cut-off” or “Alloc Rec”) was applied.
- The product category rules for this EPD recognize fly ash, silica fume and slag as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a concrete material input.
- A portion (30%) of the reported fleet energy use for truck mixing plants was allocated to the mixing facility.

Calculated Results A1-A3

Core Mandatory Impact Indicator		**per m^3**	**per yd^3**
Global warming potential	kg CO2e	303.94	232.38
Depletion potential of the stratospheric ozone layer	kg CFC11e	2.40E-06	1.84E-06
Acidification potential of soil and water sources	kg SO2e	0.66	0.51
Eutrophication potential	kg Ne	0.09	0.07
Formation potential of tropospheric ozone	kg O3e	18.35	14.03
Abiotic depletion potential for fossil resources	MJ, NCV	1900.59	1453.10
Abiotic depletion potential for non-fossil mineral resources *	kg Sbe	1.37E-04	1.04E-04
Fossil fuel depletion	MJ Surplus	47.10	36.01
Use of Primary Resources			
Renewable primary energy carrier used as energy*	MJ, NCV	72.25	55.24
Renewable primary energy carrier used as material *	MJ, NCV	0.00	0.00
Non-renewable primary energy carrier used as energy *	MJ, NCV	1983.61	1516.58
Non-renewable primary energy carrier used as material *	MJ, NCV	0.00	0.00
Secondary Material, Secondary Fuel and Recovered Energy			
Secondary material *	kg	0.00	0.00
Renewable secondary fuel *	MJ, NCV	0.00	0.00
Non-renewable secondary fuel	MJ, NCV	0.00	0.00
Recovered energy *	MJ, NCV	0.00	0.00
Mandatory Inventory Parameters			
Consumption of freshwater resources	m3	2.21	1.69
Calcination and carbonation emissions	kg CO2e	146.25	111.82
Indicators Describing Waste			
Hazardous waste disposed *	kg	0.16	0.12
Non-hazardous waste disposed *	kg	0.38	0.29
High-level radioactive waste, conditioned, to final repository *	m3	8.95E-04	6.85E-04
Intermediate- and low-level radioactive waste, to final repository*	m3	1.01E-07	7.73E-08
Components for re-use*	kg	0.00	0.00
Materials for recycling *	kg	0.00	0.00
Materials for energy recovery *	kg	0.00	0.00
Recovered energy exported from the product system *	MJ, NCV	0.00	0.00

Emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in these categories, noted by *.

Data Sources

Portland Cement and Limestone Cement, ASTM C595, AASHTO M240, or CSA A3001	CalPortland - Oro Grande Type III	2021	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Slag Cement, ASTM C989	Slag Cement Association EPD of North America Slag Cement (2021)	2021	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Fly Ash, ASTM C618	None, no incoming burden, only inbound transport is considered*	N/A	N/A	N/A
Silica Fume, ASTM C1240	None, no incoming burden, only inbound transport is considered*	N/A	N/A	N/A
Crushed Aggregates, coarse and fine, ASTM C33	ecoinvent 3.4: "Gravel, crushed {RoW}| production | Cut-off, U" (2018), modified with US average electricity	2001	World/US	Technology: very good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Natural Aggregates, coarse and fine, ASTM C33	ecoinvent 3.4: "Gravel, round {RoW}| gravel and sand quarry operation | Cut-off, U" (2018), modified with US average electricity	2001	World/US	Technology: very good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Manufactured Lightweight Aggre- gates, ASTM C330	ecoinvent 3.4: Expanded clay {RoW}| production | Cut-off, U (2018), modified with US average electricity	2000	World/US	Technology: good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Admixtures, ASTM C494	EFCA EPDs for Air Entrainers, Plasticisers and superplasticisers, Hardening Accelerators, Set Accelerators, Water Resisting Admixtures, and Retarders (2015)	2020	North America	Technology: very good, Time: very good, Geography: fair, Completeness: very good, Reliability: very good
Steel Fibers	CRSI EPD for Fabricated Steel Reinforcement (2017)	2017	North America	Technology: very good, Time: very good, Geography: fair, Completeness: very good, Reliability: very good
Synthetic Fibers	USLCI 2014: Polypropylene resin, at plant/RNA	2014	North America	Technology: very good, Time: very good, Geography: fair, Completeness: very good, Reliability: very good
Batch and Wash Water, ASTM C1602	ecoinvent 3.4: Tap water {RoW}| market for | Cut-off, U (2018), modified with US average electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good
Road Transport	USLCI 2014: Transport, combination truck, short-haul, diesel powered/tkm/RNA (2014)	2010	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Rail Transport	USLCI 2014: Transport, train, diesel powered /US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Ocean Transport	USLCI 2014: Transport, ocean freighter, average fuel mix/US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Electricity	ecoinvent 3.4: Electricity, low voltage {XX}| market for | Cut-off, U (2018)	2015	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Diesel	USLCI 2014: Diesel, combusted in industrial boiler / US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Gasoline	USLCI 2014: Gasoline, combusted in equipment /US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Liquefied Propane Gas	USLCI 2014: Liquefied petroleum gas, combusted in industrial boiler /US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Hazardous Solid Waste	ecoinvent 3.4: Hazardous waste, for incineration {RoW}| treatment of hazardous waste, hazardous waste incineration | Alloc, Rec, U (2018), modified with US electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good
Non-Hazardous Solid Waste	ecoinvent 3.4: Inert waste {RoW}| treatment of, sanitary landfill | Alloc Rec, U (2018), modified with US average electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good

References

American Concrete Institute (2009) ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

American Concrete Institute (2009) ACI 211.2: Standard Practice for Selecting Proportions for Structural Lightweight Concrete

American Concrete Institute (2008) ACI 318: Building Code Requirements for Structural Concrete.

ASTM International (2018) ASTM C94: Standard Specification for Ready-Mixed Concrete.

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CSA Group (2014) CSA A23.1-09/A23.2-14 - Concrete materials and methods of concrete construction / Test methods and standard practices for concrete.

EN 15804:2012 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.

European Federation of Concrete Admixture Associations (2015). EFCA Environmental Declarations for Admixtures.

ISO 14040 Environmental Management - Life cycle assessment - Principles and framework

ISO 14044:2006/AMD 1:2017/ AMD 2:2020 Environmental Management - Life Cycle Assessment - Requirements and Guidelines

International Organization for Standardization (2017) ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.

National Renewable Energy Laboratory (2019) U.S. Life Cycle Inventory Database http://www.nrel.gov/lci/

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Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., & Weidema, B. (2016) The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, 21, 1218–1230.