03 November 2023

A1 – A3 Carbon Assessment

Project Name: Data Centre Development
Address: Cruiserath Road, Dublin 15
FCC Reg. Ref.: FW22A/0308 & ABP Ref.: PL06F.318180
Assessor: Henry J Lyons
Client: Universal Developers LLC

Architecture + Interiors
henryjlyons.com

51-54 Pearse Street
Dublin D02 KA66

+353 1 888 3333
info@henryjlyons.com

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1. Overview

This report is issued on behalf of the client, Universal Developers LLC in response to third party appeals of the notification of decision of Fingal County Council dated the 18th of September 2023 under Reg. Ref.: FW22A/0308 to grant planning permission for development on a site at Cruiserath Road, Dublin 15

The John Conway and Louth Environmental Group appeal concurred with, and appended a copy of, the submission made by Colin Doyle on the Further Information response to Fingal County Council. The previous submission by Colin Doyle argued that the Carbon Assessment report prepared by HJL Architects and submitted as part of the Further Information response assessed items A4 and A5 of the assessment methodology only (relating to Transport and Construction), but that it ought to have assessed items A1 to A3 (the product stage, relating to raw materials). On this basis, it is contended that the assessment underestimated the carbon associated with the development.

The appeal submission further states the following:
"Based on the quantities of concrete and steel listed in the report, and using typical factors for associated emissions, I calculate emissions of over 27,000 tonnes, which would be 664kgCO/m2, when added to the approx. 100/m2 for A4 and AS gives a total of 764 kg/m2. This is more than seven times the estimate by Henry J Lyons."

The Planning Authority confirmed their requirement for an assessment of items A4 and A5 as was submitted. However, in response to the foregoing appeal this report has now been prepared to assess items A1 to A3 also. The report compares a baseline and a mitigation scenario for the shell construction and fitout of the proposed works including A1-A3. The material type and quantities modelled are based on information taken from the drawings and bill of quantities (BoQ).

The assessment was carried out using OneclickLCA software in compliance with EN 15978 and Level(s) indicator 1.2, according to current best practice. Where project specific information was not available, information from existing data sources for similar projects were used as a guide followed by national industry averages based on OneClickLCA software recommendations for the region.[1]

Project Details:

	Description
Building Type	Data centre
Gross internal floor area	GIA of proposed new buildings 43,011m^2
Project stage	Early design
Construction Year	2024-2028
System Boundary	A1 – A3
Assessment Scope	The proposed data centre development at Cruiserath Road, Dublin 15, including data centre buildings F, G and E and the following ancillary structures: MV buildings, Bike shelters, Bin storage, Water tank storage, Diesel tank storage.

Table 1. Project details

[1] https://www.oneclicklca.com/support/faq-and-guidance/documentation/database/

2. Results Summary

The **estimated** Global Warming Potential (GWP) results are summarised in Table 2 below. Detailed results are provided in Section 5. As this is an early-stage analysis carried out at planning appeal stage a tolerance of ± 20% of the overall result has been applied as seen in Table 2.

The mitigation scenario is likely to generate over 52% less carbon during the product stage (A1-A3) than the baseline scenario. See section 6 for details.

Indicator	Unit	Product Stage (A1-A3)
GWP +20%	$kgCO_2e /m^2$	621.2
CGWP	$kgCO_2e /m^2$	517.7
GWP -20%	$kgCO_2e /m^2$	414.2
Notes	Impacts refer to the GWP of 1m 2 of GIA of the Shell & fitout of proposed data centre development at Cruiserath Road, Dublin 15 and ancillary buildings for module A1-A3 only.	

Table 2a. Results summary of baseline scenario

Indicator	Unit	Product Stage (A1-A3)
GWP +20%	kgCO2 e /m2	295.4
GWP	kgCO2 e /m2	246.2
GWP -20%	kgCO2 e /m2	197
Notes	Impacts refer to the GWP of 1m 2 of GIA of the Shell & fitout of proposed data centre development at Cruiserath Road, Dublin 15 and ancillary buildings for module A1-A3 only.	

Table 2b. Results summary of mitigation scenario

Details of the materials, material quantities, and associated Environmental Product Declarations [EPDs] used to carry out this study are provided in Appendix C.

3. Assessment scope and system boundaries

3.1 System boundaries

The assessment measures and reports the GWP of the product stage, consisting of life cycle stages **A1 (Raw material supply), A2 (Transport)** and **A3 (manufacturing)** with particular care to account for materials of significant GWP, **within the context of the knowledge and information available at time of assessment.** The boundaries of the assessment are illustrated in Figure 1 below. A description of the life cycle stages is provided in **Appendix A.**

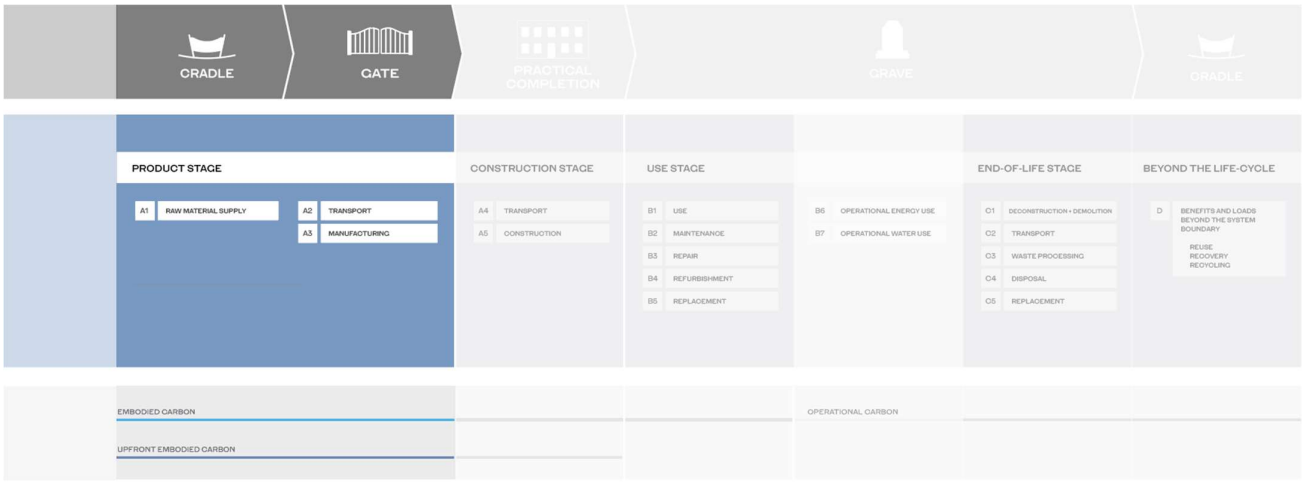

Figure 1. Boundaries of carbon assessment

3.2 Assessment scope

The assessment refers to both the BoQ and drawings to estimate material quantities of the proposed constructions. See Appendix C for a list of all inputs and related EPDs where available. The assessment accounts for the following building elements

Elements			Inclusion
1. Shell (substructure & superstructure)			
1.1	Foundations (substructure)	Piles	Y
		Basements	Y
		Retaining walls	N
1.2	Load bearing structural frame	Frame (beams, columns & slabs)	Y
		Upper floors	Y
		External walls	Y
		Balconies	N
1.3	Non-load bearing elements	Ground floor slab	Y
		Internal walls, partitions & doors	Y
		Stairs & ramps	Y
1.4	Facades	External wall systems, cladding & shading devices	Y
		Façade openings (including windows & external doors)	Y
		External paints, coatings & renders	N
1.5	Roof	Structure	Y
		Weatherproofing	N
1.6	Parking facilities	Above ground & underground	N

Elements			Inclusion
2. Core			
2.1	Fittings & furnishings	Sanitary fittings	N
		Cupboards, wardrobes & worktops	N
		Ceilings	N
		Wall & ceiling finishes	N
		Floor coverings & finishes	N
2.2	In-built lighting system	Light fittings	N
		Control systems & sensors	N
2.3	Energy system	Heating plant & distribution	N
		Cooling plant & distribution	N
		Electricity generation & distribution	N
2.4	Ventilation system	Air handling units	N
		Ductwork & distribution	N
2.5	Sanitary systems	Cold water distribution	N
		Hot water distribution	N
		Water treatment systems	N
		Drainage system	N
2.6	Other systems	Lifts & escalators	N
		Fire fighting installations	N
		Communication & security installations	N
		Telecoms & data installations	N

Elements			Inclusion
3. External works			
3.1	Utilities	Connections & diversions	N
		Substations & equipment	N
3.2	Landscaping	Paving & other hard surfacing	N
		Fencing, railings & walls	N
		Drainage system	N

Table 3: Scope of carbon assessment

Note:

- Materials, products and systems related to the architectural elements of the project have been selected based on educated assumptions and past experience and are subject to change as the detail design of the building develops at later project stages.
- MEP is excluded from the study
- Fluid based finishes including paint, resins and sealants are not accounted for in this study

4. Assessment software

The calculations were performed with OneClickLCA calculation tool. The software is fully compliant with EN 15978 standard. One Click LCA has been third party verified by ITB for compliance with the following LCA standards: EN 15978, ISO 21931–1 and ISO 21929, and data requirements of ISO 14040 and EN 15804. The official letters of compliance can be found at the following link:
https://www.oneclicklca.com/wp-content/uploads/2016/11/360optimi-verification-ITB-Certificate-scanned-1.pdf

ITB is a certification organisation and a Notified Body (EC registration nr. 1488) to the European Commission designated for construction product certification. Polish Accreditation Board assures the independence and impartiality of ITB services (Accreditation Certificates are: AB 023, AC 020, AC 072, AP 113). ITB activities are conducted in accordance to the requirements of the following assurance standards: ISO 9001, ISO/IEC 27001, ISO/IEC 17025, EN 45011, and ISO/IEC 17021.[2]

5. Detailed Results

Results for Global warming potential (GWP), $kgCO_2^e$ /m^2 baseline scenario.

Life Cycle stage	Structure	TCO_2 ^{e}	TCO_2 ^{e}	$kgCO_2$ ^{e} /m^2
Product stage (A1 – A3)	Datacentre F	10,447.7	22,265.2	517.7
	Datacentre G	10,447.7		
	Datacentre E	864.2		
	Ancillary structures	505.6		
Total embodied carbon likely to be generated per GIA m2 during the product stage (A1 - A3)				**517.7 $kgCO_2$ ^{e} /m^2**
Notes	Impacts refer to the GWP of 1m^2 of GIA of the Shell & fitout of proposed data centre development at Cruiserath Road, Dublin 15 and ancillary buildings for module A1 - A5 only. Tolerance of ± 20% should be allowed on all figures			

Table 4: GWP breakdown of baseline scenario product phase (A1-A3)

[2] https://www.oneclicklca.com/fi/iso-en-compliant-lca-software/

6. Mitigation scenario

The following mitigation scenario is proposed for adoption in order to limit the upfront carbon emissions likely to be generated during the product stage (A1-A3) of the proposed development from the baseline scenario.

The **mitigation scenario is estimated to generate 52% less carbon** during the product stage **(A1 – A3)** then baseline scenario.

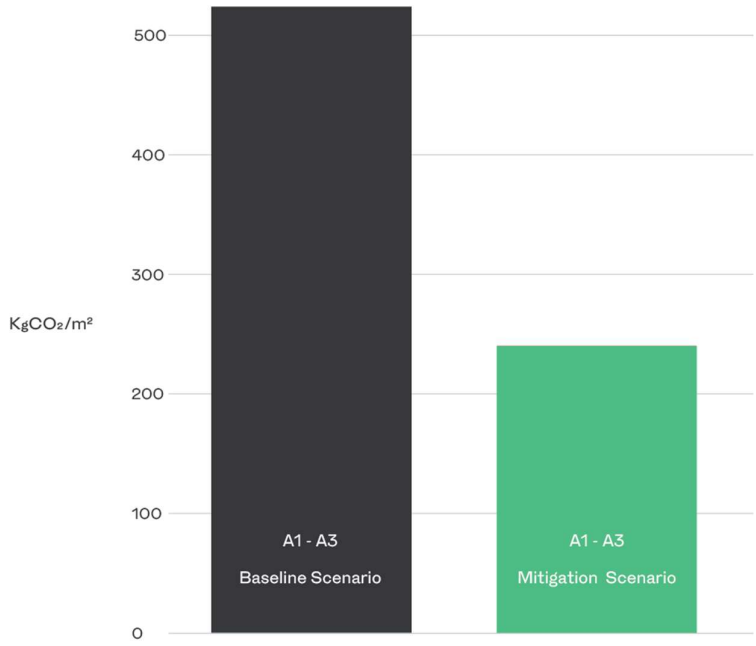

Figure 2. Estimated carbon reduction of mitigation scenario to baseline scenario for shell & fitout A1-A3.

Baseline Scenario					Mitigation Scenario		
Life Cycle stage	**Structure**	**TCO_2 e**		**$kgCO_2$ e /m^2**	**$kgCO_2$ e**		**$kgCO_2$ e /m^2**
Product stage (A1 – A3)	Datacentre F	10,447.7			4,893.7		
	Datacentre G	10,447.7			4,893.7		
	Datacentre E	864.2			440.1		
	Ancillary structures	505.6	22,265.2	517.7	360.6	10,588.1	246.2
Total embodied carbon likely to be generated per GIA m2 during the product stage (A1 - A3)				**517.7**			**246.2**
Notes:	Impacts refer to the GWP of 1m^2 of GIA of the shell & fitout of proposed data centre development at Cruiserath Road, Dublin 15 and ancillary buildings for module A1 – A3 only. Tolerance of ± 20% should be allowed on all figures						

Table 4. Results for GWP of baseline and mitigation scenario

The mitigation scenario includes the following actions:

- Low carbon products and manufacturers were specified where possible to reduce A1-A3 emissions. Lower Carbon metal sandwich panels are used in place of the higher carbon metal sandwich panels of the baseline scenario.

- The upfront embodied carbon of concrete was reduced from baseline scenario by specifying concrete with 40% GGBS content in mitigation scenario.

- The embodied carbon of steel was reduced in the mitigation scenario in comparison to the baseline by specifying steel with a high recycled content. The steel reinforcement bars of the mitigation scenario contain 97% recycled content for steel reinforcement bars, and steel is specified from low carbon manufacturers.

Appendix A - Building life cycle stages and modules[3]

Life Cycle Stage	Modules	Description
Production Stage	A1 Raw material supply	Includes emissions generated when raw materials are taken from nature, transported to industrial units for processing and processed. Loss of raw material and energy are also taken into account.
	A2 Transport	Include exhaust emissions resulting from the transport of all raw materials from suppliers to the manufacturer's production plant as well as impacts of production of fuels.
	A3 Manufacturing	Covers the manufacturing of the production materials and fuels used by machines, as well as handling of waste formed in the production processes at the manufacturer's production plants until end-of-waste state.
	A4 Transport to site	Includes exhaust emissions resulting from the transport of building products from manufacturer's production plant to building site as well as the environmental impacts of production of the used fuel.
	A5 Construction	Covers the exhaust emissions resulting from using energy during the site operations, the environmental impacts of production processes of fuel and energy and water as well as handling of waste until the end-of-waste state.
Use Stage	B1-5 Maintenance and material replacement	The environmental impacts of maintenance and material replacements (B1-B5) include environmental impacts from replacing building products after they reach the end of their service life. The emissions cover impacts from raw material supply, transportation and production of the replacing new material as well as the impacts from manufacturing the replacing material as well as handling of waste until the end-of-waste state.
	B6 Energy use	Includes exhaust emissions from any building level energy production as well as the environmental impacts of production processes of fuel and externally produced energy. Energy transmission losses are also taken into account
	B7 Water use	Includes all water used and its treatment (pre- and post-use) during the normal operation of the building (excluding during maintenance, repair, replacement and refurbishment).
End of Life Stage	C1- C4 Deconstruction	Includes impacts for processing recyclable construction waste flows for recycling (C3) until the end-of-waste stage or the impacts of pre-processing and landfilling for waste streams that cannot be recycled (C4) based on type of material. Additionally deconstruction impacts include emissions caused by waste energy recovery.
Benefits and loads beyond the system boundary	D	The external benefits include emission benefits from recycling building waste. Benefits for reused or recycled material types include positive impact of replacing virgin based material with recycled material and benefits for materials that can be recovered for energy cover positive impact for replacing other energy streams based on average impacts of energy production.

Table 6. Building life cycle stages described

[3]Table based on EN level(s) indicator 1.2 https://susproc.jrc.ec.europa.eu/product-bureau/sites/default/files/2020-10/20201013%20New%20Level(s)%20documentation_Indicator%201.2_Publication%20v1.0.pdf and onelclickLCA reporting template https://oneclicklca.zendesk.com/hc/en-us/article_attachments/360013784259/One_Click_LCA_reporting_template_for_LCA_EN15978.docx

Appendix B - Data sources and assumptions

A1-A3 Product

The carbon emissions likely to be generated during the construction of the proposed development was calculated using OneClickLCA software. The assessment refers to both BoQ and architectural drawings to estimate material quantities of the proposed constructions.

The data sourcing of the environmental impact of materials followed an information hierarchy, where project and manufacturer specific EPDs were not available, national industry averages followed by generic data points based on OneClickLCAs database and recommendations were utilised.

A4 Transport to site

The default transport scenarios for construction material as defined by RICS "Whole life carbon assessment for the built environment, 1st Ed., Nov.2017" (see Table 7 below) were used as the values for emissions associated with transportation of construction materials and products to the site.

Transport scenario	Km by road	Km by sea
Locally manufactured. E.g. concrete, aggregate, earth	50	-
Nationally manufactured. E.g. plasterboard, blockwork, insulation	300	-
European manufactured. E.g. CLT, facade modules, carpet	1,500	-
Globally manufactured. E.g. specialist stone cladding	200	10,000

Table 7. RICs default transport distances

A5 Construction

Site construction operations are calculated using the average site impacts based on OneClickLCA software recommendations of climate zone average impacts, which assumes on site electricity use at a rate of 37 kWh/m2 (GFA) and total use of diesel 4.5 l/m2 (GFA).

B1 - B5 Maintenance & material replacement

Outside the scope of this assessment.

B6 Energy Use

Outside the scope of this assessment.

B7 Water Use

Outside the scope of this assessment.

Appendix C - Material Input of Carbon Calculation

BASELINE SCENARIO - Data Centre F and G

Item Description	Quantity		Further Description / Assumptions	EPD mapping
concrete c12/15	1270	m3	accounts for: generator exhaust generator compound generator plinth substructure raft slab substructure blinding substructure preprufe ground floor	Ready-mix concrete, low-strength, generic, C12/15 (1700/2200 PSI), 0% recycled binders in cement (220 kg/m3 / 13.73 lbs/ft3)
concrete c30/37	12052	m3	accounts for: ancillary buildings, generator yard, generator compound,generator plinth, foundations ground floor, stair core, stair landing, floors	Ready-mix concrete, generic (consultation), C30/37, 0% recycled content in cement
concrete c35/45	1650	m3	structural cores	Ready-mix concrete, normal strength, generic, C35/45 (5000/6500 PSI) with CEM I, 0% recycled binders (340 kg/m3; 21.2 lbs/ft3 total cement)
hot rolled steel coil	3368000	kg	assumed as the elements of the main structural frame (columns and beams including roof support frame)	Hot rolled steel coil, average for Ireland (consultation)
cold rolled steel coil	295840	kg	secondary support steel for building envelope (purlins)	*Steel purlins and framing, 7850 kg/m3 (Voestalpine Metsec plc)*
reinforcement bars	1728000	kg		Reinforcement steel (rebar), generic, 0% recycled content (only virgin materials), A615
metal steel deck	432000	kg		Galvanized profiled steel decking, for composite floor slabs/decks, 1 mm sheet thickness, 11.62 kg/m2, ComFlor® 60 1.0mm (Tata Steel Europe, Tata Steel International (2021))
aluminium	49186	kg	secondary framing elements for the cladding and roofing system	Steel purlins and framing, 7850 kg/m3 (Voestalpine Metsec plc)

metal sandwich panels 100mm	4182	m2	metal sandwich panels	Sandwich panel with insulation foam core and double steel siding, U = 0.18 W/m2K, Core thickness = 100 mm, 11.788 kg/m2, 117.88 kg/m3, KS 1000 Trapezoidal Quadcore RW Panel (Kingspan (2020))
metal sandwich panels 40mm	10450	m2		Sandwich panel with insulation foam core and double steel siding, U = 0.18 W/m2K, Core thickness = 100 mm, 11.788 kg/m2, 117.88 kg/m3, KS 1000 Trapezoidal Quadcore RW Panel (Kingspan (2020))
metal sandwich panels 150mm	3684	m2		Steel faced fire proof sandwich panels with stone wool core, 28.2 kg/m2, 150 mm, AST E, AST F, AST F+ (Paroc)
plaster boards	1574344	kg	19mm gyproc manufactured in Ireland	Gypsum plasterboard, fire resistant, moisture resistant, 19 mm, 16.13 kg/m2, 849 kg/m3, fire resistance class A2-s1, d0, CoreBoard (Saint-Gobain Gyproc, Kingscourt plant)
steel studs	121766	kg		*Structural steel profiles, generic, 0% recycled content (only virgin materials), I, H, U, L, and T sections, S235, S275 and S355*
PIR	96392	kg		*PIR insulation boards, low emissivity foil faced, 66 mm, L = 0.022 W/mK, R = 3 m2K/W, 2.05 kg/m2, 31 kg/m3, TP10, TF70, Therma Duct, TW50, TW55 (Kingspan (2021))*
rockwool	12684	kg		*Rock wool insulation, unfaced, R = 1 m2K/W, Lambda = 0.044 W/mK, 44 mm, 22 kg/m3 (Rockwool)*
steel doors	40880	kg		Security door, R=3.7 W/m2K, 75.86 kg/unit, AASD Fire Door (ASSA ABLOY)
glass	20488	kg		Fire rated safety glass, 5-17 mm, avg. weight 20.6 kg/m2, KERALITE® (Vetrotech)

BASELINE SCENARIO - Data Centre E

Item Description	Quantity		Further Description / Assumptions	EPD mapping
concrete c12/15	44	m3	ready-mix concrete, m10 (c10) (acc limited) to ready-mix concrete, low-strength, generic, c12/15 (1700/2200 psi), 30% recycled binders in cement (220 kg/m3 / 13.73 lbs/ft3)	Ready-mix concrete, low-strength, generic, C12/15 (1700/2200 PSI), 0% recycled binders in cement (220 kg/m3 / 13.73 lbs/ft3)
concrete c30/37	416	m3		Ready-mix concrete, generic (consultation), C30/37, 0% recycled content in cement
concrete c35/45	60	m3	Accounts for: structural cores	Ready-mix concrete, normal strength, generic, C35/45 (5000/6500 PSI) with CEM I, 0% recycled binders (340 kg/m3; 21.2 lbs/ft3 total cement)
hot rolled steel coil	122932	kg	elements of the main structural frame (columns and beams including roof support frame)	Hot rolled steel coil, average for Ireland (consultation)
cold rolled steel coil	33202	kg	secondary support steel for building envelope (purlins)	*Steel purlins and framing, 7850 kg/m3 (Voestalpine Metsec plc)*
reinforcement bars	63072	kg		Reinforcement steel (rebar), generic, 0% recycled content (only virgin materials), A615
metal steel deck	14963	kg	metal deck	Galvanised profiled steel decking, for composite floor slabs/decks, 1 mm sheet thickness, 11.62 kg/m2, ComFlor® 60 1.0mm (Tata Steel Europe, Tata Steel International (2021))
aluminium	3397	kg	secondary framing elements for the cladding and roofing system	Steel purlins and framing, 7850 kg/m3 (Voestalpine Metsec plc)
metal sandwich panels 100mm	427	m2	metal sandwich panels	Sandwich panel with insulation foam core and double steel siding, U = 0.18 W/m2K, Core thickness = 100 mm, 11.788 kg/m2, 117.88 kg/m3, KS 1000 Trapezoidal Quadcore RW Panel (Kingspan (2020))
metal sandwich panels 40mm	1215	m2	metal sandwich panels	Sandwich panel with insulation foam core and double steel siding, U = 0.18 W/m2K, Core thickness = 100 mm, 11.788 kg/m2, 117.88 kg/m3, KS 1000 Trapezoidal Quadcore RW Panel (Kingspan (2020))

metal sandwich panels 150mm	413	m2		Steel faced fire proof sandwich panels with stone wool core, 28.2 kg/m2, 150 mm, AST E, AST F, AST F+ (Paroc)
plaster boards	54435	kg	plaster board	Gypsum plasterboard, fire resistant, moisture resistant, 19 mm, 16.13 kg/m2, 849 kg/m3, fire resistance class A2-s1, d0, CoreBoard (Saint-Gobain Gyproc, Kingscourt plant)
steel studs	4275	kg		*Structural steel profiles, generic, 0% recycled content (only virgin materials), I, H, U, L, and T sections, S235, S275 and S355*
PIR	3278	kg		*PIR insulation boards, low emissivity foil faced, 66 mm, L = 0.022 W/mK, R = 3 m2K/W, 2.05 kg/m2, 31 kg/m3, TP10, TF70, Therma Duct, TW50, TW55 (Kingspan (2021))*
rockwool	428	kg		*Rock wool insulation, unfaced, R = 1 m2K/W, Lambda = 0.044 W/mK, 44 mm, 22 kg/m3 (Rockwool)*
steel doors	1411	kg		Security door, R=3.7 W/m2K, 75.86 kg/unit, AASD Fire Door (ASSA ABLOY)
glass	713	kg		Fire rated safety glass, 5-17 mm, avg. weight 20.6 kg/m2, KERALITE® (Vetrotech)

BASELINE SCENARIO - Ancillary Buildings

Item Description	Quantity		Further Description / Assumptions	EPD mapping
MV Building (2)				
concrete c35/45	367	m3	roof and floor slab	Ready-mix concrete, normal strength, generic, C35/45 (5000/6500 PSI) with CEM I, 0% recycled binders (340 kg/m3; 21.2 lbs/ft3 total cement)
			+ internal wall	
			+ foundations	
concrete block	180	m3	external wall	Lightweight concrete block, 13N, 0.35 W/mK, 1183.93 kg/m3, Thermal Liteblock (Roadstone)
metal sandwich panels 40mm	840	m2	cladding	Sandwich panel with insulation foam core and double steel siding, U = 0.18 W/m2K, Core thickness = 100 mm, 11.788 kg/m2, 117.88 kg/m3, KS 1000 Trapezoidal Quadcore RW Panel (Kingspan (2020))
steel doors	10	units	double doors	Security door, R=3.7 W/m2K, 75.86 kg/unit, AASD Fire Door (ASSA ABLOY)
steel doors	2	units	single	
Bins (3) + Bike shelter (2)				
steel perforated panel system	0.2	m3		*Galvanised steel value, average for Ireland (consultation)*
concrete c35/45	2	m3	ground slab	*Ready-mix concrete, normal strength, generic, C35/45 (5000/6500 PSI) with CEM I, 0% recycled binders (340 kg/m3; 21.2 lbs/ft3 total cement)*
steel perforated panel system	0.4	m3		*Galvanised steel value, average for Ireland (consultation)*
concrete c35/45	8	m3	ground slab	*Ready-mix concrete, normal strength, generic, C35/45 (5000/6500 PSI) with CEM I, 0% recycled binders (340 kg/m3; 21.2 lbs/ft3 total cement)*
galvanised steel shelter	4	units		*Galvanised steel bicycle shelters, 76.7 kg/unit, DONNEE PAR DEFAUT (DED)*

Water (2) + Diesel Tank (1)				
green screen frame	2	m3	calculations tab under estimated green screen frame	*Steel purlins and framing, 7850 kg/m3 (Voestalpine Metsec plc)*
concrete c35/45	565	m3	rising wall	*Ready-mix concrete, normal strength, generic, C35/45 (5000/6500 PSI) with CEM I, 0% recycled binders (340 kg/m3; 21.2 lbs/ft3 total cement)*
			foundations	
			floor slabs	
			basement walls	
concrete c35/45	68	m3		*Ready-mix concrete, normal strength, generic, C35/45 (5000/6500 PSI) with CEM I, 0% recycled binders (340 kg/m3; 21.2 lbs/ft3 total cement)*
steel perforated panel system	0.5	m3		*Galvanised steel value, average for Ireland (consultation)*