Chapter 13
Climate

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13. CLIMATE

13.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) assesses the impact of the DART+ West project (hereafter referred to as the 'proposed development'), on Climate during the construction phase and operational phase. This chapter describes and assesses the likely direct, indirect, secondary and cumulative significant effects of the proposed development on Climate. This chapter also provides a characterisation of the receiving environment within the proposed development and within a wider study area in the vicinity of the proposed development.

This chapter should be read in conjunction with the following chapters, and their appendices, which present related impacts arising from the proposed development and proposed mitigation measures to ameliorate the predicted impacts:

- Chapter 4 Description of the Proposed Development.
- Chapter 5 Construction Strategy.
- Chapter 6 Traffic and Transportation.
- Chapter 12 Air Quality.
- Chapter 19 Material Assets: Resource and Waste Management.
- Chapter 24 Major Accidents and Disasters.
- Site Specific Flood Risk Assessment Report.

The assessment is based on a reasonable worst-case scenario with respect to potential climatic impacts arising from the proposed development as described in Chapter 4 and Chapter 5 of this EIAR. The proposed development description is based on the design prepared to inform the planning stage of the proposed development and to allow for a robust assessment as part of the Environmental Impact Assessment Process.

13.2 Legislation, policy and guidance

13.2.1 Legislation

International legislation

Ireland is party to both the United Nations Framework Convention on Climate Change (UNFCCC) (UNFCC 1992) and the Kyoto Protocol (UNFCC 1997). The Paris Agreement (UNFCC 2015), which entered into force in 2016, is an important milestone in terms of international climate change agreements and includes an aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 gigatonnes per year as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to GHG emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made in the Paris Agreement on elevating adaption onto the same level as action to cut and curb emissions.

In order to meet the commitments under the Paris Agreement, the European Union (EU) enacted 'Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action and amending Regulation (EU) No. 525/2013' (hereafter referred to as the Regulation) (European Parliament and Council of Europe 2018). The Regulation aims to deliver, collectively by the EU in the most cost-effective manner possible, reductions in GHG emissions from the Emission Trading Scheme (ETS) and non-ETS sectors of 43% and 30%, respectively, by 2030 compared to 2005. The ETS is an EU-wide scheme which regulates the GHG emissions of larger industrial emitters including electricity generation, cement manufacturing and heavy industry. The non-ETS sector includes all domestic

GHG emitters which do not fall under the ETS scheme and thus includes GHG emissions from transport, residential and commercial buildings and agriculture. Ireland's obligation under the Regulation is a 30% reduction in non-ETS GHG emissions by 2030 relative to its 2005 levels.

National legislation

In 2015, the Climate Action and Low Carbon Development Act was enacted by the Oireachtas. The purpose of the Climate Act was to enable Ireland '*to pursue, and achieve, the transition to a low carbon, climate resilient and environmentally sustainable economy by the end of the year 2050*' (3. (1) of No. 46 of 2015). This is referred to in the Climate Action and Low Carbon Development Act as the '*national transition objective*'.

In June 2020, the Government published the Programme for Government – Our Shared Future (Government of Ireland 2020). In relation to climate, there is a commitment to an average 7% per annum reduction in overall greenhouse gas emissions from 2021 to 2030 (51% reduction over the decade) with an ultimate aim to achieve net zero emissions by 2050. Policy changes will include the acceleration of the electrification of the transport system, including electric bikes, electric vehicles and electric public transport, alongside a ban on new registrations of petrol and diesel cars from 2030. In addition, there will be a policy to ensure an unprecedented model shift in all areas by a reorientation of investment to walking, cycling and public transport.

Following on from Ireland declaring a climate and biodiversity emergency in May 2019 and the European Parliament approving a resolution declaring a climate and environment emergency in Europe in November 2019, the Government approved the publication of the Climate Action and Low Carbon Development (Amendment) Bill in March 2021, and it was signed into Law in July 2021 by the President. The Climate Action and Low Carbon Development (Amendment) Act was prepared for the purposes of giving statutory effect to the core objectives stated within the Climate Action Plan.

The purpose of the Climate Action and Low Carbon Development (Amendment) Act is to provide for the approval of plans 'for the purpose of pursuing the transition to a climate resilient, biodiversity rich and climate neutral economy by no later than the end of the year 2050'. The 2021 Climate Act will 'provide for carbon budgets and a sectoral emissions ceiling to apply to different sectors of the economy'. The 2021 Climate Act defines the carbon budget as 'the total amount of greenhouse gas emissions that are permitted during the budget period'.

The Climate Action and Low Carbon Development Act made provision for a national mitigation plan (which was quashed by the Supreme Court in FOIE v The Government of Ireland & Ors on 31 July 2020). However, the 2021 Climate Act has subsequently removed any reference to a national mitigation plan and instead refers to both the Climate Action Plan, first published in 2019 and updated in 2021, and a series of National Long Term Climate Action Strategies.

This assessment has been prepared in accordance *inter alia* with EU Directive 2011/92/EU as amended by Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment ("the EIA Directive"), the Transport (Railway Infrastructure) Act 2001 (as amended and substituted), the European Union (Railway Orders) (Environmental Impact Assessment) (Amendment) Regulations 2021 (S.I. No. 743/2021) which give further effect to transposition of the EIA Directive by amending the Transport (Railway Infrastructure) Act 2001.

13.2.2 Policy

National Policy

The Climate Act adaptation plan, referred to as the 'national climate change adaptation framework', which is required to be submitted to Government for approval every five years, outlines a range of objectives to:

- Specify the national strategy for the adaptation measures in different sectors which reduces the vulnerability of the State to the negative effects of climate change and to avail of the positive effects of climate change that may occur.
- Take into account any existing obligations of the State under the law of the EU or any international agreement.

The 2021 CAP (DCCAE 2021), published in November 2021, outlines the current status across key sectors including electricity, transport, built environment, industry and agriculture and outlines the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. The 2021 CAP also details the required governance arrangements for implementation including carbon-proofing of policies, establishment of carbon budgets, a strengthened Advisory Council and greater accountability to the Oireachtas. The 2021 CAP (in Section 15.3) acknowledges that policies need to be better aligned to achieve more ambitious targets for modal shift, which will involve the building of supporting infrastructure. This is intended to result in a significant increase in public transport and active travel journeys. The 2021 CAP also states that there will be an expansion of sustainable-travel measures.

The 2021 CAP identifies the electrification of transport as the most cost-effective abatement opportunity. The 2021 CAP outlines a range of targets for electrification of vehicles including:

- Increasing the number of passenger electric vehicles (EVs) on the road to 845,000 by 2030, from a 2018 number of c. 2,000.
- Reaching 95,000 electric vans and trucks by 2030, from a 2018 number of c. 85.
- Commence delivery of DART+ (Action 240).
- Removal of obstacles to decarbonisation of our transport fleet.
- Procuring 1,500 low-emission buses for public transport in cities.
- Increasing the biofuel blend rate from the current E5 and B5 blends to E10 and B20 in petrol and diesel, respectively (i.e. increasing the percentage of bioethanol in petrol from 5% to 10% and increasing the amount of biodiesel in diesel from 5% to 20%).

The 2021 CAP has set a transport sector reduction target in GHG emissions of 42% to 50% relative to 2030 pre- National Development Plan 2018 – 2027 (hereafter referred to as the NDP) (Government of Ireland 2018) projections.

The Climate Action Plan (DCCAE 2021) outlines the current status across key sectors including electricity, transport, built environment, industry and agriculture and outlines the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. The Climate Action Plan also details the required governance arrangements for implementation which includes:

- Carbon-proofing of policies.
- The establishment of carbon budgets.
- A strengthened Climate Change Advisory Council.
- Greater accountability to the Oireachtas.

The DART+ Programme is specifically mentioned in the Climate Action Plan under Action 240. The Climate Action Plan notes that a modal shift from private to public transport should be facilitated by implementation of major sustainable-mobility projects such as DART Expansion, MetroLink, and the BusConnects Programme. These projects will assist in achieving the committed additional 500,000 public transport and active travel journeys daily by 2035. This modal shift from the private car to sustainable transport such as the DART+ is also supported through the Sustainable Mobility Policy Action Plan 2022 – 2025 published April 2022 (Department of Transport 2022). This plan aims to making it easier to switch between walking, bike, bus and rail on your journey and move the public transport fleet to low and zero emission vehicles. Core action 12 of the decarbonisation of public transport relates to the Commence delivery of DART+ Programme, with the DART+ West Railway Order being submitted in 2022.

In relation to the sectoral emissions ceiling, the Minister for the Environment, Climate and Communications (the Minister for the Environment) shall prepare and submit to government the maximum amount of

greenhouse gas emissions that are permitted in different sectors of the economy during a budget period and different ceilings may apply to different sectors. In relation to carbon budgets, the Climate Action and Low Carbon Development (Amendment) Act states '*A carbon budget, consistent with furthering the achievement of the national climate objective, shall be proposed by the Climate Change Advisory Council, finalised by the Minister and approved by the Government for the period of 5 years commencing on the 1 January 2021 and ending on* 31 *December 2025 and for each subsequent period of 5 years (in this Act referred to as a 'budget period')*'. The carbon budget is to be produced for 3 sequential budget periods with the third carbon in draft format. The carbon budget can be revised where new obligations are imposed under the law of the European Union or international agreements or where there are significant developments in scientific knowledge in relation to climate change. The Climate Action and Low Carbon Development Act provided for the establishment of the Climate Change Advisory Council (hereafter referred to as the Advisory Council) with the function to advise and make recommendations on the preparation of the national mitigation and adaptation plans and compliance with existing climate obligations.

The Climate Change Advisory Council is to advise and make recommendations on the following:

- The preparation of a climate action plan.
- The preparation of a national long term climate action strategy.
- The preparation of a national adaptation framework.
- The finalization and revision of a carbon budget.
- Compliance with any existing obligations of the State under EU law or any international agreements.

The Climate Change Advisory Council is to conduct a review by 15 September in each year of the progress made during the immediately preceding year in, these reviews started in 2017:

- Achieving reductions in greenhouse gas emissions.
- Complying with the carbon budget and each sectoral emissions ceiling for that period.
- Furthering the achievement of the national climate objective.

The Minister with responsibility for each sector, will give an account of matters during the period to which the annual report relates including:

- Sector specific progress under the most recent Climate Action Plan and any significant failure to implement such policies and measures, or to achieve sector specific targets.
- Whether there has been a reduction or increase in GHG emissions based on the EPA report.
- Compliance with the sectoral emissions ceiling and any measures envisaged to address any failures to comply with the target.
- The implementation of adaptation policy measures and any adaptation policy measures envisaged, where a sectoral adaptation plan has been prepared.

The Minister for the Environment shall request each local authority to make a 'local authority climate action plan' lasting five years and to specify the mitigation measures and the adaptation measures to be adopted by the local authority. Each local authority shall consult and co-operate with an adjoining local authority in making a local authority climate action plan and co-ordinate the mitigation measures and adaptation measures to be adopted, where appropriate. Each local authority is also required to consider any significant effects the implementation of the local authority climate action plan may have on the adjoining local authority.

The Electricity & Gas Networks Sector Climate Change Adaptation Plan prepared under the National Adaptation Framework has been prepared by the Department of Communications, Climate Action and Environment (DCCAE 2019b) and considers future climate change impacts on energy infrastructure and aims to reduce vulnerability by building resilience in the energy sector. The plan proposes to avoid or minimise future adverse impacts within the sector and to exploit opportunities. Steps include diversification of energy sources, improved communication between relevant bodies/stakeholders, a requirement for energy network companies to continue to ensure climate change is taken into account in planning and design standards and engineering management practices and identification of vulnerable areas and measures to take with respect to climate impacts.

The Transport Climate Change Sectoral Adaptation Plan (DTTAS 2019) was also prepared under the National Adaptation Framework used the six-step approach outlined in the Sectoral Planning Guidelines for Climate Change Adaptation. The plan states that the adaptation measures should enable continued services and maintained infrastructure as well as safeguarding new assets from longer term impacts by ensuring that current design specifications will adequately address future infrastructure needs. Appendix II of the plan discusses how future climate change has the potential to impact the transportation and heavy rail network, the risks involved in these impacts (i.e. heat waves which increased risk of rail buckling and misalignment of tracks which would increase the need for network-wide speed restrictions), the risks associated with the impacts and consequences of such risks.

Regional Climate Change Policy

A Dublin Metropolitan Climate Action Regional Office (CARO) was established as one of four regional climate change offices, in response to Action 8 of the 2018 National Adaptation Framework (NAF) (DCCAE 2018). One of its roles is to assist the local authorities within the region in preparing their Climate Change Action Plan. The four local authorities within the Dublin region (Dublin City Council (DCC), Fingal County Council (FCC), South Dublin County Council (SDCC) and Dún Laoghaire Rathdown Council (DLRCC)) each have individual climate change action plans. The individual plans were prepared having regard to 'A Strategy Towards Climate Change Action Plans for the Dublin Local Authorities' (Codema 2017a). This combined plan stated aims including aiding the Councils in tackling climate change and setting a path to tackling the challenges related to the consequences of climate change. As the proposed development will pass through both DCC and FCC, a more detailed discussion on DCC and FCC's jurisdictions respective climate action plans is outlined below.

The DCC 'Climate Change Action Plan' (DCC and Codema 2019) outlines a number of goals and plans to prepare for and adapt to climate change. There are five key action areas within the plan: energy and buildings, transport, flood resilience, nature-based solutions and resource management. Some of the transport-related measures promoted within the DCC Climate Action Plan involve the development of segregated cycle routes, the promotion of bike share schemes and promotion of the use of green infrastructure. Transportation integration is discussed within the DCC Climate Action Plan with DCC confirming that they will work with the National Transport Authority (NTA), TII, Dublin Bus, Iarnród Éireann, Bus Éireann, Road Safety Authority (RSA) and private operators to improve the connectivity of public transport systems. The proposed development will directly connect with DART, Luas and the proposed BusConnects. The DCC Climate Change Action Plan noted that transport accounted for 24.8% of GHG emissions in 2018 with 32% of transport in Dublin completed using a private car. DCC aims to achieve a doubling of all active travel and public transport trips and to halve private vehicle trips in Dublin by 2030. Action T50 is to implement policy to increase modal shift to public transport. The DART+ Programme aims to add additional capacity to cope with the model shift.

FCC has also produced a 'Climate Change Action Plan for 2019–2024' (FCC and Codema 2019) which outlines FCC's goals to mitigate GHG emissions and plans to prepare for and adapt to climate change. Appendix II of the FCC plan states that transport accounted for 44.6% of FCC total GHG emissions in 2016. The FCC Plan states that FCC Climate Change Action Plan aims to reduce car dependency by encouraging modal shifts from car to more sustainable modes, including public transport and cycling. Similar to DCC, FCC states that it aims to work with the relevant transportation bodies to introduce measures to achieve better integration of transportation and land use planning, modal shifts and promote interchange between modes. A target of a 40% reduction in the Council's GHG emissions by 2030 has been set by Fingal County Council. Part of the mechanism to achieve these goals will be through the improvement of public transport, the DART+ Programme (previously referred to as DART Expansion) is specifically mentioned as part of this integrated transport strategy (Action T24).

The FCC Climate Change Action Plan highlights the risks that climate change poses to the transportation network with risks mainly associated with extreme weather events and sea level rise. The FCC Climate Change Action Plan notes that sea level rise, extreme weather events (and in particular cold snaps, heat waves and dry spells) and coastal, fluvial and pluvial flooding have the greatest future risk when both the

likelihood and consequence are accounted for. Increases in fluvial and pluvial flooding will cause road damage, which can lead to disruption of transport services.

As well as DCC and FCC the proposed development also passes through Kildare and Meath. Ensuring that climate adaptation considerations are mainstreamed into all plans and policies and integrated into all operations and functions of the local authority is noted as one of the main functions of KCC Climate Adaptation Strategy 2019 – 2024 (Kildare County Council 2019). Kildare is at risk of potential climate impacts including wetter winters and drier summers, which could lead to water shortages. The strategy includes 121 adaptation actions set out under the six high level goals in order to ensure any potential impacts due to climate change are not as significant. Timeframes for these goals vary from 1-5 years depending on the specific goal.

The Meath County Council (MCC) Climate Action Strategy (Meath County Council 2018) notes that its vision for climate change action presents a bold, exciting future for the county. The strategy aims to reduce CO_2 emissions of the county by at least 40% by 2030 while increasing the county's resilience by adapting to the impacts of climate change. Another stated aim is to support the NTA in the delivery of a strategic multi-modal park-and-ride facility at M3 Parkway and support the improvement of existing rail transport infrastructure at the train station. The measures also state an objective to support the electrification of rail lines.

Iarnród Éireann Strategy 2027 (published by Iarnród Éireann in 2021) supports national, regional and local climate policy. The Strategy has set a target for 2027 of 600 new electric and battery powered carriages which will expand services and result in almost 80% of journeys being potentially emission free (pending the source of the electricity). This includes the extension of the electrified DART services to Drogheda, Maynooth, M3 Parkway, Hazelhatch and Greystones, with the potential for the electrification of the Intercity services in future. As well as reducing emissions, there are also considerations of the potential impacts of climate change on the rail network. Iarnród Éireann aims to ensure that mitigation measures are put in place against coastal erosion, extreme weather and flooding to ensure rail connectivity is maintained. By 2027, Iarnród Éireann strategy states that 27 million annual passenger journeys will have been switched from diesel to electric due to network upgrades, with 77% of the electricity being supplied by renewable sources. In 2019, 2.75% of the network was electrified with an aim for this to be increased to 10% by 2027 and 40% by 2040. For parts of the network which cannot be electrified in the short to medium term, a transition to hybrid trains on InterCity and Regional services can reduce fuel consumption by up to 25%.

The National Transport Authority has published its Draft Greater Dublin Area Transport Strategy 2022-2042 (NTA 2022). This Transport Strategy is based on national policies on sustainability as set out in climate action and low carbon legislation, and in climate action plans. The strategy states that there is a goal of all urban public transport vehicles operating State services in the Greater Dublin Area to be zero-emissions by 2035. The overall transport strategy includes the DART+ Programme, increasing the electrified rail network from roughly 50 km to over 150 km while also increasing demand. The NTA aim for this strategy to contribute to Ireland's transition to a low carbon and climate resilient society. The Strategy also notes that the DART+ Programme will be accompanied by a significant investment in rail carriages which will be required to serve these corridors. The new fleet will either be fully electric train sets or battery electric fleet which can operate in advance of full electrification, using terminal charging arrangements. This can assist in reducing the reliance on fossil fuel powered engines.

13.2.3 Guidance

The assessment has been undertaken with reference to the most appropriate guidance documents relating to climate which are set out in the following sections. In addition to specific climate guidance documents, the following guidelines were considered and consulted in the preparation of this chapter:

- Environmental Protection Agency (EPA) Guidelines on the Information to be contained in Environmental Impact Statements (EPA 2002).
- Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) (EPA 2003).

- Draft Advice Notes for Preparing Environmental Impact Statements (EPA 2015a).
- Guidelines on the Information to be contained in Environmental Assessment Reports (hereafter referred to as the EPA Guidelines) (EPA 2022).

The assessment has made reference to national guidelines, where available, in addition to international standards and guidelines relating to the assessment of GHG emissions and associated climatic impact. These are summarised below:

- Climate Action and Low Carbon Development Act (Act. No. 46 of 2015) (hereafter referred to as the Climate Act).
- Climate Action and Low Carbon Development (Amendment) Act 2021 (No. 32 of 2021) (hereafter referred to as the 2021 Climate Act).
- National Adaptation Plan (DCCAE 2017).
- Climate Action Plan 2021 (hereafter referred to as the CAP) (DCCAE 2021).
- Department of Transport, Tourism and Sport (DTTAS) Transport – Climate Change Sectoral Adaptation Plan (DTTAS 2019).
- General Scheme of the Climate Action (Amendment) Bill 2019 (hereafter referred to as the General Scheme).
- Dublin City Council (DCC) Climate Change Action Plan 2019 – 2024 (DCC and Codema 2019).
- The Kildare County Council Climate Adaptation Strategy 2019 – 2024 (Kildare County Council 2019).
- The Meath County Council (MCC) Climate Action Strategy 2019 - 2024 (Meath County Council 2018).
- Fingal County Council (FCC) Climate Change Action Plan 2019 – 2024 (FCC and Codema 2019).
- European Commission 2030 Climate and Energy Policy Framework (European Commission 2014).
- Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (European Commission, 2013).
- Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report (European Commission, 2017).
- Transport Infrastructure Ireland (TII) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (TII 2011).
- Design Manual for Roads and Bridges (DMRB): LA 114 – Climate (UKHA 2019).
- Institute of Environmental Management & Assessment (IEMA) Assessing GHG Emissions and Evaluating their Significance (IEMA 2017).
- IEMA EIA Guide to: Climate Change Resilience and Adaptation (IEMA 2020a).
- IEMA GHG Management Hierarchy (IEMA 2020b).
- Institute of Environmental Management & Assessment (IEMA) Assessing GHG Emissions and Evaluating their Significance (IEMA 2022).

13.3 Methodology

The Institute of Environmental Management and Assessment (IEMA) guidance note on "Assessing Greenhouse Gas Emissions and Evaluating their Significance" (IEMA 2022) states that "*the crux of significance regarding impact on climate is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050"*. Mitigation has taken a leading role within the Guidance compared to the previous edition published in 2017. Early stakeholder engagement is key and therefore mitigation should be considered from the outset of the project and continue throughout the project's lifetime in order to maximise GHG emissions savings.

The assessment aims to quantify the difference in GHG emissions between the proposed development and the baseline scenario (the alternative project/solution in place of the proposed development). This is done

by calculating the difference in whole life net GHG emissions between the two options. The IEMA EIA guidance (IEMA 2022) does not recommend a particular approach for this due to variations of situations but instead it sets out advice for the key common components necessary for undertaking a GHG emissions assessment. During the assessment IEMA recommend use of a reasonable worst-case scenario rather than an absolute worst-case scenario. The IEMA Guidance (IEMA 2022) state that GHG emissions assessment should incorporate the following steps into any climate assessment:

Set the scope and boundaries of the GHG assessment;

1. Develop the baseline.
2. Decide upon the emissions calculation methodologies.
3. Data collection.
4. Calculate/determine the GHG emissions inventory.
5. Consider mitigation opportunities and repeat steps 4 & 5.

Activities that do not significantly change the result of the assessment can be excluded where expected emissions are less than 1% of total emissions, and where all such exclusions should be clearly stated and total a maximum of 5% of total emissions.

When considering the cumulative assessment, all global cumulative GHG sources are relevant to the effect on climate change. As a result, the effects of GHG emissions from specific cumulative projects therefore in general should not be individually assessed. This is due to the fact that there is no basis for selecting any particular (or more than one) cumulative project that has GHG emissions for assessment over any other.

The assessment methodology also takes guidance from the United Kingdom (UK) Highway Agency (UKHA) Design Manuals for Roads and Bridges (DMRB) - LA 114 Climate (hereafter referred to as LA 114 Climate) (UKHA 2019) which advises that the assessment of a proposed road scheme should describe the likely significant effects on the environment resulting from both the:

- Impact of a project on climate (GHG emissions).
- Vulnerability of a project to climate change (adaptation).

While this is not a road scheme, the guidance provides a methodology for the assessment of the impacts that is applicable to the proposed development.

The following section details the specific appraisal methods utilised in order to complete the assessment in accordance with the IEMA and LA 114 Climate Guidance Documents (IEMA 2022) (UKHA 2019).

13.3.1 Study Area

The proposed development covers an extensive linear study area between Dublin City centre (Connolly / Spencer Dock Stations) and the proposed depot located west of Maynooth with a spur to the M3 Parkway Station. Full details of the project description can be found in Chapter 4 Description of the Proposed Development in Volume 2 of this EIAR.

The proposed development has been divided into six zones (A-F), namely Zone A, Zone B, Zone C, Zone D, Zone E and Zone F which are detailed in Chapter 4 of this EIAR.

Zone A extends westwards from the City Centre to Phibsborough / Glasnevin on the GSWR railway line. Zone B extends westwards along the MGWR line from the proposed Spencer Dock Station to Glasnevin Junction. Zone C continues along the MGWR line from Glasnevin junction/ Phibsborough to Clonsilla Station/Junction. Zone D continues from Clonsilla Station/Junction to M3 Parkway Station. Zone E extends from Clonsilla Station/Junction to Maynooth Station, and Zone F; Maynooth Station including offline double tracks to the proposed Maynooth depot.

Some of the proposed works are common to all sections of the proposed development and include:

- Overhead line electrification equipment (OHLE) will be required to provide electrical power to the network´s new electrified train fleet.
- Signalling upgrades and additional signalling.
- Improved boundary walls and fencing.
- Utility diversions, vegetation management and other ancillary works.

The proposed development consists of the upgrading of a currently operational railway corridor. The line originates on two spurs, one from Connolly Station and the second from the Docklands Station both of which are within 1 km of each other in the east of Dublin City Centre. These lines run through primarily residential areas with some industrial sections for approximately 14 km. The two spurs run roughly parallel and join at the Glasnevin Junction. The land use in the immediate vicinity of the proposed development is predominantly urban up to Clonsilla Junction, the split in the Maynooth and M3 Parkway railway corridors. To the west of this point, the Maynooth spur is surrounded by greenfield and some urban centres (Leixlip and Maynooth). The M3 Parkway spur is similar to the Maynooth spur, with primarily greenfield sites. The M3 Parkway line passes the urban area of Dunboyne. The study area covers a considerable area and crosses areas that are sensitive to future climate change impacts such as flooding (see the Site Specific Flood Risk Assessment (SSFRA) which has been submitted as a supporting document to the EIAR). During the operational phase, the study area focus is on GHG emissions associated with the proposed development including GHG emissions adjustments due to changes to the rail services, the maintenance depot and impacted traffic routes within the study area. Potential impacts to climate relate to alterations to road traffic patterns, power for running stations and electrified rail line, maintenance and changes to the number and type of rail and road traffic trips. The assessment of the operational phase will also examine the vulnerability of the proposed development to climate change, including the risk of flooding and the potential increased frequency of storms.

13.3.1.1 Construction phase study area

During the construction phase, the focus is on the enabling infrastructure provision, which forms the proposed development including utility diversions, land take activities, excavation works, road reconfiguration, significant construction materials and construction traffic emissions.

13.3.1.2 Operational phase study area

During the operational phase, the study area focus is on GHG emissions associated with the proposed development including GHG emissions along impacted traffic routes within the study area. Potential impacts to climate relate to alterations to road traffic patterns, power for running stations and the proposed development, maintenance and changes to the number and type of road and rail traffic trips. The assessment of the operational phase also examines the vulnerability of the proposed development to climate change, including the risk of flooding and the potential increased frequency of storms.

13.3.2 Survey methodology

The climate chapter is desktop based with no surveys undertaken.

13.3.3 Construction Phase Appraisal Method for the Assessment of Impacts

The Institute of Environmental Management and Assessment (IEMA) guidance note on “Assessing Greenhouse Gas Emissions and Evaluating their Significance” (IEMA 2022) appraisal assessment aims to quantify the difference in GHG emissions between the proposed development and the baseline scenario (the alternative project/solution in place of the proposed development). This is done by calculating the difference in whole life net GHG emissions between the two options. The IEMA EIA guidance (IEMA 2022) does not recommend a particular approach to complete this assessment and ‘LA 114 – Climate’ (UKHA 2019) Guidance has been used to provide the appraisal methods.

‘LA 114 – Climate’ (UKHA 2019) outlines the recommended sources of input data and the appraisal methodology for the assessment of impacts for both the construction phase and operational phase as

outlined in Table 13.1 (reproduced from Table 3.11.1 of LA 114 – Climate). A detailed discussion of the input data and appraisal methodology for both the construction and operational phases is detailed in Section 13.3.6.

13.3.3.1 Embodied Construction Emissions

Section 3.13 of 'LA 114 – Climate' (UKHA 2019) recommends, that when calculating GHG emissions for a project's life cycle, '*an industry recognized carbon calculation tool(s)*' should be used. The embodied construction emissions for the proposed development were calculated using the TII Carbon Assessment Tool (Version 2.1) (TII 2021). The TII Carbon Tool (TII 2021) uses emission factors from recognized sources including the Civil Engineering Standard Method of Measurement (CESSM) Carbon and Price Book database (CESSM, 2013). The carbon emissions are calculated by multiplying the emission factor by the quantity of the material that will be used over the entire construction / maintenance phase.

The assessment commences with the high-level design, through the pre-construction (site clearance) stage, followed by the assessment of the embodied carbon associated with all materials used in the construction of the proposed development, the emissions during the construction phase and additionally emissions related to waste generated during the construction phase. The tool also assesses on-going maintenance associated with the default 60-year lifetime of the development. It is generally assumed that end-of-life demolition is not relevant and thus there are no emissions associated with this stage.

The construction phase of the proposed development will result in GHG emissions from various sources, as outlined in Table 13.1. Embodied carbon refers to GHGs emitted during the manufacture, transport and use of building materials, together with end-of-life emissions. As part of the proposed development, construction phase embodied GHG emissions are categorised under the following headings:

- Land clearance activities.
- Manufacture of materials and transport to site.
- Construction works (including excavations, construction, water usage, electrical power/fuel usage, personnel travel and project size).
- Construction waste products (including transport off-site).

Detailed information for the proposed development, including volumes of materials were obtained from the design team. The proposed development is expected to have a construction phase of approximately 47 months and an operational lifespan of 60 years. Standard maintenance, as indicated through the TII Carbon tool (TII 2021), required over the operational phase has also been considered as part of the embodied construction emissions including consideration of the maintenance cycles for embodied carbon for road pavements. Given the extent of the operational phase, 'LA 114 – Climate' (UKHA 2019) states that decommissioning should be excluded from the climate assessment.

It should be noted that the quantification of materials at the preliminary design stage has been completed to assess the embodied construction carbon. The exact volumes of materials, location of waste disposal sites, sourcing of products and technical specification for materials will be finalised during the detailed design phase by the appointed contractor. Throughout the assessment, efforts have been made to provide the most likely scenario for the embodied carbon assessment.

13.3.3.2 Land Use Change

The land use change associated with the construction phase of the proposed development has been quantified using the approach outlined in Table 13.1. The DART+ West project is essentially an electrification project along an existing and established operational railway corridor and therefore the majority of the route has no land use change as a result of the proposed development. Trees are a natural carbon sink and absorb carbon dioxide (CO_2) from the atmosphere helping in the reduction of climate change; any felling of trees has the potential to result in a loss of this carbon sink thus increasing the levels of CO_2 in the atmosphere. In contrast, increased planting of trees on suitable lands will, over time, help to increase the carbon sink potential of the land and benefit climate. The change in land use associated with the proposed

development, including felling and planting of trees and vegetation, has been calculated using the methodology outlined in the Intergovernmental Panel on Climate Change (IPCC) 'Guidelines on National Greenhouse Gas Inventories – Chapter 4: Forest Land' (IPCC 2006). Consideration is also given to the 2010 European Commissions Guidelines for the calculation of land carbon stocks for the purpose of Annex V to Directive EU 2009/28/EC and operational land use change is also appropriately assessed.

Table 13.1 Sources and Life Cycle Stages for a Project's GHG Emissions (reproduced from Table 3.11.1 of LA 114 – Climate (UKHA 2019))

Main Stage of a Project Life Cycle	Sub-stage of Life Cycle	Potential Sources of GHG Emissions (Not Exhaustive)	Examples of Activity Data
Construction stage	Product stage: including raw material supply, transport and manufacture.	Embodied GHG emissions associated with the required raw materials.	Material quantities.
	Construction process stage; including transport to/from works site and construction/installation processes.	Activities for organisations conducting construction work.	Fuel/electricity consumption. Construction activity type/duration. Transportation of materials from point of purchase to site, mode / distance. Area of land use change.
	Land use change.	GHG emissions mobilised from vegetation or soil loss during construction.	Type and area of land subject to change of usage.
Operation ('use-stage') (to extend 60 years in line with appraisal period)	Operation and maintenance (including repair, replacement and refurbishment). This also includes electrical power required for stations and traction.	Energy consumption for infrastructure operation and activities of organisations conducting routine maintenance.	Fuel/electricity consumption. For vehicles, lighting and plant. Raw material quantities and transport mode/distance. Waste and arisings quantities, transport mode/distance and disposal fate.
	Use of infrastructure by the end-use (road user).	Vehicles using highways infrastructure.	Traffic count/speed by vehicle type for highway links.
	Land use and forestry.	Ongoing land use GHG emissions/sequestration each year.	Type and area of land subject to change in usage. Net change in vegetation.
Opportunities for reduction	GHG emissions potential of recovery including reuse and recycling GHG emissions potential of benefits and loads of additional functions associated with the study system.	Avoided GHG emissions through substitution of virgin raw materials with those from recovered sources.	Waste and arisings material quantities and recycling/reuse fate.

Note: The first life cycle stage is 'construction', which includes GHG emissions from the construction process and the manufacture/transport of materials. The second life cycle stage is 'operation', which includes:

1) Operation and maintenance, repair, replacement, refurbishment and land use change (operational maintenance GHG emissions); and

2) Emissions from end-users (operational user GHG emissions).

The third life cycle stage comprises opportunities to minimise production/use of GHG emissions i.e. the potential for reduction of GHG emissions through reuse and recycling during the construction of the proposed development.

13.3.3.3 Traffic Related Emissions

Section 3.16 of 'LA 114 – Climate' appraisal guidance recommends that '*an appropriate validated traffic model shall be used to estimate operational road user GHG emissions*. The guidance also outlines the approach for defining the scope of the assessment. 'LA 114 – Climate' states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed development and should be included in the assessment:

- A change of more than 10% in AADT.
- A change of more than 10% to the number of heavy-duty vehicles.

- A change in daily average speed of more than 20km/hr.

Due to the setup of the traffic model for the proposed development, the preferred option of use of the National Transport Authority's (NTA) Environmental Appraisal Module, which is based on the ENEVAL software, to calculate GHG emissions was not feasible. The ENEVAL software is recommended by the Codema in the publication 'Developing CO_2 Baselines – A Step-by-Step Guide for your Local Authority' (Codema 2017b). However, the ENEVAL software requires use of the NTA Regional Model System which was not required for use by the traffic engineers for this project. Section 12.3.5.1 of Chapter 12 Air Quality details the two types of models used as part of the road traffic assessment. One is a "simple assessment" or DMRB assessment and the other a "detailed assessment" or ADMS assessment.

Section 12.3.5.1 of Chapter 12 Air Quality discusses the UK DMRB Screening Model (UKHA 2007) (Version 1.03c, July 2007) (UKHA 2007) methodology which has historically been used routinely for the climate impact of schemes which impact road traffic in Ireland (TII 2011). However, the emission factors in the DMRB are based on the COPERT III database with the DMRB last updated in 2007. The database does not take account of the recent advances in engine technology and thus is predicted to overestimate emissions data. The procedures given by TII in the Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (TII 2011), LA 114 – Climate (UKHA 2019) and the methodology provided in Annex 2 in the UK DMRB (UKHA 2007) was used to model the construction and operational phases of the proposed development where a simple assessment was deemed suitable for the air quality assessment. The assessment focuses on determining the resulting change in emissions of CO_2. Annex 2 provides a method for the prediction of the regional impact of emissions of these pollutants from road schemes. The regional impact of the additional vehicle movements due to the proposed development on emissions of CO_2 was assessed using the DMRB screening model (UKHA 200 7). The inputs to the regional model, which provides information on the CO_2 emissions consists of information on road link lengths, AADT movements and annual average traffic speeds. The road links which were modelled using this technique are shown in Table 12.25 (see Chapter 12 in Volume 2 of this EIAR) and Drawing no. MAY-MDC-ENV-ROUT-DR-V-120004-D in Volume 3A of this EIAR for the construction phase and Table 12.50 (see Chapter 12 in Volume 2 of this EIAR), Table 12.56 (see Chapter 12 in Volume 2 of this EIAR), Drawing no. MAY-MDC-ENV-ROUT-DR-V-120013-D in Volume 3A of this EIAR and Drawing no. MAY-MDC-ENV-ROUT-DR-V-120015-D in Volume 3A of this EIAR for the operational phase.

Section 12.3.5.2 of Chapter 12 outlines the detailed assessment known as ADMS which is required to be used in areas which meet certain criteria. This model has been used in the Spencer Dock region due to the sensitivity of the baseline air quality environment. In addition to the emissions discussed in Chapter 12 Air Quality the model produces the annual CO_2 emissions per road link. The model set up is as detailed in Section 12.3.5.2 Chapter 12 Air Quality and the road links which were modelled using this technique are shown in Table 12.30 (see Chapter 12 in Volume 2 of this EIAR) and Drawing no. MAY-MDC-ENV-ROUT-DR-V-120006-D in Volume 3A of this EIAR.

Table 13.1 outlines the sources and activity classes for the operational phase of the proposed development including operational end-use (road user) and operation and maintenance. The construction phase traffic movements are also included as part of embodied carbon assessment detailed in Section 13.3.3.1 as this assessment accounts for emissions that are outside of the study area for the traffic assessment. Hence there will be a degree of double counting.

13.3.4 Operational phase Appraisal Method for the Assessment of Impacts

The operational phase impact of the proposed development has two significant sources that have the potential to lead to a change in GHG emissions. The most significant potential change in GHG emissions is the operational emissions shift from diesel to electricity. A change from fossil fuels to electricity, which can be provided from renewable sources, has significant potential for reducing emissions.

In addition to the running of the rail stock and stations, there will be electrical power requirements for the running of the proposed depot, Spencer Dock Station and the substations. There is also the potential for

road traffic related emissions associated with the operational phase of the proposed development. Standard maintenance required over the operational phase has also been considered as part of the Construction phase embodied construction emissions.

The closure of level crossings at Ashtown, Coolmine, Porterstown, Clonsilla, Barberstown and Blakestown has the potential to impact the distribution of road traffic in these areas. There is the potential to change total GHG emissions if the redistributed routes for traffic are longer or more congested.

13.3.4.1 Traffic Related Emissions

Operational phase traffic emissions were modelled as per the construction phase traffic, as described in Section 12.3.5.1 in Chapter 12 Air Quality in Volume 2 of this EIAR. The operational phase redistribution of traffic due to level crossing closures has the potential to change emissions. In addition, the depot will have parking available for staff members. The potential for GHG from these two elements has been calculated using the appraisal method discussed in Section 13.3.3.3.

The closure of level crossings at Ashtown, Coolmine, Porterstown, Clonsilla, Barberstown and Blakestown has the potential to impact the distribution of road traffic in these areas. An assessment by the traffic engineers deemed only two of the areas to be impacted by operational phase changes due to level crossing closures – Ashtown and Clonsilla.

There are no stations which have increased car parking facilities as part of the proposed development and although additional drop off of railway passengers are likely, they are not predicted to attract significant additional private car journeys or impact per LA 114 Guidance (Section 13.3.3.3).

13.3.4.2 Operational phase Rail Emissions

Fossil fuel powered trains have the potential to have impacts on climate. The proposed development aims to reduce local and regional emissions of fossil fuels by the electrification of the rail line. The proposed Do-Something (DS) scenario (i.e. the future scenario with the proposed development operational) will become heavily weighted towards electric multiple units (EMUs) with some diesel multiple units (DMUs) on the line due to shared use with intercity lines. Unlike the diesel units, the EMUs will have no localised tailpipe emissions. Table 12-12 in Section 12.3.6.4 of Chapter 12 Air Quality in Volume 2 of this EIAR details information on the current fuel usage by the DMUs per km travelled. In addition, information has been provided on the electric power required to power an EMU (DART Unit 8537) for a km (1.43 kWh/km). For the DS the power usage has been modelled as requiring 80% of the Do-Nothing (DN). Therefore, for the DS scenario the proposed 10 car trains has been assumed to require the same power as the DN 8 car trains.

Emissions for diesel units are provided using the European Monitoring and Evaluation Programme (EMEP) and European Environment Agency (EEA) 2019 Air Pollutant Emission Inventory Guidebook for Railways (EMEP and EEA 2019). The guidebook is part of a series published which are designed to facilitate reporting of emission inventories by countries to The United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution and the EU National Emission Ceilings Directive. Emissions of CO_2, CH_4 and N_2O are also included in the guidebook (see Table 13.2). Details on the three pollutants can be found in Section 13.4.2.

Emissions from diesel engines can be broken into three categories:

- Shunting locomotives.
- Railcars.
- Line-haul locomotives.

Table 13.2 Rail Emission Factors of Climate Related Pollutants

Tier 2 Shunting Locomotives			
Pollutant	**Kg/Fuel Tonne Note 1**	**Kg Pollutant/Km Note 2**	**g Pollutant /Km**
CO_2	3190	1.79	1788
CH_4	0.176	0.00010	0.100
N_2O	0.024	0.00001	0.013
Tier 2 Rail Cars			
Pollutant	**Kg/Fuel Tonne Note 1**	**Kg Pollutant/Km Note 2**	**g Pollutant /Km**
CO_2	3140	1.76	1760
CH_4	0.179	0.00010	0.100
N_2O	0.024	0.00001	0.013
Tier 2 Line-Haul Locomotives			
Pollutant	**Kg/Fuel Tonne Note 1**	**Kg Pollutant/Km Note 2**	**g Pollutant /Km**
CO_2	3140	1.76	1760
CH_4	0.182	0.00010	0.102
N_2O	0.024	0.00001	0.013

Note 1: Emissions factors from Air Pollutant Emission Inventory Guidebook for Railways (EMEP and EEA 2019)

Note 2: Emission factors based on Air Pollutant Emission Inventory Guidebook for Railways (EMEP and EEA 2019) and Iarnród Éireann average Diesel usage

The approach for the DMUs, referred to as Tier 2 in the Guidance (EMEP and EEA 2019), is based on apportioning the total fuel used by railways to that used by different locomotive technology types as the measure of activity. It assumes that the fuel can be apportioned for example using statistics on the number of locomotives, categorised by type, and their average usage, e.g. from locomotive maintenance records.

EMUs are powered by electricity generated at stationary power plants as well as other sources. As the rail stock move from DMUs to EMUs the associated emissions will be emitted at the powerplants generating electricity rather than through the DMU tailpipe. The emissions of pollutants generated due to the electricity power demand for the EMUs can be calculated using the carbon intensity of the fuel mix used in the generation of electricity nationally. In addition to the running of the railway corridor there will be energy required for running the proposed depot and Spencer Dock Station. These are used to assess the impact of the proposed development on regional pollutants and compare with Ireland's National Emissions Reduction Directive (Directive 2001/81/EC) 2030 targets.

The carbon intensity is the amount of CO_2 that will be released per kilowatt hour (kWh) of energy of a given fuel. For most fossil fuels the emissions per unit is almost constant, but in the case of electricity it will depend on the fuel mix used to generate the electricity and on the efficiency of the technology employed. A figure for carbon (CO_2) is updated by Sustainable Energy Authority of Ireland (SEAI) annually. The provisional 2020 carbon intensity figure of 295.1 gCO_2/kWh has been published on the SEAI website (SEAI 2021).

This carbon intensity is applicable for 2020 however it is expected that the pollution intensity per kWh will reduce by the opening year. The 2021 Climate Action Plan (CAP) has set a national target of up to 80% of electricity demand by renewables by 2030 for the national electricity grid. Currently, approximately 40% of the national grid electricity comes from renewable sources. Increasing the proportion of renewables, which will not have any additional fossil fuel emissions associated with them, will reduce the emissions per kWh of electricity produced on the national grid. The remaining power on the national grid will be supplied by fossil fuels, the emissions of which are carefully controlled by the EPA under the suppliers Industrial Emissions Directive, which ensures that CO_2 emissions will be controlled.

An estimation of the 2030 carbon intensity has been made for the purposes of this assessment assuming a national target of 80% of electricity demand by renewables having been met. The figure of 102.047 gCO_2/kWh was calculated based on a normalization of the 2020 carbon intensity and increasing the percentage renewables to 80%. This is an estimation of the potential future carbon intensity, the true value may be lower or higher depending on the carbon intensity of other fuels used to generate the remaining 20% and the changes in loss in transformation, transmission and distribution processes.

IÉ have agreed to purchase up to 80% of its operational demand from certified low or zero carbon electricity for operations. A Corporate Power Purchase Agreement (CPPA) is a financial contract with a renewable generator that will allow for a guaranteed source of renewable power for the operation of the proposed development in future. This will ensure that should the CAP target of 80% renewables not be achieved the proposed development will still achieve the target within itself. For the purposes of the assessment, it has been assumed both the DN and DS have 80% renewables.

Table 13.3 Estimated Emission Factors of Regional Pollutants per kWh

Pollutant	Kg Pollutant/kWh
CO_2 (2030) at 80% Renewables	0.102047

13.3.5 Impact Assessment Criteria

13.3.5.1 Construction and Operational phase Significance Criteria

'LA 114 – Climate' (UKHA 2019) outlines a recommended approach for determining the significance of both the construction and operational phases. The approach is based on comparing the '*Do Something*' scenario and the net project GHG emissions (i.e. *Do Something – Do Nothing*) to the relevant carbon budgets, where available.

After the publication of the 2021 Climate Act in July 2021 and the 2021 CAP, carbon budgets and sectoral ceilings for the transport sector will be adopted in the coming months and will be outlined in the 2022 CAP which will allow a comparison with the net CO_2 project GHG emissions. When assessing significance, LA 114 Climate recommends that the assessment of projects as significant should only occur 'where increases in GHG emissions will have a material impact on the ability of Government to meet its carbon reduction targets'.

Given the current absence of specific sectoral carbon budgets in Ireland, it is anticipated that any changes in net GHG emissions (either positive or negative) due to the proposed development will be significant. This viewpoint aligns with the Institute of Environmental Management and Assessment (IEMA) guidance note on 'Assessing Greenhouse Gas Emissions and Evaluating their Significance' (IEMA 2017) which advises that all carbon emissions contribute to climate change and in the absence of a defined threshold (e.g. national sector-specific targets and trajectories), any increase (or decrease) in carbon emissions may be considered as significant.

'LA 114 – Climate' (UKHA 2019) outlines a recommended approach for determining the significance of both the Construction and Operational phases. The approach is based on comparing the '*Do Something*' scenario and the net project GHG emissions (i.e. *Do Something – Do Nothing* to the relevant carbon budgets, where available.

Currently, no carbon budgets on a sectoral basis are available in Ireland. When assessing significance, LA 114 Climate recommends that the assessment of projects as significant should only occur '*where increases in GHG emissions will have a material impact on the ability of Government to meet its carbon reduction targets'*.

There are three overarching principles which are particularly relevant when considering the aspect of significance in the 2010 IEMA Principles Series on Climate Change Mitigation & EIA (IEMA 2010):

- The GHG emissions from all projects will contribute to climate change, the largest interrelated cumulative environmental effect.
- The consequences of a changing climate have the potential to lead to significant environmental effects on all topics in the EIA Directive (e.g. human health, biodiversity, water, land use, air quality).
- GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit; as such any GHG emissions or reductions from a project might be considered to be significant. The environmental limit is the national global GHG emission budget that defines a level of dangerous climate change, and any GHG emission that contributes to exceedance of that budget or threatens efforts to stay within it can be considered as significant.

The 2020 Guidance (IEMA 2022) document builds on those principles with three points:

- When evaluating significance, all new GHG emissions contribute to a negative environmental impact; however, some projects will replace existing development or baseline activity that has a higher GHG profile. The significance of a project's emissions should therefore be based on its net impact over its lifetime, which may be positive, negative or negligible.
- Where GHG emissions cannot be avoided, the goal of the EIA process should be to reduce the project's residual emissions at all stages.
- Where GHG emissions remain significant, but cannot be further reduced, approaches to compensate the project's remaining emissions should be considered.

Significance determination (IEMA 2022) takes account of any embedded or committed mitigation measures that form part of the design and should be considered.

- **Major or moderate adverse impact (significant):** A project that follows a 'business-as-usual' or 'do minimum' approach and is not compatible with the net zero[1] trajectory by 2050 or sectoral based transition to next zero targets, results in a significant adverse effect. It is down to the consultant completing the assessment to differentiate between the 'level' of significant adverse effects e.g. 'moderate' or 'major' adverse effects. A project's impact can shift from significant adverse to non-significant effects by incorporating mitigation measures that substantially improve on business-as-usual and meet or exceed the science-based emissions trajectory of ongoing but declining emissions towards net zero. Meeting the minimum standards set through existing policy or regulation cannot necessarily be taken as evidence of avoiding a significant adverse effect. This is particularly true where policy lags behind the necessary levels of GHG emission reductions for a science based 1.5°C compatible trajectory towards net zero.
- **Minor adverse impact (not significant):** A project that is compatible with the budgeted, science based 1.5°C trajectory (in terms of rate of emissions reduction) and which complies with up-to-date policy and 'good practice' reduction measures to achieve an impact that has a minor adverse effect but is not significant. The project may have residual impacts but is doing enough to align with, and contribute to, the relevant transition scenario. A 'minor adverse' or 'negligible' non-significant effect conclusion does not necessarily refer to the magnitude of GHG emissions being carbon neutral[2] (i.e. zero on balance) but refers to the likelihood of avoiding severe climate change and achieving net zero by 2050. A 'minor adverse' effect or better is a high bar and indicates exemplary performance where a project meets or exceeds measures to achieve net zero earlier than 2050.
- **Negligible Impact (not significant):** A project that achieves emissions mitigation that goes substantially beyond the reduction trajectory, or substantially beyond existing and emerging policy compatible with that trajectory, and has minimal residual emissions, is assessed as having a negligible effect that is not significant.
- **Beneficial Impact (significant):** A project that causes GHG emissions to be avoided or removed from the atmosphere has a beneficial effect that is significant. Only projects that actively reverse

[1] Net Zero: "*When anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period.*" Net zero is achieved where emissions are first educed in line with a 'science-based' trajectory with any residual emissions neutralised through offsets.

[2] Carbon Neutral: "*When anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period irrespective of the time period or magnitude of offsets required.*"

(rather than only reduce) the risk of severe climate change can be judged as having a beneficial effect.

Where the fundamental reason for a proposed development is to combat climate change and this beneficial effect drives the project need, then it is likely to be significant.

As further context to this approach to significance, it is recognised that there are many activities and sectors which are contributing to net GHG emissions in Ireland. Large industrial and power GHG emissions are captured in the context of the EU-wide ETS which has set defined targets which are being met due to the structure of the Cap-and-Trade mechanism which allows the price of carbon to rise to ensure that GHG emissions are reduced with the least cost. Most other activities such as agriculture, transport, built environment, waste and smaller industry, however, are subject to the GHG Regulations which has set a specific target for Ireland of a 30% reduction in GHG emissions by 2030.

13.3.6 Significance Criteria – Vulnerability of Proposed Development to Climate Change

'LA 114 – Climate' (UKHA 2019) outlines an approach for undertaking a risk assessment where there is a potentially significant impact on the proposed development receptors due to climate change. The risk assessment assesses the likelihood and consequence of the impact occurring to each receptor, leading to the evaluation of the significance of the impact. The operational phase assessment, after identifying the hazards and benefits of the climate change impacts, assesses the likelihood and consequences using the framework outlined in Table 13.4 and Table 13.5. The guidance advises that for the construction phase, a qualitative description of disruption risk is to be reported. This assessment approach is used as an example of an appropriate method in the IEMA EIA Guide to: Climate Change Resilience and Adaptation (IEMA 2020a).

Table 13.4 Likelihood Categories

Likelihood Category	Description (Probability and Frequency of Occurrence)
Very high	The event occurs multiple times during the lifetime of the project (60 years) e.g. approximately annually, typically 60 events.
High	The event occurs several times during the lifetime of the project (60 years) e.g. approximately once every five years, typically 12 events.
Medium	The event occurs limited times during the lifetime of the project (60 years) e.g. approximately once every 15 years, typically 4 events.
Low	The event occurs during the lifetime of the project (60 years) e.g. once in 60 years.
Very Low	The event occurs can occur during the lifetime of the project (60 years).

Table 13.5 Measure of Consequence

Consequence of Impact	Description
Very large adverse	Operation – national level (or greater) disruption to strategic route(s) lasting more than 1 week.
Large adverse	Operation – national level (or greater) disruption to strategic route(s) lasting more than 1 day but less than 1 week or regional level disruption to strategic route(s) lasting more than 1 week.
Moderately adverse	Operation – regional level disruption to strategic route(s) lasting more than 1 day but less than 1 week.
Minor adverse	Operation – regional level disruption to strategic route(s) lasting less than 1 day.
Negligible	Operation –disruption to an isolated section of a strategic route lasting more less than 1 day.

The likelihood and consequence of each impact is combined in the form of a matrix to identify the significance of each impact, as outlined in Table 13.6. The significance conclusions for each impact are

based on and incorporate confirmed design and mitigation measures. Where the assessment concludes that the project is significant, 'LA 114 – Climate' states that '*the design and mitigation hierarchy should be re-assessed to reduce the significance of impacts to an acceptable level (not significant)'*.

Table 13.6: Significance Matrix

Measure of Consequence		Measure of Likelihood				
		Very Low	**Low**	**Medium**	**High**	**Very High**
	Very Large	NS	S	S	S	S
	Large	NS	NS	S	S	S
	Moderate	NS	NS	S	S	S
	Minor	NS	NS	NS	NS	NS
	Negligible	NS	NS	NS	NS	NS

Note: NS = Not significant; S = Significant

13.3.7 Consultation

Consultation is important in order to ensure that a sufficiently robust environmental baseline is established for the proposed development and its surroundings, full details of the consultations are detailed in Chapter 3 (Alternatives). Consultation helps to identify specific concerns and issues relating to climate early in the process. Public consultation was conducted as part of the early-stage design of the proposed development. The following organisations were also consulted:

- Dublin City Council.
- Fingal County Council.
- Meath County Council.
- Kildare County Council.
- Environmental Protection Agency.
- Sustainable Energy Authority Ireland (SEAI).

No specific climatic issues were raised as part of the consultation process by these organisations.

13.3.8 Difficulties encountered/ Limitations

A reasonable worst-case scenario describes the most significant potential environmental impacts arising from the proposed development based on the project information available at this stage of the project, advised by an experienced and competent project design team. Difficulties were encountered during the quantification of materials at the design stage in order to assess the embodied construction carbon. The exact volumes of materials, location of waste disposal sites, sourcing of products and technical specification for materials are finalised during the detailed design phase and by the appointed contractor. Throughout the assessment, efforts have been made to provide the most likely or a conservative scenario of the embodied carbon assessment.

Where it is required to make assumptions as the basis of the assessment presented here, these assumptions are based on advice from competent project designers and are clearly outlined within the chapter.

13.4 Receiving Environment

Climate is defined as the average weather over a period of time (usually 30 years), whilst climate change is a significant change to the average weather. Climate change is a natural phenomenon but in recent years human activities, through the release of GHGs, have impacted on the climate (IPCC 2015). The release of

anthropogenic GHGs is altering the Earth's atmosphere resulting in a 'Greenhouse Effect'. This effect is causing an increase in the atmosphere's heat trapping abilities resulting in increased average global temperatures over the past 40 years. The release of CO_2 as a result of burning fossil fuels, has been one of the leading factors in the creation of this 'Greenhouse Effect'. The most significant GHGs are CO_2, methane (CH_4) and nitrous oxide (N_2O).

For the purposes of this assessment, the definition outlined in Council Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (European Parliament and Council of Europe 2009) for GHGs has been used. In 'Annex V, C. Methodology Point 5' the relevant GHGs are defined as CO_2, CH_4 and N_2O. CO_2 accounted for 60.8% of total GHG emissions in Ireland in 2020 while CH_4 and N_2O combined accounted for 37.7% (EPA 2021a).

GHGs have different efficiencies in retaining solar energy in the atmosphere and different lifetimes in the atmosphere. In order to compare different GHGs, emissions are calculated on the basis of their Global Warming Potential (GWPs) over a 100-year period, giving a measure of their relative heating effect in the atmosphere. The IPCC Fifth Assessment Report (AR5) (IPCC 2015) sets out the global warming potential for 100-year time period (GWP100) for CO_2 as the basic unit (GWP = 1) whereas methane gas (CH_4) has a global warming potential equivalent to 28 units of CO_2 and N_2O has a GWP100 of 265.

13.4.1 Vulnerability of the Proposed Development to Climate Change

'LA 114 – Climate' (UKHA 2019) outlines that the study area for assessing a project's vulnerability to climate change should be based on the construction footprint / project boundary (including compounds and temporary land take). Impacts as a result of climate change involve increases in global temperatures and increases in the number of rainfall days per year. Ireland has seen increases in the annual rainfall in the north and west of the country, with small increases or decreases in the south and east including in the region where the proposed development will be located (EPA 2017). The EPA has compiled a list of potential adverse impacts as a result of climate change including the following which may be of relevance to the proposed development:

- More intense storms and rainfall events.
- Increased likelihood and magnitude of river and coastal flooding.
- Water shortages in summer in the east.
- Adverse impacts on water quality.
- Changes in distribution of plant and animal species.

The historical regional weather data for Casement Aerodrome which is considered representative of the current climate in the region of the proposed development is shown in Table 13.7 (Met Éireann 2020). The region of the proposed development has a temperate, oceanic climate, resulting in mild winters and cool summers. The Met Éireann weather station at Casement Aerodrome, County Dublin, is the nearest weather and climate monitoring station to the proposed development that has meteorological data recorded for the 30-year period from 1981 to 2010. The monitoring station is located approximately 8km south of the proposed development at its nearest point. Meteorological data recorded at Casement over the 30-year period from 1981 to 2010 indicates that the wettest months were October and December, and the driest month on average was February. July was the warmest month with a mean temperature of 15.7°C.

The recent weather patterns and extreme weather events recorded by Met Éireann have been reviewed. A noticeable feature of the recent weather has been an increase in the frequency and severity of storms with notable events including Storm Darwin in February 2014, Storm Emma in March 2018 and Storm Ophelia in October 2018. The maximum wind gust for Casement Airport occurred during Storm Ophelia, peaking at 117km/hr with a 10-minute speed of 85km/hr.

Heavier historical rainfall events have also been recorded in recent years including heavy rainfall and flooding in the summer of 2008, severe flooding in November 2009, and heavy rainfall in the Greater Dublin

Area on 24 October 2011. The rainfall recorded on 24 October 2011 totalled 76.5mm over a 9-hour period at Casement Airport, which has an annual probability of 60 years.

Future climate predictions undertaken by Met Éireann have been published in 'Ireland's Climate: the road ahead' (Met Éireann 2013) based on four scenarios (RCP2.6, RCP4.5, RCP6.0 and RCP8.5) which is named with reference to a range of radiative forcing values for the year 2100 (i.e. 2.6, 4.5, 6.0 and 8.5 W/m^2 (watts per square metre)) respectively with focus on RCP4.5 (medium-low) and RCP8.5 (high) scenarios. In terms of mean temperatures, it is predicted that increases of between 1 to 3 degrees Celsius will occur under RCP4.5 rising to 2 to 4 degrees under RCP8.5. Warm extremes are expected to rise by 2 to 3 degrees (RCP4.5) but by up to 5 degrees under RCP8.5.

The EPA sponsored research project 'Ensemble of regional climate model projections for Ireland (Report No. 159)' (EPA 2015b) has projected significant decreases in mean annual, spring and summer precipitation amounts with extended dry periods. The decreases are largest for summer, with reductions ranging from 0% to 13% and from 3% to 20% for the medium-to-low and high emission scenarios, respectively. Conversely increases of heavy precipitation of up to 20% are projected to occur during the winter and autumn months. The number of extended dry periods is projected to increase substantially by mid-century during autumn and summer.

In relation to storms, the report indicates that the overall number of North Atlantic cyclones is projected to decrease by 10% coinciding with a decrease in average mean sea-level pressure of 1.5 hectopascals (hPa) for all seasons by mid-century. Wind energy is also predicted to decrease for spring, summer and autumn with a projected increase in winter. A projected increase in extreme storm activity is expected to adversely affect the future wind energy supply.

Future climate predictions undertaken by the EPA have been published in 'Research 339: High-resolution Climate Projections for Ireland – A Multi-model Ensemble Approach (EPA 2020b). The future climate was simulated under both Representative Concentration Pathway 4.5 (RCP4.5) (medium-low) and RCP8.5 (high) scenarios. This study indicates that by the middle of this century (2041–2060), the mid-century mean annual temperatures are projected to increase by 1–1.2°C and 1.3–1.6°C for the RCP4.5 and RCP8.5 scenarios, respectively, with the largest increases in the east. Warming will be enhanced at the extremes (i.e. hot days and cold nights), with summer daytime and winter night-time temperatures projected to increase by 1–2.4°C. There will be a substantial decrease of approximately 50% projected in the number of frost and ice days. Summer heatwave events are expected to occur more frequently, with the largest increases in the south. In addition, precipitation is expected to become more variable, with substantial projected increases in the occurrence of both dry periods and heavy precipitation events.

Table 13.7 30-Year Historical Weather Data for Casement Aerodrome 1981 to 2010 (source Met Éireann 2021)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature (degrees Celsius)													
Mean Daily Max	8.0	8.2	10.2	12.4	15.2	17.9	19.8	19.5	17.1	13.6	10.2	8.3	13.4
Mean Daily Min	2.1	2.0	3.3	4.1	6.6	9.4	11.5	11.3	9.5	7.0	4.2	2.4	6.1
Mean Temperature	5.1	5.1	6.8	8.2	10.9	13.6	15.7	15.4	13.3	10.3	7.2	5.4	9.7
Absolute Max.	15.2	15.9	17.3	22.7	24.9	27.6	31.0	29.5	25.4	21.3	17.7	14.8	31.0
Min. Maximum	-3.0	-0.7	2.3	4.5	7.1	10.2	10.6	11.7	10.8	5.2	-3.1	-4.7	-4.7
Max. Minimum	11.3	13.0	11.5	12.6	13.8	17.2	18.1	18.3	17.8	16.4	13.8	12.7	18.3
Absolute Min.	-12.4	-8.0	-9.0	-5.5	-2.4	0.4	4.6	2.2	0.2	-4.1	-9.1	-15.7	-15.7
Mean Num. of Days with Air Frost	7.5	7.7	4.6	3.4	0.8	0.0	0.0	0.0	0.0	1.3	4.3	7.6	37.2
Mean Num. of Days with Ground Frost	14.0	14.0	11.0	11.0	4.0	0.0	0.0	0.0	1.0	4.0	9.0	14.0	82.0
Mean 5cm Soil	3.7	3.6	5.3	8.4	12.6	15.7	17.1	16.0	12.8	9.2	6.0	4.2	9.6
Mean 10cm Soil	3.9	3.8	5.2	7.6	11.4	14.6	16.2	15.3	12.6	9.2	6.2	4.4	9.2
Mean 20cm Soil	4.6	4.5	5.9	8.1	11.5	14.5	16.3	15.8	13.4	10.1	7.1	5.1	9.7
Relative Humidity (%)													
Mean at 0900UTC	87.2	86.7	84.5	80.1	77.4	77.7	79.7	82.2	84.5	86.3	88.9	88.4	83.6
Mean at 1500UTC	82.2	76.7	71.8	67.7	67.3	67.9	68.9	69.0	71.8	76.6	81.6	84.1	73.8
Sunshine (hours)													
Mean Daily Duration	1.7	2.5	3.3	5.1	6.0	5.3	4.9	4.8	4.1	3.3	2.2	1.5	3.7
Greatest Daily Duration	8.1	9.2	10.9	13.2	15.4	16.0	15.5	14.4	12.3	10.1	8.5	6.9	16.0
Mean Num. of Days with No Sun	8.9	5.8	4.4	2.5	1.8	2.1	1.6	1.1	2.4	4.5	7.0	9.9	52.0
Rainfall (mm)													
Mean Monthly Total	63.8	48.5	50.7	51.9	59.1	62.5	54.2	72.3	60.3	81.6	73.7	75.7	754.2
Greatest Daily Total	30.0	32.2	31.1	38.7	29.8	97.5	33.7	89.3	51.1	50.1	82.0	46.8	97.5
Mean Num. of Days with >= 0.2mm	17	14	16	14	15	14	15	16	14	16	16	16	183
Mean Num. of Days with >= 1.0mm	12	10	11	10	11	10	10	11	10	12	11	12	130

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean Num. of Days with >= 5.0mm	4	3	3	3	3	3	3	4	4	4	4	5	43
Wind (knots)													
Mean Monthly Speed	13.6	12.9	12.4	9.8	9.1	8.6	8.8	9.0	9.6	11.1	11.6	12.3	10.7
Max. Gust	80	78	71	59	63	51	58	55	59	65	66	82	82
Max. Mean 10-Minute Speed	57	54	47	43	43	36	39	36	38	44	46	57	57
Mean Num. of Days with Gales	4.5	3.2	2.1	0.6	0.4	0.1	0.1	0.2	0.3	1.2	1.9	3.5	18.1
Weather (Mean No. of Days with.)													
Snow or Sleet	4.1	3.9	2.5	1.1	0.1	0.0	0.0	0.0	0.0	0.0	0.5	2.3	14.6
Snow Lying at 0900UTC	1.8	1.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	4.1
Hail	1.0	1.5	2.7	2.4	1.5	0.2	0.2	0.1	0.2	0.2	0.7	0.6	11.3

13.4.2 Existing GHG Emissions Baseline

'LA 114 – Climate' (UKHA 2019) states that a baseline climate scenario should identify, consistent with the study area for the project, GHG emissions without the project for both the current and future baseline (i.e. Do-Nothing scenarios).

Given the circumstances of Ireland's declaration of a climate and biodiversity emergency in May 2019 and the November 2019 European Parliament approval of a resolution declaring a climate and environment emergency in Europe, in conjunction with Ireland's current failure to meet its EU binding targets in the Regulation (EU 2018/842). Changes in GHG emissions either beneficially or adversely are of more significance than previously viewed prior to these declarations. Thus, the baseline climatic environment should be considered a highly sensitive environment for the assessment of impacts.

Data published in 2021 (EPA 2021a) predicts that Ireland will exceed its 2020 annual limit set under EU's Effort Sharing Decision (ESD) No 406/2009/EC by 6.73 million tonnes CO_2 equivalent (Mt CO_{2eq}). For 2020, total national emissions are estimated to be 57,699 Mt CO_{2eq} as shown in Table 13.8. The sector with the highest emissions is agriculture at 37.1% of the total, followed by transport at 17.9%. GHG emissions from the transport sector reduced by 15.7% in 2020, however COVID restrictions likely impacted on this reduction. Railways were responsible for 0.2% of transport emissions in 2020.

The main source of CH_4 and N_2O is from the agriculture sector (93%) with transport accounting for less than 2% of the overall total CH_4 and N_2O emissions (EPA 2021a).

Table 13.8 Total National GHG Emissions In 2020

Category	Kilotonnes CO_{2eq}	% Of Total GHG emissions
Waste	907	1.51%
Energy Industries	8,683	15.77%
Residential	7,119	10.90%
Manufacturing Combustion	4,522	7.66%
Commercial Services	937	1.49%
Public Services	896	1.48%
Transport	10,304	20.35%
Industrial Processes	2,113	3.77%
F-gases	785	1.79%
Agriculture	21,432	35.31%
Total	57,699	100%

In relation to transport GHG emissions, the dominant source is road transportation at 94% of total transport GHG emissions as shown in Table 13.9. Railways made up of 1.1% of transportation emissions in 2020.

Table 13.9 Total Transport GHG Emissions In 2019

Category	Kilotonnes CO_{2eq}	% Of Total GHG emissions
Domestic aviation	18.63	0.2%
Road transportation	9706.52	94.2%
Railways	108.79	1.1%
Domestic navigation	322.65	3.1%
Other transportation	147.77	1.4%
Total	10,304	100%

The opening year (2028) of the proposed development has total projected GHG emissions for Ireland, with additional measures in place (including the implementation of the Climate Action Plan 2021), of 49,874 kt (kilotonnes) CO_{2eq} with transport emissions accounting for 10,229 kt CO_{2eq} or 21% of total emissions (EPA 2021b). The 2040 total projected GHG emissions for Ireland, with additional measures in place, are 49,792 kt CO_{2eq}. Transport emissions account for 4,407 kt CO_{2eq} or 9% of the total (EPA 2021b). No data is available post-2040 and thus a comparison with the design year is not possible.

13.5 Description of Potential impacts

The proposed development will involve the electrification, significant increase in train services and passenger capacity of the Maynooth & M3 Parkway lines and links Iarnród Éireann, Dublin Bus, proposed MetroLink, BusConnects and Luas services, assisting in creating fully integrated public transport in the Greater Dublin Area. The total length of the proposed development is approximately 40 kilometres. When considering a development of this nature, the potential climate impact on the surroundings must be considered for each of two distinct stages:

- Construction phase.
- Operational phase.

Two scenarios are assessed throughout the following sections:

- 'Do-Nothing' scenario (DN): which assumes that the proposed development is not in place in future years.
- 'Do-Something scenario (DS), which assumes that the proposed development is in operation in future years.

13.5.1 Potential Construction Impacts

13.5.1.1 Construction Road Traffic Impacts

As noted in Section 13.3.3.3 there is the potential for construction related road traffic impacts, these related to additional vehicles on the road or the redistribution of other road users as a result of the proposed development. Construction phase traffic impacts will fluctuate depending on the works progressing, however for the construction assessment traffic volumes are assumed to occur for the full construction period and therefore are likely to overpredict emissions. In addition, these emissions are partly double counted in the construction phase assessment as transport of materials is included within the embodied carbon assessment in Section 13.5.1.2. The redistribution of private vehicles is not included in the embodied carbon assessment hence this assessment is also required.

Construction phase mass CO_2 emissions for road links included in Table 12.25 and Table 12.30 of Chapter 12 Air Quality have been summed (Table 13.10). The results show that the construction phase traffic emissions modelled using the DMRB and ADMS assessment for the proposed development will increase CO_2 945 tonnes of CO_2 annually or by 3,701 tonnes of CO_2 over the 47-month construction phase. When considered across the full 60-year project lifespan, emissions are annualised as 62 tonnes of CO_2./ annum.

The significance criteria for impacts (IEMA 2022) states that the impact significance must be taken from the project as a whole over its lifecycle rather than individual elements. Mitigation will be required in order to minimise the contribution of the embodied carbon from the construction of the proposed development and therefore the overall significance rating.

Table 13.10 Construction phase Road Traffic Climate Impact Assessment

Scenario	Scenario	CO_2 (tonnes/annum)
Construction phase Road Traffic	Do Nothing	16,119
	Do Something	17,064
Increment during construction (47 months)		3,701
Increment during construction (47 months) annualised over project lifespan		62
Annualised Impact (%) (Compared to 2030 emission ceiling limit)		0.00018%

13.5.1.2 Construction Embodied Carbon Impacts

To quantify the Construction phase embedded carbon, the assessment team utilised the TII Carbon toolkit (TII 2021). This toolkit has the ability to quantify carbon in infrastructure projects using Ireland-specific emission factors and data.

Detailed project information including tonnage of materials was obtained from the Engineering Design Team. The proposed development is expected to have a Construction phase of 47 months approximately and an operational lifespan of 60 years. The operational lifespan of 60 years is the default used in the TII Carbon Tool (TII 2021) and is the default in LA 114 Climate (UKHA 2019). 60 years is also the timeline for the appraisal of the BusConnects business case. The predicted GHG emissions can be averaged over the full construction phase and the lifespan of the proposed development to give the predicted annual emissions to allow for direct comparison with annual emissions and targets.

Combined Construction and Maintenance Phase emissions have been compared against the Ireland's non-ETS 2030 target of 33,381.3 Kt CO_{2eq} (as set out in Commission Implementing Decision (EU) 2020/2126 of 16 December 2020 on setting out the annual emission allocations of the Member States for the period from 2021 to 2030 pursuant to Regulation (EU) 2018/842 of the European Parliament and of the Council).

The assessment commences with the high-level design, through the pre-construction (site preparation) stage, followed by the assessment of the embodied carbon associated with all materials used in the construction of the road, the emissions during the construction phase and additionally emissions related to waste generated during the construction phase. The tool also assesses on-going maintenance associated with the default 60-year lifetime of the proposed development. For public infrastructure projects such as roads or railways it is generally assumed that end-of-life demolition is not relevant and thus there are no emissions associated with this stage.

The assessment has been broken down into a number of segments;

- Ashtown Footbridge.
- Coolmine Footbridge.
- Connolly Station.
- Depot.
- OHLE.
- Permanent Way (including over bridge works).
- Spencer Dock Station.
- Substations.
- Level Crossings.
- General Quantities.

General Quantities accounts for all; fuel usage, water usage, site clearance, travel to site, and waste. Where travel distances for material sourcing are currently unknown the following assumptions have been made:

- Locally – 50 km.

- Regionally – 100 km.
- Nationally – 250 km.

When a material cannot be produced in Ireland (i.e. steel) boat freight emissions have also been applied.

Based on the TII Carbon Tool (TII 2021), the breakdown of the activities between the different phases of the proposed development has been assessed. As shown in Table 13.11 and Table 13.12, the assessment indicates that the key phases of the GHG generation are the embodied carbon of the construction materials and maintenance (use), which when combined account for almost 71% of all carbon emissions. Pre-construction and construction activities is expected to account for approximately 16.3% of all emissions.

Construction waste is predicted to account for 11.8% of the overall emissions. 35% of the soil removed from the proposed Spencer Dock station are assumed to be reused onsite. Overall, the proposed development achieves a 60% onsite reusability for waste materials. The potential for reuse of soils is discussed in Chapter 9 Land and Soils. The reuse and minimisation of other waste materials is discussed in Chapter 19 Material Assets: Resource and Waste Management.

The proposed Spencer Dock station accounts for the highest volume of the overall embodied carbon. The station requires significant volumes of excavation, steel and concrete in order to construct it.

The proposed development is estimated to result in total Construction phase (including maintenance over a 60-year period) GHG emissions of 221,679.62tonnes embedded CO_{2eq} for materials over the 47-month period. This is equivalent to an annualised total of 0.64% of Ireland's non-ETS 2030 target. Over the predicted 60-year lifespan the annualised emissions due to the initial Construction phase and ongoing maintenance of the proposed development is projected to reach, at most, 0.010% of Ireland's non-ETS 2030 emissions target (Table 13.12). The significance criteria for impacts (IEMA 2022) states that the impact significance must be taken from the project as a whole over its lifecycle rather than individual elements. Mitigation will be required in order to minimise the contribution of the embodied carbon from the construction of the proposed development and therefore the overall significance rating.

Table 13.11 Construction & Maintenance Stage Greenhouse Gas Emissions

Project Element	Before Use ($kgCO_2e$)				Use: Including Maintenance ($kgCO_2e$)	Total
	Pre-Construction	Embodied Carbon	Construction Activities	Construction Waste		
Ashtown Footbridge	22	806,439	213	-	1,012	807,686
Coolmine Footbridge	-	728,498	2,804	-	457	731,759
Connolly Station	-	2,125,559	4,001	-	1,481,038	3,610,598
Depot	-	15,184,209	99,929	-	2,004,103	17,288,241
OHLE	-	3,050,009	24,758	-	8,655,967	11,730,735
Permanent Way	-	16,680,385	141,068	-	61,874,417	78,695,870
Spencer Dock Station	-	24,376,266	168,346	-	1,704,245	26,248,857
Substations	453	991,917	9,014	-	92,153	1,093,537
Level Crossings	6,349	17,478,948	43,405	-	1,763,296	19,291,999
General	293,018	-	35,525,492	26,361,826	-	62,180,336
Total ($kgCO_2e$)	299,842	81,422,229	36,019,030	26,361,826	77,576,690	221,679,618

Project Element	Before Use ($kgCO_2e$)				Use: Including Maintenance ($kgCO_2e$)	Total
	Pre-Construction	Embodied Carbon	Construction Activities	Construction Waste		
% Of Total	0.14%	36.73%	16.25%	11.89%	34.99%	100.000%

Table 13.12: Summary of Construction & Maintenance Stage Greenhouse Gas Emissions

Project Element	Total (kgCO2e)	Total ($KiloTonneCO_2e$)	% Of overall total ($kgCO_2e$)	Total Annualised ($KiloTonneCO_2e$)	Annualised as % of 2030 Target
Ashtown Footbridge	807,686	0.81	0.4%	0.013	0.00004%
Coolmine Footbridge	731,759	0.73	0.3%	0.011	0.00003%
Connolly Station	3,610,598	3.61	1.6%	0.056	0.00017%
Depot	17,288,241	17.29	7.8%	0.270	0.00081%
OHLE	11,730,735	11.73	5.3%	0.184	0.00055%
Permanent Way	78,695,870	78.70	35.5%	1.231	0.00369%
Spencer Dock Station	26,248,857	26.25	11.8%	0.411	0.00123%
Substations	1,093,537	1.09	0.5%	0.017	0.00005%
Level Crossings	19,291,999	19.29	8.7%	0.302	0.00090%
General	62,180,336	62	28.0%	0.973	0.00291%
Total	221,679,618	221.68	100%	3.468	0.01039%

13.5.2 Impact of Climate Change on the Proposed Development Construction Phase

'LA 114 – Climate' (UKHA 2019) outlines an approach for undertaking a risk assessment where there is a potentially significant impact on proposed development receptors due to climate change. The risk assessment assesses the likelihood and consequence of the impact occurring to each receptor, leading to the evaluation of the significance of the effect. Appropriate flood risk measures and extreme weather events have been considered as part of the construction planning. The guidance advises that for the Construction phase, a qualitative description of disruption risk be reported. The potential for changes to long-term seasonal averages as a result of climate change are not considered to be as significant by the construction year as models consider the mid-century for predictions (EPA 2020b).

Flooding on construction sites, specifically within high flood risk areas such as the depot lands and Docklands have the potential to occur during the construction phase. Therefore, mitigation measures will be put in place during the Construction phase. A Construction Environmental Management Plan (CEMP) will be prepared for the proposed development. An Environmental Operating Plan (EOP) will be prepared as part of the CEMP, see Appendix D in Appendix A5.1 in Volume 4 of this EIAR. An Incident Response Plan (see Appendix F within Appendix A5.1 in Volume 4 of the EIAR) will be prepared as part of the CEMP detailing the procedures to be undertaken in the event of flood risks. Monitoring of weather forecasts to ensure that necessary actions will be implemented in time at construction sites prior to prolonged / extreme weather events. Mitigation put in place also includes the continuous monitoring of water levels in the Liffey Estuary and Lyreen Stream to provide advance warning of potential flooding. Works for the Spencer Dock station will occur in an area which is effectively defended to the 1 in 1000 year Coastal / fluvial event.

As this is construction phase risk rather than operational phase risk there will not yet be any regional reliance on the infrastructure, which is the main consideration in the measure of consequences. Therefore, for the proposed development the measure of consequences can be classed as negligible. Thus, in line with the

methodology outlined in Table 13.4, Table 13.5 and Table 13.6, the likelihood of construction phase climate change related extreme weather and flooding is assessed to be of low likelihood and with a negligible impact leading to a finding of a *not significant* effect.

13.5.2.1 Land Use Change

The construction phase of the proposed development is predicted to result in the temporary removal of grassland to facilitate the construction compounds, where appropriate and the permanent change of land use at the depot. However, overall, there will be a negligible impact on carbon sequestration as a result of the construction phase of the proposed development.

The landscaping plan includes the widespread planting of native Irish species of trees and shrubs and wildflower planting. It is predicted that 11 Ha of replanting will be completed in association with the construction phase of the proposed development. 9.05 ha of grassland will have a change in land use due to the proposed development with the loss of a carbon sink. These have been included in the embodied carbon calculations under "general" within Table 13.12.

13.5.3 Potential Operational Impacts

13.5.3.1 Maintenance Phase Embodied Carbon Impacts

The proposed development is expected to have an operational lifespan of 60 years. The predicted maintenance phase GHG emissions can be averaged over the full lifespan of the proposed development to give the predicted annual emissions to allow for direct comparison with annual emissions and targets. Only GHG emissions generated from the areas on the rail corridor that were directly constructed as a result of the proposed development have taken place are considered in this assessment, as routine maintenance, and associated GHG emissions generated, would be carried out on the existing infrastructure, irrespective of the proposed development.

Maintenance phase emissions have been compared against the Ireland's non-ETS 2030 target of 33,381.3 Kt CO_{2eq} (as set out in *EU Commission Decision 2020/2126 of 16th December 2020 on setting out the annual* emissions *allocations of the Member States for the period from 2021 to 2030*).

The TII Carbon Tool (TII 2020) assesses on-going maintenance associated with the default 60-year lifetime of the proposed development. For major public infrastructure, it is generally assumed that end-of-life demolition is not relevant and thus there are no emissions associated with this stage.

The proposed development is estimated to result in total maintenance phase GHG emissions of 77,577 tonnes CO_{2eq} over the predicted 60-year lifespan as shown in Table 13.11. The annualised emissions due to the ongoing maintenance of the proposed development is predicted to reach, at most, 1,217 tonnes CO_{2eq} or 0.0036 % of Ireland's non-ETS 2030 emissions target. These emissions have also been included in the totals provided for the construction stage.

The significance criteria for impacts (IEMA 2022) states that the impact significance must be taken from the project as a whole over its lifecycle rather than individual elements. Mitigation will be required in order to minimise the contribution of the embodied carbon from the maintenance of construction materials of the proposed development and therefore the overall significance rating.

13.5.3.2 Operational Rail Impacts

The proposed development 's primary objective is to provide a higher frequency, higher capacity, electrified heavy rail service. The Do Nothing (DN) and Do Something (DS) regional emissions from the railway have been quantified using the assessment method detailed in Section 13.3.4.2.

Table 13.13 shows the change to rail numbers on rail sections which are currently in operation using data provided by Iarnród Éireann. The rail traffic figures can be used in conjunction with the length of the section

and the emission factors detailed in Section 13.3.4.2 to calculate the mass pollutant emission. A sizable increase in the number of carriages and trains daily are proposed as part of the proposed development. In addition to the sections compared to the DN in Table 13.13, the EMUs for the proposed Spencer Dock Station and the depot west of Maynooth have also been included in the mass emission calculations.

For the DN information has been provided on the number of carriages each locomotive has attached, this information has been utilised in calculating the total number of trains and carriages on a section of track. For the DS all EMUs are assumed to have 10 carriages with DMUs remaining with 6 carriages. In addition, both passenger and technical movements have been included for the DN and DS. As a result of the increased rail numbers and carriage on individual trains there is an overall increase of 346% in daily carriage numbers.

Table 13.13 Changes to Rail Numbers

Section of Track	DMU		Change Carriages Daily	EMU		Change Carriages Daily
	DN Carriages Daily	DS Carriages Daily	(% increase from DN)	DN Carriages Daily	DS Carriages Daily	(% increase from DN)
Connolly to East Wall Jct.	273	282	9 (3%)	712	1,072	360 (132%)
East Wall Jct. to Connolly	275	282	7 (3%)	710	968	258 (94%)
Connolly to North Strand Jct.	385	174	-211 (-55%)	-	784	784 (204%)
North Strand Jct. to Glasnevin	409	174	-235 (-57%)	-	1,312	1312 (321%)
Glasnevin to Islandbridge Jct.	111	-	-111 (-100%)	-	880	880 (793%)
Islandbridge Jct. to Glasnevin	114	-	-114 (-100%)	-	872	872 (765%)
Glasnevin to North Strand Jct.	415	174	-241 (-58%)	-	1,256	1256 (303%)
North Strand Jct. to Connolly	373	174	-199 (-53%)	-	752	752 (202%)
Docklands to Glasnevin (Spencer Dock to Glasnevin in DS)	49	-	-49 (-100%)	-	872	872 (1780%)
Glasnevin to Clonsilla	339	174	-165 (-49%)	-	1,280	1280 (378%)
Clonsilla to Maynooth	291	174	-117 (-40%)	-	816	816 (280%)
Maynooth to Maynooth Depot	62	174	112 (181%)	-	-	0 (0%)
Maynooth Depot to Maynooth	54	174	120 (222%)	-	-	0 (0%)
Maynooth to Clonsilla	283	174	-109 (-39%)	-	760	760 (269%)
Clonsilla to Glasnevin	339	174	-165 (-49%)	-	1,224	1224 (361%)
Glasnevin to Docklands (Glasnevin to Spencer Dock in DS)	49	-	-49 (-100%)	-	872	872 (1780%)

Section of Track	DMU		Change Carriages Daily	EMU		Change Carriages Daily
	DN Carriages Daily	DS Carriages Daily	(% increase from DN)	DN Carriages Daily	DS Carriages Daily	(% increase from DN)
Clonsilla to M3 Parkway	75	-	-75 (-100%)	-	448	448 (597%)
M3 Parkway to Clonsilla	83	-	-83 (-100%)	-	456	456 (549%)
Connolly to Pearse	364	6	-358 (-98%)	650	1,824	1174 (323%)
Pearse to Connolly	360	6	-354 (-98%)	650	1,832	1182 (328%)
Docklands to East Wall Jct.	-	-	-	-	-	-
East Wall Jct. to Spencer Dock	-	-	-	-	-	-
North wall to North Strand Jct. (Spencer Dock to North Strand Jct. in DS)	24	-	-24 (-100%)	-	536	536 (2233%)
North Wall to East Wall Jct. (Spencer Dock to East Wall Jct. in DS)	30	-	-30 (-100%)	-	-	0 (0%)
East Wall Jct. to North Wall	18	-	-18 (-100%)	-	-	0 (0%)
North Strand Jct. to North wall (North Strand Jct. to Spencer Dock in DS)	18	-	-18 (-100%)	-	504	504 (2800%)
Total	**4,793**	**2,316**	-2477 (-52%)	**2,722**	**19,320**	16598 (346%)

The majority of these reductions of DMU carriages (Table 13.13) result from the shift from diesel units to electric rail units. The impact in emissions is significant enough that the increased frequency and capacity of the service does not result in an overall adverse impact. The emissions in the DS include emissions with respect to the generation of electricity to power the EMUs. As the national grid decarbonises in line with the 2021 CAP (up to 80% renewables by 2030) the improvements will become larger as fewer fossil fuels will be required to generate each kWh. Emissions calculations are based on this 80% target being reached by the national grid. IÉ have agreed to purchase of up to 80% of its operational demand from certified low or zero carbon electricity operations. This will ensure that should the CAP target of 80% renewables not be achieved the project will however still achieve this percentage. The additional movements on the rail line at the depot near Maynooth and the Spencer Dock area have also been included in the total DS emissions.

Mass pollutant emissions produced in both the DN and DS scenarios during the operational phase are shown in Table 13.14 and Table 13.15 respectively. Table 13.16 shows the change in mass emissions between the DM and DS. Emissions have been compared against the Ireland's non-ETS 2030 target of 33,381.3 Kt CO_{2eq} (as set out in *EU Commission Decision 2020/2126 of 16th December 2020 on setting out the annual emissions allocations of the Member States for the period from 2021 to 2030*).

Table 13.14 Do-Nothing Rail Emissions

Track Section	DN DMU Kg CO_2	DN EMU Kg CO_2
Connolly to East Wall Jct.	443.1	83.2
East Wall Jct. to Connolly	410.0	0.0
Connolly to North Strand Jct.	154.9	0.0

Track Section	DN DMU Kg CO_2	DN EMU Kg CO_2
North Strand Jct. to Glasnevin	2040.2	0.0
Glasnevin to Islandbridge Jct.	1091.4	0.0
Islandbridge Jct. to Glasnevin	1114.9	0.0
Glasnevin to North Strand Jct.	2069.4	0.0
North Strand Jct. to Connolly	149.9	0.0
Docklands to Glasnevin (Spencer Dock to Glasnevin in DS)	345.0	0.0
Glasnevin to Clonsilla	8309.6	0.0
Clonsilla to Maynooth	7587.7	142.5
Maynooth to Maynooth Depot	420.6	0.0
Maynooth Depot to Maynooth	369.4	0.0
Maynooth to Clonsilla	7365.7	0.0
Clonsilla to Glasnevin	8309.6	446.0
Glasnevin to Docklands (Glasnevin to Spencer Dock in DS)	374.5	0.0
Clonsilla to M3 Parkway	0.0	0.0
M3 Parkway to Clonsilla	0.0	0.0
Connolly to Pearse	1138.2	0.0
Pearse to Connolly	1133.0	0.0
Docklands to East Wall Jct.	0.0	0.0
East Wall Jct. to Spencer Dock	0.0	213.3
North wall to North Strand Jct. (Spencer Dock to North Strand Jct. in DS)	48.3	0.0
North Wall to East Wall Jct. (Spencer Dock to East Wall Jct. in DS)	58.1	0.0
East Wall Jct. to North Wall	34.9	0.0
North Strand Jct. to North wall (North Strand Jct. to Spencer Dock in DS)	36.2	0.0
Sum Daily (kg Pollutant)	43,005	885
Sum Annually (kg Pollutant)	15,696,783	322,998
Sum Daily (kg Pollutant)	43,890	
Sum Annually (kg Pollutant)	16,019,781	
Sum Annually (Tonnes Pollutant)	16,020	
% Of the 2030 Limit Value	0.0480%	

Table 13.15 Do-Something Rail Emissions

Track Section	DS DMU Kg CO_2	DS EMU Kg CO_2
Connolly to East Wall Jct.	464.4	125.3
East Wall Jct. to Connolly	435.4	106.1
Connolly to North Strand Jct.	68.1	21.8
North Strand Jct. to Glasnevin	844.9	452.2
Glasnevin to Islandbridge Jct.	0.0	571.7
Islandbridge Jct. to Glasnevin	0.0	566.5
Glasnevin to North Strand Jct.	844.9	432.9
North Strand Jct. to Connolly	68.1	20.9
Docklands to Glasnevin (Spencer Dock to Glasnevin in DS)	0.0	466.8
Glasnevin to Clonsilla	4174.2	2179.6

Track Section	DS DMU Kg CO_2	DS EMU Kg CO_2
Clonsilla to Maynooth	4503.4	1499.1
Maynooth to Maynooth Depot	1153.3	0.0
Maynooth Depot to Maynooth	1153.3	0.0
Maynooth to Clonsilla	4503.4	1396.2
Clonsilla to Glasnevin	4174.2	2084.2
Glasnevin to Docklands (Glasnevin to Spencer Dock in DS)	0.0	466.8
Clonsilla to M3 Parkway	0.0	0.0
M3 Parkway to Clonsilla	0.0	0.0
Connolly to Pearse	18.5	399.8
Pearse to Connolly	18.5	401.5
Docklands to East Wall Jct.	0.0	0.0
East Wall Jct. to Spencer Dock	0.0	0.0
North wall to North Strand Jct. (Spencer Dock to North Strand Jct. in DS)	0.0	67.4
North Wall to East Wall Jct. (Spencer Dock to East Wall Jct. in DS)	0.0	0.0
East Wall Jct. to North Wall	0.0	0.0
North Strand Jct. to North wall (North Strand Jct. to Spencer Dock in DS)	0.0	63.3
Sum Daily (kg Pollutant)	22,425	11,322
Sum Annually (kg Pollutant)	8,184,974	4,132,543
Sum Daily (kg Pollutant)	33,747	
Sum Annually (kg Pollutant)	12,317,518	
Sum Annually (Tonnes Pollutant)	12,318	
% Of the 2030 Limit Value	0.0368%	

The proposed development results in a decrease in overall CO_2 emissions as shown in Table 13.16. The reduction in emissions is shown to be even greater when normalised in Table 13.17 for the number of km in the DN and DS scenarios. These calculations assume 80% renewables have been met both in the DN and DS.

The significance criteria for impacts (IEMA 2022) states that the impact significance must be taken from the project as a whole over its lifecycle rather than individual elements.

Table 13.16 Change in Rail Emissions

DS - DN- All Rail	Kg CO_2
Change Daily (kg Pollutant)	-10,143
Change Annually (kg Pollutant)	-3,702,263
DS as % of DN	-16%
Change as % of the 2030 National Target (Article 4(1) of Directive 2016/2284)	-0.011%
Change in DMU carriage km	-9,603
DS DMU carriage km as % of DN	53%
Change in EMU carriage km	74,436
DS EMU carriage km as % of DN	2539%

Table 13.17 Rail Emissions per Carriage KM

kg CO_2 Carriage KM	
DN Passenger CO_2	1.864
DS Passenger CO_2	0.382
DS - DN Passenger CO_2	-1.482
% Reduction in CO_2 per Carriage KM	80%

13.5.3.3 Operational Road Traffic Impacts

For the operational phase, two areas which the traffic consultant has deemed to have the potential for impact due to traffic redistribution associated with the proposed development have been assessed. Impact scenarios have been modelled representing the worst-case traffic impacts, as advised by the proposed development traffic consultants (see Chapter 6 Traffic and Transportation in Volume 2 of this EIAR). The traffic will be most impacted due to the closure of level crossings. Level crossings are a significant constraint to railway operations and surrounding road networks, causing congestion and increased journey times for all modes of transport, including pedestrians and cyclists. Their closure will also remove the periodic blockages on the road system which are a source of carbon emissions, which are currently very pronounced, especially in the morning and evening peak commuter periods (for example, Coolmine level crossing is closed for approximately 40 minutes between 08.00-09.00 each weekday). Not all level crossing closures will impact road traffic to the same degree. The two areas of likely potential impact are:

- Traffic Related Impact Study Area 1 (hereafter known as Area 1): Operational phase impacts in proximity to the Ashtown level crossing; and
- Traffic Related Impact Study Area 2 (hereafter known as Area 2): Operational phase impacts in proximity to the Coolmine and Clonsilla level crossings.

The road links (a road link is a segment of road between two junctions) modelled are shown in Chapter 12 Air Quality Table 12.50 and Chapter 12 Table 12.56 for Ashtown and Coolmine/Clonsilla respectively. Further details on the proposed development traffic redistribution are contained within the Construction Traffic Management Plan.

As per Section 3.16 of 'LA 114 – Climate' appraisal guidance which recommends that '*an appropriate validated traffic model shall be used to estimate operational road user GHG emissions*' and method detailed in Section 13.5.1.1 climate impacts due to the two study areas has been assessed. All road link data provided for the study areas has been assessed regardless of them being below or above the 10% change scoping criteria in Section 13.5.1.1.

13.5.3.3.1 Area 1: Ashtown

As part of the proposed development, the Ashtown level crossing shall be permanently closed to accommodate the increase in rail service associated with the increased frequency and improved operation of the line. A pedestrian and cyclist bridge and a new vehicle underpass along Mill Lane will replace the Ashtown level crossing. Altogether these structures will maintain vehicular, pedestrian and bicycle access through the railway line and the Royal Canal. The traffic used in this assessment is detailed in Table 12.50 of the air quality chapter.

The impact of the proposed development on emissions of CO_2 were also assessed using the Design Manual for Roads and Bridges screening model (see Table 13.18). The results show that the proposed development will increase CO_2 emissions by 0.0005% of Ireland's EU Target in the opening year of 2028 and by 0.0009% in the design year of 2043. Design year emissions for 2043 must be taken with a high degree of caution as the model does not include for electric vehicles or changes to emissions past 2025. In accordance with the CAP by 2045 the NCT will no longer be issued for cars with fossil fuel engines, therefore emissions in 2043 are most likely significantly over estimated.

The significance criteria for impacts (IEMA 2022) states that the impact significance must be taken from the project as a whole over its lifecycle rather than individual elements.

Table 13.18 Operational Road Traffic Climate Impact Assessment Study Area 1

Year	Scenario	CO_2 (tonnes/annum)
2028	Do Nothing	13,526
	Do Something	13,696
2043	Do Nothing	13,755
	Do Something	14,068
Increment in 2028		169 Tonnes
Increment in 2043		312.9 Tonnes
Emission Ceiling (kilo Tonnes) 2028		**35,625 kilo-tonnes per annum**
Emission Ceiling (kilo Tonnes) 2030		**33,381 kilo-tonnes per annum**
Impact in 2028 (%)		0.0005%
Impact in 2043 (%) (Compared to 2030 emission ceiling limit)		0.0009%

13.5.3.3.2 Area 2: Coolmine and Clonsilla

An operational phase assessment of the impact of traffic has been conducted for the Coolmine/Clonsilla area. The traffic used in this assessment is detailed in Table 12.56 of Chapter 12 Air Quality.

The impact of the proposed development on emissions of CO_2 impacting climate were also assessed using the Design Manual for Roads and Bridges screening model (see Table 13.19). The results show that the impact of the proposed development will be to increase CO_2 emissions by 0.0014% of Ireland's EU Target in the opening year of 2028 and by 0.0013% in the design year of 2043. Design year emissions for 2043 must be taken with a high degree of caution that the model does not include for electric vehicles or changes to emissions past 2025. Therefore, emissions in 2043 are most likely significantly over estimated, in particular as in accordance with the CAP by 2045 the NCT will no longer be issued for cars with fossil fuel engines.

The significance criteria for impacts (IEMA 2022) states that the impact significance must be taken from the project as a whole over its lifecycle rather than individual elements. Mitigation will be required in order to minimise the contribution of the embodied carbon from the construction of the proposed development and therefore the overall significance rating.

Table 13.19 Operational Road Traffic Climate Impact Assessment Study Area 2

Year	Scenario	CO_2 (tonnes/annum)
2028	Do Nothing	12,834
	Do Something	13,315
2043	Do Nothing	13,742
	Do Something	14,164
Increment in 2028		481.8 Tonnes
Increment in 2043		422.2 Tonnes
Emission Ceiling (kilo Tonnes) 2028		**35,625 kilo-tonnes per annum**
Emission Ceiling (kilo Tonnes) 2030		**33,381 kilo-tonnes per annum**
Impact in 2028 (%)		0.0014%

Year	Scenario	CO_2 (tonnes/annum)
Impact in 2043 (%) (Compared to 2030 emission ceiling limit)		0.0013%

The impact of the proposed development on emissions of CO_2 impacting climate for the combined two study areas were also calculated (see Table 13.20). The results show that the impact of the proposed development will be to increase CO2 emissions by 0.0018% of Ireland's EU Target in the opening year of 2028 and by 0.0022% in the design year of 2043. As noted previously, the design year emissions for 2043 must be taken with a high degree of caution.

The significance criteria for impacts (IEMA 2022) states that the impact significance must be taken from the project as a whole over its lifecycle rather than individual elements. Mitigation will be required in order to minimise the contribution of the embodied carbon from the construction of the proposed development and therefore the overall significance rating.

Table 13.20 Combined Operational Road Traffic Climate Impact

Year	Scenario	Area 1: CO_2 (tonnes/annum)	Area 2: CO_2 (tonnes/annum)	Combined: CO_2 (tonnes/annum)
2028	Do Nothing	13,526	12,834	26,360
	Do Something	13,696	13,315	27,012
2043	Do Nothing	13,755	13,742	27,497
	Do Something	14,068	14,164	28,232
Increment in 2028 (Tonnes)		169.6	481.8	651
Increment in 2043 (Tonnes)		312.9	422.2	735
Emission Ceiling (kilo Tonnes) 2020		**35,625**		
Emission Ceiling (kilo Tonnes) 2030		**33,381**		
Impact in 2028 (%)		0.0005%	0.0014%	0.0018%
Impact in 2043 (%) (Compared to 2030 emission ceiling limit)		0.0009%	0.0013%	0.0022%

13.5.3.4 Non-Rail Power Requirements

In addition to the above, there is the potential for some carbon emissions from the depot, Spencer Dock station and substations. These project elements require electricity to operate, in addition, the depot proposes to utilise natural gas for heating.

As the national grid decarbonises in line with the 2021 CAP (up to 80% renewables by 2030) the improvements will become larger as fewer fossil fuels will be required to generate each kWh. Emissions calculations are based on this 80% target being reached by the national grid. IÉ have agreed to the purchase of up to 80% of its operational demand from certified low or zero carbon electricity operations. This will ensure that should the CAP target of 80% renewables not be achieved the proposed development will however still achieve this percentage. Therefore, an estimated 2030 carbon intensity figure of 102.04 gCO_2/kWh is used when calculating the non-rail power requirement emissions as discussed in Section 13.3.4.2.

There will be some use of natural gas at the proposed depot west of Maynooth. These emissions have been considered with respect to the Directive (EU) 2015/219 which is commonly known as Medium Combustion Directive (MCD). The carbon intensity of natural gas is 202.2 gCO_2/kWh (SEAI 2022). The combined total output of natural gas at the depot is 188.12 kW, the MCD states that individual combustion plants with a rated thermal input less than 1 MW (1,000 kW) should not be considered for the purpose of calculating the total rated thermal input of a combination of combustion plants. Therefore, the likely effect due to combustion emissions from the depot can be considered *not significant*.

In addition to the depot, there is a single 80 KVA diesel generator in the proposed substations. There are considered a minor emission point and are put in place as an emergency backup in the unlikely event that power is cut to the substation. The substations have looped connection with the ESB (redundant connection) and therefore already has a backup which will be used prior to the generator being required. The six substations each have an electrical power requirement of 43.6 kW.

The total emissions from substations, the depot and Spencer Dock Station are 841.49 tonnes of CO_2 annually. There is the potential for this to decrease with improved technology or additional renewables proportion in electricity.

The significance criteria for impacts (IEMA 2022) states that the impact significance must be taken from the project as a whole over its lifecycle rather than individual elements.

Table 13.21 Non-Rail Power Requirements

Location	Electricity (kWH/year)	Natural Gas (kWH/year)
Substations	2,293,508	N/A
Depot	2,130,000	1,648,000
Spencer Dock station	557,141	N/A
Total	4,980,650	1,648,000
Carbon Intensity (gCO_2/KWH)	102.05	202.20
Tonnes CO_2 Annually	508.26	333.23
Total Tonnes CO_2 Annually	841.49	
Impact as % of Irelands 2030 Target	0.0025%	

13.5.4 Impact of Climate Change on the Proposed Development Operational phase

Climate adaptation seeks to ensure adequate resilience of major projects to the adverse impacts of climate change, such as increased flooding or droughts. Mitigation, on the other hand, seeks to reduce the emissions of greenhouse gases by implementing low-carbon energy options. Adaptation during the design phase of the proposed development aims to ensure potential climate change impacts will not significantly impact the operational phase. In addition, with the change from DMU's to EMU's the flood level that would impact the operations of the railway is reduced by 200mm.

A risk assessment has been conducted for potentially significant impacts on the proposed development associated with climate change. The risk assessment assesses the likelihood and consequence of potential impacts occurring and then provides an evaluation of the significance of the impact using the framework set out in Section 13.3.6.

13.5.4.1 Flood Risk

Flooding of the local transport infrastructure is a potential impact of climate change on the proposed development. A comprehensive Site Specific Flood Risk Assessment (SSFRA) has been carried out, full details can be found in the supporting document SSFRA to the EIAR. The SSFRA included climate change factors as per the OPW Mid-Range Future climate scenario as part of the assessment.

The proposed development is classified as a “highly vulnerable” development with respect to OPW guidance on flooding (FRA) as it comprises essential transport infrastructure. The guidelines stipulate that typically highly vulnerable developments are only appropriate within Flood Zone C (low risk areas).

Surface Water Flooding

The existing rail corridor is drained via positive drainage, i.e., gullies and surface water carrier pipes. Track lowering has been avoided at locations prone to flooding. New gullies will be connected to the existing

drainage network. Additional hardstanding area from the proposed junction upgrades will be negligible and should not increase capacity in such quantities to result in a flood risk. Although various locations within the development have been identified as potentially at risk from pluvial flooding, the implementation of SuDS throughout the scheme is seen as sufficient to mitigate this risk. The drainage design for the scheme has incorporated an appropriate allowance for climate change.

Fluvial /Coastal Flooding

Existing information indicates that the Docklands / Newcomen area is liable to flood in extreme events with increased flooding likely due to future effects of climate change. Currently the Docklands / Newcomen area is defended to the 0.5%AEP coastal event (1 in 200 year). These municipal defences managed by the local authority and OPW will require adaption to reduce the impact of climate change in the future. It is envisaged that flooding will be managed at this location through the adoption of flood resilient design and materials, flood warning systems and flood emergency response planning and implementation. Flood forecasting is appropriate as tidal inundation is the primary flood source.

The hydraulic modelling undertaken as part of the SSFRA has identified significant flooding between Maynooth and Kilcock. The track at this location cannot be raised due to potential conflicts with preserving heritage aspects of Jackson's Bridge. In order to provide a sufficient level of protection to the line, the development has been moved offline on a raised embankment over the floodplain. Proposed crossings have been sized as to maintain existing flood levels. Bridges soffits are to maintain a freeboard of >300mm above the 1%AEP (+ climate change) flood level while the minimum rail level will maintain a freeboard of >500mm above the 0.1%AEP (+ climate change) events.

The depot level will be a minimum of 300mm above the 0.1%AEP flood level (+ climate change). Residual flood risk will be managed by the implementation of a flood emergency response plan which should form part of the facilities management plan. The depot area and minor watercourse were not covered by the CFRAMS study.

The proposed development will be designed to incorporate flood resilient construction measures and materials. The proposed development including flood risk management elements will be subject to a maintenance plan. The maintenance of the proposed development will be undertaken by the relevant competent authority. In the case of a flood event exceeding the design event, the flood emergency response plans will ensure safe egress to appropriate refuge locations.

Flood Risk Conclusions

The Site-Specific Flood Risk Assessment (SSFRA) has considered the local hydrological conditions pertaining to the DART+ West project and identified flood risk areas throughout the development lands. Where development is to be proposed within areas of flood risk, appropriate flood risk management measures have been adopted. The findings of the SSFRA indicate that flood risk to the scheme can be managed with negligible effect on flood risk elsewhere.

A number of key areas of the proposed development were found to have elevated levels of flood risk however management strategies are outlined in order to mitigate this risk. With the design mitigation measures in place the probability and frequency likelihood are considered in accordance with the criteria set out in Section 13.3.6 to have the potential to be low likelihood i.e. the event occurs approximately every fifteen years (Table 13.4). The measure of consequences (Table 13.5) can be classed as minor adverse as an operational phase impact would cause regional level disruption to strategic route lasting less than 1 day. The significance conclusion (Table 13.6) indicates that the impact is not significant and therefore the significance of impacts is at an acceptable level in accordance with LA 114 (UK HA 2019) Guidance leading to a finding of a *not significant* effect.

13.5.4.2 Increased Temperature

Future climate predictions undertaken by the EPA have been published in 'Research 339: High-resolution Climate Projections for Ireland – A Multi-model Ensemble Approach (EPA 2020b). Mid-century mean annual temperatures are projected to increase by 1–1.2°C and 1.3–1.6°C for the RCP4.5 and RCP8.5 scenarios, respectively, with the largest increases in the east. Warming will be enhanced at the extremes (i.e. hot days and cold nights), with summer daytime and winter night-time temperatures projected to increase by 1–2.4°C.

These increased temperatures have the potential to cause the temperature of materials, such as tracks / OHLE / asphalt / bitumen, to increase. However, based on an increase in temperature of between 1 to 3 degrees Celsius under RCP4.5, it is considered that the impact of increased temperatures on materials will not be significant.

The probability and frequency likelihood are considered in accordance with the criteria set out in Section 13.3.6 to have the potential to be low likelihood i.e. the event occurs approximately every fifteen years (Table 13.4). The measure of consequences (Table 13.5) can be classed as minor adverse as an operational phase impact would cause regional level disruption to strategic route lasting less than 1 day. The significance conclusion (Table 13.6) indicates that the impact is not significant and therefore the significance of impacts is at an acceptable level in accordance with LA 114 (UK HA 2019) Guidance leading to a finding of a *not significant* effect.

13.5.4.3 Ice or Snow

Future climate predictions undertaken by the EPA have been published in 'Research 339: High-resolution Climate Projections for Ireland – A Multi-model Ensemble Approach (EPA 2020b) predicts that there will be a substantial decrease of approximately 50% are projected in the number of frost and ice days for the RCP4.5 and RCP8.5 scenarios. Snowfall is projected to decrease substantially by the middle of the century with "likely" reductions of 51% and 60% for the RCP4.5 and RCP8.5 scenarios, respectively.

Overhead line equipment has the potential to be impacted by ice or snow events. Unmitigated, this is likely to occur with a high consequence of impact. The overhead line equipment will be designed to take into account a range of minimum and maximum temperatures (-20^{o}c to +40^{o}c) and loads under current and future climate conditions. The contact and messenger overhead wires will be automatically tensioned which will adjust for additional loading from ice, snow or wind. Ice loading has been considered within the design and a 9.5 mm radial thickness of ice coating has been applied for protection. The mechanical tension in the contact and messenger wires will be maintained within the system design parameters. In addition, Iarnród Éireann have a Snow Plan in place which can be activated if snow or ice are forecast.

The probability and frequency likelihood are considered in accordance with the criteria set out in Section 13.3.6 to have the potential to be medium i.e. the event occurs approximately every fifteen years (Table 13.4). The measure of consequences (Table 13.5) can be classed as minor adverse as an operational phase impact would cause regional level disruption to strategic route lasting less than 1 day. The significance conclusion (Table 13.6) indicates that the impact is not significant and therefore the significance of impacts is at an acceptable level in accordance with LA 114 (UK HA 2019) Guidance leading to a finding of a *not significant* effect.

13.5.4.4 Major Storm Damage

In Chapter 24 Major Accidents and Disasters (Volume 2 of this EIAR), an assessment of the risk potential of meteorological events such as gale force winds, storms or hurricane was undertaken.

In terms of extreme weather, the EPA (EPA 2015b) is predicting a reduction in storms and wind intensity by mid-century and thus the risk of extreme weather impacting on the proposed development is not significant. However, more recent EPA research (EPA 2020b) show an overall reduction of ≈10% in the numbers of storms affecting Ireland and suggest an eastward extension of the more severe windstorms over Ireland and the UK from the middle of the century. However, the research notes that this should be taken with some

caution as extreme storms are rare events. In addition the research indicated reduction in windspeed by the mid-century. A summer reduction in 10-m wind speed range from 0.3% to 3.4% for the RCP4.5 scenario and from 2% to 5.4% for the RCP8.5 scenario.

The Electricity & Gas Networks Sector Climate Change Adaptation Plan prepared under the National Adaptation Framework has been prepared by the Department of Communications, Climate Action and Environment (DCCAE 2019b) which considers future climate change impacts on energy infrastructure and aims to reduce vulnerability by building resilience in the energy sector. In addition there is a Transport Climate Change Sectoral Adaptation Plan (DTTAS 2019) which was also prepared under the National Adaptation Framework. These adaptation plans will ensure that the future electrical supply will have added resilience. The electrical supply will be direct to the project by way of an underground cable which will be resistant to storm damage. The substations have looped connections with the ESB (redundant connection) and therefore already have a backup which will be used prior to the generator being required. In addition, there is a single 80 KVA diesel generator in the proposed substations as a backup in the event of storm damage. The detailed design of the proposed development will be in accordance with all relevant codes and standards, including IS EN 1991-1-4:2005 Eurocode 1: Actions on structures – general actions - Wind actions. In addition, mitigation against lightning strikes will be accounted for by utilisation of methods contained in IEC 62305 'Protection Against Lightning, Part 2, Risk Management'.

Iarnród Éireann have a management protocol (CCE-TMS-311 Iarnród Éireann Weather Management Procedures) for preparedness and response to extreme weather events. This protocol includes assessing the operability of the network for services and co-operating and communicating with emergency services and national stakeholders, including participation in the National Emergency Coordination Group, to ensure passengers are accommodated insofar as is practical and safe. In addition, they have a management protocol to facilitate passenger services being brought back into operation as quickly and safely as possible after an extreme weather event.

The probability and frequency likelihood are considered in accordance with the criteria set out in Section 13.3.6 to have the potential to be high i.e. the event occurs approximately every five years (Table 13.4). This is an unmitigated scenario, however due to the design these events can be mitigated to reduce the probability and frequency likelihood to low (approximately once in the proposed development's lifespan). Given the importance of the proposed development the measure of consequences (Table 13.5) can be classed as moderately adverse as an operational phase impact would cause disruption on regional level disruption to strategic routes but it is unlikely that temperatures would cause shutdown for longer than a week. The significance conclusion (Table 13.6) indicates that the impact is not significant and therefore the significance of impacts is at an acceptable level in accordance with LA 114 (UK HA 2019) Guidance leading to a finding of a *not significant* effect.

13.5.4.5 Land Use Change

The operational phase of proposed development will not result in any significant change in land use in addition to the areas considered in the construction phase. Thus, there will be a negligible impact on carbon sequestration as a result of the operational phase of the proposed development.

13.6 Mitigation Measures

The proposed development sets out mitigation measures with respect to the construction and operational phases in order to reduce its impact on climate related GHG emissions by implementing low-carbon energy options. The IEMA GHG Management Hierarchy (IEMA 2020b) should be following as an overarching strategy for impact minimisation. The Hierarchy is as follows:

- First Eliminate
  - Influence business decisions/use to prevent GHG emissions across the lifecycle.
  - Potential exists when organisations change, expand, rationalise or move business.

  - Transition to new business model, alternative operation or new product/service.
- Then Reduce
  - Real and relative (per unit) reductions in carbon and energy.
  - Efficiency in operations, processes, fleet and energy management.
  - Optimise approaches (e.g. technology) and digital as enablers.
- If you can't eliminate or reduce, then Substitute
  - Adopt renewables/low-carbon technologies (on site, transport etc).
  - Reduce carbon (GHG) intensity of energy use and of energy purchased.
  - Purchase inputs and services with lower embodied/embedded emissions.
- The final option is to Compensate
  - Compensate 'unavoidable' residual emissions (removals, offsets etc).
  - Investigate land management, value chain, asset sharing, carbon credits.
  - Support climate action and developing markets (beyond carbon neutral).

Iarnród Éireann will actively purchase materials and services with lower embodied/embedded emissions. Where possible the aim is to design out and eliminate potential impacts completely. Where this is not possible impacts should be reduced/substituted to reduce impacts. Finally, if impacts cannot be eliminated by design or reduced/substituted then the IEMA GHG Management Hierarchy final mitigation measure that should be considered is compensation, this includes the use of carbon offsets.

IEMA Guidance (IEMA 2022) states that the crux of significance regarding impact on climate is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050. The proposed development's sustainability aims align with the project being net zero by 2050 and the mitigation measures below will be implemented in order to ensure that this aim is met.

13.6.1 Construction Phase

Construction traffic and the embodied energy of construction materials will be the dominant source of greenhouse gas emissions as a result of the Construction phase of the proposed development. Construction vehicles, generators etc., may give rise to some CO_2 and N_2O emissions.

13.6.1.1 Construction Phase Embodied Carbon Mitigation

A series of mitigation measures have been incorporated into the construction design with the goal of reducing the embodied carbon associated with the Construction phase of the proposed development. These mitigation measures include:

- The replacement, where feasible, of concrete with concrete containing 30% fly ash replacement. The majority (80%) of concrete is assumed to be RC 32/40MPa which has an embodied carbon of 298 $kgCO_2e$ per m^3 with 30% fly ash replacement compared to a standard embodied carbon of 359 $kgCO_2e$ per m^3, a 17% reduction. The remaining 20% is assumed to be a mixture of other strengths, with an assumption of 10% being a lower grade RC 20/25 MPA (290 $kgCO_2e$ per m^3 reduces to 235 $kgCO_2e$ per m^3) and 10% being a higher strength RC 45/50 MPA (413 $kgCO_2e$ per m^3 reduces to 338 $kgCO_2e$ per m^3). This measure has been included in the calculations within Section 13.3.3.1 and resulted in a saving of 13,719 tonnes CO_2e.
- Steel will be sourced from continental Europe where a high proportion of it is made from recycled materials. Discussions with a potential supplier confirmed that reinforcement for concrete is always produced using recycled material at no additional financial cost, structural steel is produced using recycled materials at no additional financial cost and steel for cladding can have the recycled content stipulated in contracts for a small cost (5-7% additional cost). Iarnród Éireann will pursue procurement of the highest recycled steel content that is available for the particular steel usage. This may vary depending on engineering constraints.
- The proposed development will minimise wastage of materials due to poor timing or over ordering on site thus helping to minimise the embodied carbon footprint of the site.

- Waste generated during the construction phase will be carefully managed according to the accepted waste hierarchy set out in the Waste Framework Directive (2008/98/EC), which gives precedence to prevention, minimisation, reuse and recycling over disposal with energy recovery and finally disposal to landfill. As reuse and recycling capacity is unknown for the construction year a conservative approach has been taken during the assessment. This assumes all waste that is not guaranteed to be reused onsite will be sent to landfill.
- Detailed design will investigate the use of tapial blocks made of rammed earth which can replace the concrete piles and a concrete wall as the interior finishing face within the Spencer Dock excavation.

The significance criteria for impacts (IEMA 2022) states that the impact significance must be taken from the project as a whole over its lifecycle rather than individual elements and therefore will be discussed in the residual impacts section.

13.6.1.2 Construction Phase Road Traffic Mitigation

Some site-specific mitigation measures will be implemented during the Construction phase of the proposed development to ensure construction traffic emissions are reduced. A Construction Traffic Management Plan (CTMP) (See Appendix A6.3 in Volume 4 of this EIAR) and a Mobility Management Plan (MMP) will be implemented throughout the construction stage to avoid congestion and thus reduce GHG emissions. All plant and machinery will be maintained and serviced regularly.

Construction vehicles, generators etc., will give rise to some GHG emissions, however the proposed development impact on climate due to traffic (Section 13.5.1.1) will be minimised through mitigation measures. The following mitigation measures will be put in place to minimise emissions:

- Implement a policy which prevents idling of vehicles both on and off-site including HGV holding sites.
- Construction phase traffic should be monitored to ensure construction vehicles are using the designated haul routes.
- All plant and machinery will be maintained and serviced regularly.
- Efficient scheduling of deliveries to minimise number of road trips required.
- Construction vehicles will conform to the current EU emissions standards and where reasonably practicable, their emissions should meet upcoming standards prior to the legal requirement date for the new standard. This will ensure emissions on haul routes are minimised.

In addition, as part of the proposed development a Construction Traffic Management Plan (CTMP) will be put in place for the construction phases, see Appendix A6.3 in Volume 4 of this EIAR. The CTMP will be put in place for the construction phase following consultation with local authorities. Regional roads, primary roads and sections of the motorway will be used at every opportunity in order to reduce traffic impacts to local roads with reduced capacity which may result in traffic congestion and increased emissions. In addition, the CTMP proposed to minimize construction impacts on pedestrians, cyclists and on the operation of bus services which will ensure public transport remains a priority.

A Mobility Management Plan (MMP) will also be put in place for the Construction phase. This plan will support and promote sustainable travel for construction staff travelling to and from the proposed development site. This will be achieved by setting out a strategy for eliminating barriers preventing travel by sustainable travel modes, improving travel choices and significantly reducing single occupancy car trips. Parking will not be available at construction sites for works. The MMP would be an active document that will require to be updated on a regular basis as construction activities take place and will present a series of measures designed to encourage travel to the constructions site(s) in a sustainable way.

13.6.2 Operational phase

13.6.2.1 Maintenance Phase Embodied Carbon Mitigation

The maintenance phase GHG emissions will primarily consist of the maintenance of materials which were used in construction. No specific mitigation is set out however where possible, materials should be replaced

in the most sustainable manner available. This may mean different materials used in replacement during the operational phase.

13.6.2.2 Operational Phase Rail Mitigation

During the impact assessment it was assumed that the DN and DS achieved the CAP target of 80% renewables.

Iarnród Éireann have agreed to purchase up to 80% of its operational demand from certified low or zero carbon electricity for operations. A Corporate Power Purchase Agreement (CPPA) is a financial contract with a renewable generator that will allow for a guaranteed source of renewable power for the operation of the proposed development in future. This will ensure that should the CAP target of 80% renewables not be achieved the project will still achieve the target within itself. Should the national grid not achieve its target of 80% renewables by 2030 then the CPPA will further the beneficial impact of the proposed development.

Over 80% of Iarnród Éireann (Iarnród Éireann 2021) energy consumption is diesel fuel. In addition to changing the rail corridor to facilitate a change from DMUs to EMUs, further mitigation through the improvements in fuel efficiency for the remaining DMUs will implemented. These include using timetable optimisation and driver training, fuel consumption telematics for older rolling stock, Auto-Shut down for a significant portion of the fleet, matching train sizes to customer demand and elimination of Temporary Speed Restrictions (TSRs) arising from infrastructure renewals.

In addition a number of fuel efficiency programs are currently in progress / on-trial (Iarnród Éireann 2021). These include the trial replacement of ICR gearboxes, replacement of ICR diesel engines with hybrid drives, Envirox fuel additive to increase fuel efficiency and to keep diesel engine DP filters clean and replacement of diesel vans with electric road vehicles supported by charging points at depots and stations.

13.6.2.3 Operational Phase Demand

The proposed development also aims to reduce the energy demand with passive architectural strategies, reducing energy consumption with energy-efficient equipment and producing energy with renewable technologies. Energy is also related to CO_2 emissions and IÉ's future Carbon Neutrality goal. The use of building design to maximise natural lighting and solar gain, use of motion-controlled lighting systems and LEDs will reduce building energy requirements.

Potable water consumption will be minimised using low consumption fixtures and recycling and reuse of greywater. In addition, Iarnród Éireann will prioritise the use of environmentally friendly materials and the use of recycled and recyclable materials during the operation of the proposed development.

A Depot Sustainability Strategy has been produced with an objective to design a functional, efficient and comfortable building with a minimum environmental impact, being an nZEB, Nearly Zero Energy Building and achieving EXEED certification. This will mitigate operational phase energy demand and ensure it is minimised.

The Iarnród Éireann Sustainability strategy (Iarnród Éireann 2021 and 2022) notes the following key mitigation measures for reduction in their carbon footprint:

- Compliance with relevant ISO and national NSAI energy and environmental standards.
- Contributing to transport sector decarbonisation including improving fleet and buildings fuel / energy performance, fleet hybridisation, phased network electrification and promoting and facilitating a shift to rail.
- Recycling of 70% of all waste.
- Near Zero Energy Building standard in all new buildings, and upgrades of 140 existing buildings to minimum BER B.
- Reduction in overall carbon emissions by 51% between 2021 to 2030.

- Improving operations, infrastructure and fleet climate change resilience including partnership approach to emergency responses and wide-ranging mitigation measures including coastal protection.
- Reducing environmental impacts including LEAN management, waste and water management, green procurement in support of the circular economy and site decontamination.
- Protecting habitats and promoting biodiversity in a partnership approach.

The above actions and others within the Iarnród Éireann Sustainability strategy will be implemented as part of Iarnród Éireann's future mitigation and this includes the proposed development mitigation.

13.6.2.4 Operational Phase Road Traffic Mitigation

The impact of the operational phase road traffic from the proposed development on national greenhouse gas emissions will be insignificant in terms of Ireland's obligations under the EU 2030 Target (Government of Ireland, 2021b). The proposed development aims to facilitate a modal shift away from private road transport to electrified public transport. The increased frequency and capacity of the railway corridor will provide a more attractive alternative to private car travel, encouraging more passenger travel by more sustainable modes while providing a better quality of life for citizens. Total trip demand is increasing into the future in line with population, employment and jobs growth. A greater share of the demand will be by sustainable modes (public transport, walking and cycling) and move away from private transport.

Iarnród Éireann (2022) in their 2021 to 2030 Sustainability Plan have committed to 100% electric or hybrid road vehicles by 2030.

13.7 Monitoring

No monitoring measures are proposed for the operational phase.

13.8 Residual Effects

13.8.1 Construction Phase

When the quantifiable Construction phase GHG mitigation measures detailed in the mitigation section of this chapter are implemented, GHG emissions from the proposed development are predicted to be as detailed in Table 13.22. The significance criteria for impacts (IEMA 2022) states that the impact significance must be taken from the project as a whole over its lifecycle rather than individual elements and therefore will be discussed in the Section 13.8.3.

Table 13.22 Summary of Predicted Construction Phase Residual Impacts

Project Phase		CO_2 Tonnes Annualised
Construction phase	Embodied Carbon	3,468
	Road Vehicle Emissions	15
Annual CO_2 Emissions		4,110

13.8.2 Operational Phase

When the quantifiable operation phase GHG mitigation measures, such as use of 80% renewable electricity, detailed in the mitigation section of this chapter are implemented, GHG emissions from the proposed development are predicted to be as detailed in Table 13.23. The significance criteria for impacts (IEMA

2022) states that the impact significance must be taken from the project as a whole over its lifecycle rather than individual elements and therefore will be discussed in the Section 13.8.3.

Table 13.23 Summary of Predicted Operational Phase Residual Impacts

Project Phase		CO_2 Tonnes Annualised
Operational phase	Rail Emissions	-3,702
	Power and Heat	841
	Road Vehicle Emissions	651
	Annual CO_2 Emissions	-2,210

13.8.3 Summary of Residual Effects

The significance criteria for impacts (IEMA 2022) states that the impact significance must be taken from the project as a whole over its lifecycle. Considering the IEMA significance criteria set out in Section 13.3.5.1 the operational phase of the proposed development can be considered to beneficially contribute to Ireland's target of net zero. However, the impacts of embodied carbon from the construction phase results with a residual impact of 1,273 tonnes CO_2 annually or 0.0038% of Ireland's 2030 CO_2 targets. The residual impact is equivalent to five return flights from Dublin to New York annually.

The proposed development aims to assist in the transition to a low carbon and climate-resilient society. As a result of the proposed development there is an 80% reduction in CO_2 emissions on a per carriage km for the direct operational phase rail impacts of the proposed development as per Table 13.17. The assessment is based on 80% renewables for the DN and DS power. If the percentage of renewables is further decreased as Ireland transitions to net carbon zero by 2050 then the impact of the proposed development will further decrease resulting in a beneficial impact in future. In addition, future changes in DMU efficiency or technologies may result in lower emissions from the remaining DMU within the rail stock.

IMEA significance (IEMA 2022) notes that:

> *"Minor adverse impact (not significant): A project that is compatible with the budgeted, science based 1.5°C trajectory (in terms of rate of emissions reduction) and which complies with up-to-date policy and 'good practice' reduction measures to achieve that has a minor adverse effect that is not significant. The project may have residual impacts but is doing enough to align with and contribute to the relevant transition scenario. A 'minor adverse' or 'negligible' non-significant effect conclusion does not necessarily refer to the magnitude of GHG emissions being carbon neutral[3] (i.e. zero on balance) but refers to the likelihood of avoiding severe climate change and achieving net zero by 2050. A 'minor adverse' effect or better is a high bar and indicates exemplary performance where a project meets or exceeds measures to achieve net zero earlier than 2050.*
>
> *Negligible Impact (not significant): A project that achieves emissions mitigation that goes substantially beyond the reduction trajectory, or substantially beyond existing and emerging policy compatible with that trajectory, and has minimal residual emissions, is assessed as having a negligible effect that is not significant."*

The operational phase of the DART+ project is consistent with and supports Project Ireland 2040, the National Development Plan 2017 to 2028, the National Planning Framework, the Sustainable Mobility Policy Action Plan 2022 – 2025 and the Climate Action Plan 2021. DART+ is a key deliverable measure in the Climate Action Plan 2019 to achieve targets for modal shift. The National Planning Framework and the National Development Plan list the DART+ Programme as a cornerstone project to assist in transition to a low carbon society. By creating a resilient, accessible public transport network, DART+ West project will

[3] Carbon Neutral: "*When anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period irrespective of the time period or magnitude of offsets required.*"

provide an attractive alternative to private car travel, encouraging more passenger travel by more sustainable modes.

Dublin was selected in April 2022 as one of the EU Mission Cities (European Commission 2022), a program which has an aim to produce 100 climate-neutral and smart cities by 2030. The Cities Mission will receive €360 million of Horizon Europe funding covering the period 2022-23, to start the innovation paths towards climate neutrality by 2030. The research and innovation actions will address clean mobility, energy efficiency and green urban planning, and offer the possibility to build joint initiatives and ramp up collaborations in synergies with other EU programmes. Improvements in public transport such as those put forward in the proposed development will be essential in achieving this ambitious goal set by the European Commission.

The Promotion of the Use of Energy from Renewable Sources Directive (EU) 2018/2001 specifies a legally binding 14% renewable energy in transport target to be achieved by all Member States by 2030. Given its use of electricity, the proposed development has an ability to utilise renewable energy throughout its operation and assist in Ireland meeting this target.

In line with the IEMA significance criteria set out in Section 13.3.5.1 the overall residual impact of the proposed development is considered to be *non-significant and minor adverse in the short term*, however as Ireland further progresses towards net carbon zero and the percentage of renewables within electricity utilised for rail further increases the long-term impact of the proposed development has the potential to be considered *not significant and negligible or even significant and beneficial*.

Table 13.24 Summary of Predicted Construction and Operational phase Residual Impacts

Project Phase		CO_2 Tonnes Annualised
Construction phase	Embodied Carbon	3,468
	Road Vehicle Emissions	15
Operational phase	Rail Emissions	-3,702
	Power and Heat	841
	Road Vehicle Emissions	651
Annual CO_2 Emissions		1,273
As % of Irelands 2030 CO_2 targets		0.0038%

13.9 Cumulative Effects

The construction and operational phases within the climate chapter are considered cumulatively within the impact assessment. This is in line with IEMA Assessing GHG Emissions and Evaluating their Significance (IEMA 2022) which states that the impact significance must be taken from the project as a whole over its lifecycle rather than individual elements and therefore will be discussed in the Section 13.8.3.

The cumulative assessment of relevant plans and projects is undertaken separately in Chapter 26 of this EIAR.

13.10 References

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