Environmental **P**roduct **D**eclaration

Plastics Pipe Institute

A Cradle-to-Gate EPD of 1¼" DR11 Black HDPE Conduit

ASTM INTERNATIONAL

According to
ISO 21930
ISO 14025
ISO 14040/44

Summary Results –per 1 kg of 1¼" DR11 Black HDPE Conduit ***Full Results in Table 1***		**Cradle-to-Gate Total**
Global warming potential	kg CO_2e	2.15E+00
Acidification potential of soil and water sources	kg SO_2e	7.49E-03
Eutrophication potential	kg Ne	2.98E-03
Depletion potential of the stratospheric ozone layer	kg CFC11e	3.66E-08
Formation potential of tropospheric ozone	kg O_3e	1.65E-01
Abiotic depletion potential (ADPfossil) for fossil resources	MJ, NCV	7.78E+01

Summary Results –1000 linear feet of 1¼" DR11 Black HDPE Conduit. ***Full Results in Table 2***		**Cradle-to-Gate Total**
Global warming potential	kg CO_2e	2.10E+02
Acidification potential of soil and water sources	kg SO_2e	7.30E-01
Eutrophication potential	kg Ne	2.91E-01
Depletion potential of the stratospheric ozone layer	kg CFC11e	3.57E-06
Formation potential of tropospheric ozone	kg O_3e	1.61E+01
Abiotic depletion potential (ADPfossil) for fossil resources	MJ, NCV	7.58E+03

1.0 General Information

EPD Program and Program Operator	**ASTM International** 100 Barr Harbor Drive PO Box C700 West Conshohocken, PA, 19428-2959 USA www.astm.org
General Program Instructions and Version Number	ASTM Program Operator for Product Category Rules (PCR) and Environmental Product Declarations (EPDs) - General Program Instructions, version: 6.0
Manufacturer	Plastics Pipe Institute 105 Decker Court, Suite 825 Irving, Texas -75062 https://plasticpipe.org
Declaration Number	EPD 1041
Declared Product	HDPE Conduit for power and communication applications
Declared Unit	1 kg of 1¼" DR11 Black HDPE Conduit, 1000 linear feet of 1¼" DR11 Black HDPE Conduit.
Reference PCR and Version Number	ISO-21930. 2017. "Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services." International Standardization Organization.
Markets of Applicability	Electrical Infrastructure, Utility Networks, Communications, Broadband, Fiber Optic Networks.
Date of Issue	25.07.2025
Period of Validity	24.07.2030
EPD Type	Industry Average EPD
EPD Scope	Cradle-to-Gate
Year of reported manufacturer primary data	2022
LCA Software	SimaPro v9.2
LCI Databases	USLCI, Ecoinvent 3.9, Datasmart 2023
LCIA Methodology	TRACI 2.1
LCA and EPD Developer This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	**WAP Sustainability Consulting LTD** 1701 Market Street Chattanooga, TN 37408 https://wapsustainability.com/ WAP

This declaration was independently verified in accordance with **ISO 14025:2006[4]**. ISO-21930. 2017. "Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.", serves as the core PCR. ☐ INTERNAL x EXTERNAL	
Independent Verifier This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	
LCA and EPD Manufacturer Participants	
PETROFLEX	dura-line
WL PLASTICS	IPEX by aliaxis

About the Plastics Pipe Institute

Plastics Pipe Institute, Inc. (PPI) is the major North American manufacturers trade association focused on research, advocacy and education for plastics use in pipe, conduit and infrastructure solutions. PPI's mission is improving quality of life today, and for generations to come, by championing the advancement, acceptance, and use of sustainable and resilient plastic pipe systems. The association is comprised of over 180 member companies and associates. The association promotes contemporary use of plastics piping systems for water and sewer, gas distribution, oil and gas production, industrial and mining uses, power and communications cabling, hot & cold-water plumbing, hydronics, storm water and irrigation. PPI's Power & Communications Division (PCD), a division of PPI, consists of member companies that manufacture HDPE conduit or supply raw materials and ingredients for the manufacture of HDPE conduit for power and communications cabling. PPI PCD products are sold in the North American market.

PPI serves as a channel for information sharing, issues resolution, idea exploration and successful implementation guidance. The association is dedicated to advocacy and outreach efforts in support of these goals and strives to expand the scope of overall education by broadcasting the many benefits and features of plastics pipe. As an association, PPI focuses collaborative efforts to accumulate data, concentrate facts and target resources toward advancements in applications and increases in widespread usage. PPI has a large emphasis on sustainability as its mission and this LCA study demonstrates its commitment to transparently sharing the environmental footprint of HDPE conduits products in support of generating an Environmental Product Declaration (EPD) for users of its products in North America

More information can be found at https://plasticpipe.org.

2. PRODUCT DESCRIPTION

This EPD covers an average conduit product used in electrical and communication applications across North America. The average product is based on a production-weighted mean across different conduit types and diameters manufactured by participating Plastics Pipe Institute (PPI) member facilities. The average product includes: The 1¼" DR11 Black HDPE Conduit is a durable, high-performance conduit system designed for underground and above-ground applications in power and communication cable protection. Manufactured from High-Density Polyethylene (HDPE), this conduit offers superior flexibility, impact resistance, and longevity in demanding environments. This EPD quantifies the environmental performance of the 1¼" DR11 Black HDPE Conduit**,** ensuring transparency in material selection, energy use, and sustainability efforts for stakeholders in the construction and infrastructure sectors. No substances of very high concern (as defined by the European Chemicals Agency under REACH regulation) are associated with the product system described in this EPD.

HDPE Conduit Product Variations

The 1¼" DR11 Black HDPE Conduit – Black is designed to meet a range of installation and performance requirements in electrical and communication conduit systems. Key variations include:

- **Material Composition:** Manufactured from high-density polyethylene resin (HDPE).
- **Dimensional Ratio (DR):** Available in DR 11, ensuring strength and flexibility for underground and exposed applications.
- **Color Options:** Offered in Black, with additional variations available for specific applications.
- **Compliance Standards:** Meets industry standards including ASTM F2160, CSA C22.2 No. 327, NEMA TC-7, and UL 651A, ensuring safety and durability in electrical and communication infrastructure.
- **Application:** Designed for electrical and communication conduit systems, ensuring robust protection against environmental factors and mechanical stresses.
- **Expected Service Life:** 100 years in standard conditions.

3. METHODOLOGY

The underlying LCA investigates the lifecycle stages of HDPE Conduit production in the United States from cradle-to-gate.

System Boundaries and Product Flow Diagram

The scope for the 1¼" DR11 Black HDPE Conduit follows a cradle-to-gate system boundary, encompassing the environmental impacts from raw material extraction to end of manufacturing process/ finished conduit product before shipping to job site. It includes the following modules:

A1 – Raw Material Extraction and Processing: Covers the production of virgin HDPE resin as the baseline material, along with any additives and colorants. This phase includes upstream impacts from petroleum extraction, refining, and polymerization.

A2 – Raw Material Transportation: Details the transportation of raw materials, resins, and additives to manufacturing facilities. Transport occurs primarily via trucks and rail, with distances calculated using a weighted average method.

A3 – Manufacturing: The extrusion process converts HDPE resin and additives into conduit with specified dimensions and thickness. This step includes energy consumption (electricity and natural gas), water usage, and auxiliary inputs like lubricants and packaging. The finished products are then cut and packaged, as coils or straight lengths, and prepared for shipment.

This cradle-to-gate approach provides a comprehensive assessment of the environmental performance of the 1¼" DR11 Black HDPE Conduit, promoting sustainable infrastructure development and informed decision-making for industry stakeholders.

Building Life Cycle Information Modules																
Production stage			Construction Stage		Use stage							End-of-life stage				Substitution Effects
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/ Demolition	Transport to waste	Waste processing	Disposal	Benefits Outside System
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure 1: Life Cycle Stages and Information Modules per ISO 21930:2017

Declared Unit

The declared unit for the product is defined as 1 kg of 1¼" DR11 Black HDPE Conduit and also 1000 linear feet of 1¼" DR11 Black HDPE Conduit. This unit provides a consistent basis for measuring the product's environmental impacts across different stages of production.

Data Sources

The life cycle assessment (LCA) for 1¼" DR11 Black HDPE Conduit is based on a combination of primary facility-specific data from North American manufacturing sites and secondary data from publicly available databases such as DATASMART 2023 and Ecoinvent 3.9. Primary data reflects energy consumption, material inputs, direct emissions, water usage, and waste generation specific to the 2021 production year, ensuring accuracy in manufacturing processes. Secondary data is used for raw material extraction, transportation, and upstream energy production, providing a comprehensive assessment of environmental impacts. This approach ensures alignment with ISO 14040/44 standards, maintaining completeness, consistency, and transparency in the EPD.

4. LCA Results

Tables 1-2 present the “cradle-to-gate” LCA results for 1 kg of 1¼" DR11 Black HDPE Conduit and also 1000 linear feet of 1¼" DR11 Black HDPE Conduit. This study used the TRACI (Tool for the Reduction and Assessment of Chemical and other environmental Impacts), CED (Cumulative Energy Demand), and CML (Institute of Environmental Sciences) methods to determine environmental impacts (Bare 2011) associated with the production phase of the conduit installed in a typical North American application for 100 years.

The EPD results represent a “cradle-to-gate” environmental profile for 1¼" DR11 Black HDPE Conduit manufactured at 4 different manufacturing facilities in North America for the reference year 2022. Module A1 Extraction and upstream production contributes the largest share of the LCIA category indicator results, accounting for between 77% of the Production stage (A1 to A3) potential environmental burdens. Module A3 Manufacturing is the second

largest contributor to the overall potential impacts of the production stage, accounting for between 17%. Module A2 Transportation contributed 6% to the overall potential impacts of the production stage.

Table 1: Cradle-to-gate (Total A1 to A3) environmental impacts of 1 kg of 1¼" DR11 Black HDPE Conduit

Core Mandatory Impact Indicator		A1-A3	A1	A2	A3
GWP_{total}	kg CO2e	2.15E+00	1.66E+00	1.37E-01	3.59E-01
GWP_{fossil}	kg CO2e	2.15E+00	1.66E+00	1.37E-01	3.59E-01
$GWP_{biogenic}$	kg CO2e	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ODP	kg CFC11e	3.66E-08	1.11E-08	2.41E-10	2.53E-08
AP	kg SO2e	7.49E-03	5.67E-03	9.27E-04	8.90E-04
EP	kg Ne	2.98E-03	4.63E-04	7.14E-05	2.45E-03
SFP	kg O3e	1.65E-01	1.30E-01	2.78E-02	7.37E-03
ADPf	MJ, NCV	7.78E+01	7.28E+01	1.72E+00	3.24E+00
Use of Primary Resources					
RPRE	MJ, NCV	2.50E-01	9.73E-02	3.97E-03	1.49E-01
RPRM	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRPRE	MJ, NCV	3.14E+01	2.45E+01	1.85E+00	5.08E+00
NRPRM	MJ, NCV	4.85E+01	4.85E+01	0.00E+00	0.00E+00
Secondary Material, Secondary Fuel and Recovered Energy					
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mandatory Inventory Parameters					
FW	m3	1.12E-02	9.65E-03	1.52E-05	1.52E-03
Indicators Describing Waste					
HWD	kg	1.64E-03	1.64E-03	0.00E+00	0.00E+00
NHWD	kg	6.84E-02	6.84E-02	0.00E+00	0.00E+00
HLRW	m3	1.31E-09	4.27E-10	6.55E-11	8.17E-10
ILLRW	m3	1.31E-09	4.27E-10	6.55E-11	8.17E-10
CRU	kg	7.40E-09	0.00E+00	0.00E+00	7.40E-09
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 2 Production stage (Total A1 to A3) EPD results for 1000 linear feet of 1¼" DR11 Black HDPE Conduit

Core Mandatory Impact Indicator		A1-A3	A1	A2	A3
GWP_{total}	kg CO2e	2.10E+02	161.8832	1.34E+01	35.00968
GWP_{fossil}	kg CO2e	2.10E+02	161.8832	1.34E+01	35.00968
$GWP_{biogenic}$	kg CO2e	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ODP	kg CFC11e	3.57E-06	1.08E-06	2.35E-08	2.47E-06
AP	kg SO2e	7.30E-01	0.5529384	9.04E-02	0.0867928
EP	kg Ne	2.91E-01	0.04515176	6.96E-03	0.238924
SFP	kg O3e	1.61E+01	12.6776	2.71E+00	0.7187224
ADPf	MJ, NCV	7.58E+03	7099.456	1.68E+02	315.9648
Use of Primary Resources					
RPRE	MJ, NCV	2.44E+01	9.49E+00	3.87E-01	1.45E+01
RPRM	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRPRE	MJ, NCV	3.07E+03	2.39E+03	1.80E+02	4.95E+02
NRPRM	MJ, NCV	4.73E+03	4.73E+03	0.00E+00	0.00E+00
Secondary Material, Secondary Fuel and Recovered Energy					
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mandatory Inventory Parameters					
FW	m3	1.09E+00	9.41E-01	1.48E-03	1.48E-01
Indicators Describing Waste					
HWD	kg	1.60E-01	1.60E-01	0.00E+00	0.00E+00
NHWD	kg	6.67E+00	6.67E+00	0.00E+00	0.00E+00
HLRW	m3	1.28E-07	4.16E-08	6.39E-09	7.97E-08
ILLRW	m3	1.28E-07	4.16E-08	6.39E-09	7.97E-08
CRU	kg	7.22E-07	0.00E+00	0.00E+00	7.22E-07
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00

5. LIMITATIONS

Comparability

This study does not include comparative assertions, making it difficult to benchmark HDPE conduit products against other piping materials. Differences in system boundaries, allocation methods, and data sources would need to be

harmonized to enable meaningful comparisons, limiting the use of the results for competitive product evaluations or market-based comparisons.

EPD Scope
The cradle-to-gate scope of this EPD limits its coverage to raw material extraction, transportation, and manufacturing stages. The use phase, maintenance, and end-of-life disposal are excluded from this assessment. As a result, this EPD does not provide a complete picture of the total environmental impact of the product over its full life cycle. This average EPD is not product- or manufacturer-specific and should not be used for comparative assertions. Its applicability is limited to the sizes and manufacturing methods considered in the study. Variations in product design, regional practices, or end-of-life treatments may affect results.

Accuracy of Results
The accuracy of the results may be influenced by the limited number of manufacturing facilities included in the study. Additionally, reliance on secondary data for upstream processes, such as raw material extraction and transportation, introduces variability. While primary data collection reflects actual production practices, the use of industry averages may mask specific facility-level differences, affecting the precision of the environmental impact assessments.

6. REFERENCES

Bare, Jane. 2011. “TRACI 2.0: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts 2.0.” *Clean Technologies Environmental Policy* 13 (5): 687–96.

ISO-14040. 2006. “Environmental Management: Life Cycle Assessment; Principles and Framework.” International Organization for Standardization.

ISO-14044. 2006. “Environmental Management: Life Cycle Assessments: Requirements and Guidelines.” International Standardization Organization.

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