Chapter 08
Climate

Contents

8. Climate

8.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) has considered the potential climate impacts (both positive and negative) associated with the Construction and Operational Phases of the Ringsend to City Centre Core Bus Corridor Scheme (hereafter referred to as the Proposed Scheme).

The aim of the Proposed Scheme when in operation is to provide enhanced walking, cycling and bus infrastructure on this key access corridor in the Dublin region, which will enable and deliver efficient, safe, and integrated sustainable transport movement along the corridor. The objectives of the Proposed Scheme are described in Chapter 1 (Introduction). The Proposed Scheme which is described in Chapter 4 (Proposed Scheme Description) has been designed to meet these objectives. The objectives that are specifically applicable to this assessment are to:

- Enhance the capacity and potential of the public transport system by improving bus speeds, reliability and punctuality through the provision of bus lanes and other measures to provide priority to bus movement over general traffic movements;
- Enhance the potential for cycling by providing safe infrastructure for cycling, segregated from general traffic wherever practicable; and
- Support the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets.

The Proposed Scheme will facilitate a resilient, accessible public transport and cycling network providing an attractive alternative to private car travel, encouraging more passenger travel by sustainable modes while providing a better quality of life for citizens. The improvements to sustainable modes provision as a result of the Proposed Scheme will facilitate a reduction in congestion, reduced greenhouse gas (GHG) emissions and associated air quality improvements along the Proposed Scheme, resulting in enhanced community wellbeing. The delivery of the Proposed Scheme has the effect of a reduction in total vehicle kilometres, a reduction in fuel usage, and increases to sustainable transport trips and modal share in accordance with the 2023 Climate Action Plan (CAP) (Department of Communications, Climate Action and Environment (DCCAE) 2022).

Investments in high quality public transport infrastructure and systems have been proven to result in significant modal shift. Indeed, in Dublin the Canal Cordon Report (NTA 2019) outlined that in 2019 (prior to Covid-19 restrictions) travel by sustainable modes accounted for 72% of all trips into Dublin City, compared to 59% in 2010. This positive improvement in sustainable mode uptake was facilitated by investment in walking, cycling and bus infrastructure, Luas Cross City and the re-opening of the Phoenix Park Tunnel in addition to investments in systems such as Leap Card and Real Time Passenger Information (RTPI).

Potential climate impacts associated with the Construction Phase of the Proposed Scheme assessed, included temporary activities such as utility diversions, road resurfacing and road realignments. Construction access routes are also assessed for this phase of the works.

Potential climate impacts associated with the Operational Phase of the Proposed Scheme took into account predicted changes in traffic flows along the Proposed Scheme, reallocation of road space for sustainable modes and potential for displaced traffic flows. In addition, an assessment of the Proposed Scheme in relation to its vulnerability to climate change has been undertaken.

The core assessment scenario outlined below has considered a reasonable worst-case operational scenario for assessment purposes. In addition to the core assessment scenario, alternative scenarios have been analysed in order to consider the potential for further carbon reduction should the alternative scenarios, in terms of higher bus frequencies and offline traffic signal optimisation, materialise. The assessment has been carried out according to best practice and guidelines relating to climate and greenhouse gas (GHG) emissions.

8.2 Climate Assessment Considerations

The Proposed Scheme aims to provide an attractive alternative to the private car and promote a modal shift to public transport, cycling and walking. It is, however, recognised that there will be an overall reduction in operational capacity for general traffic along the direct study area given the proposed changes to the road layout and the rebalancing of priority to walking, cycling and bus. This reduction in operational capacity for general traffic along the Proposed Scheme is likely to create some level of trip redistribution onto the surrounding road network, in the absence of wider regional wide demand management measures (outside the scope of the Proposed Scheme).

It should be noted that the Do Minimum and Do Something scenarios are based on the assumption that travel behaviour will remain broadly consistent over the assessment period (2028-2043) and that car demand data used for this assessment, represent a reasonable worst-case scenario. However, it is anticipated that societal trends in the medium to long term may reduce car demand further due to the ongoing changes to travel behaviours and further shifts towards sustainable travel; flexibility in working arrangements brought on following Covid-19 restrictions; and delayed car ownership trends that are emerging.

The assessment also assumes that goods vehicles (heavy goods vehicles (HGVs) and light goods vehicles (LGVs)) continue to grow in line with forecasted economic activity with patterns of travel remaining the same. For example, the assessment assumes a 45% and 77% increase in goods traffic versus the base year in the Opening Year (2028) and the Design Year (2043) respectively. This is considered a very conservative assumption. It should be noted, however, that the 2023 CAP (DCCAE 2022) includes reference to a freight strategy for the region which will seek to further integrate smart technologies in logistics management and may include the regulation of delivery times as far as practicable to off-peak periods to limit traffic congestion in urban areas. The 2023 Climate Action Plan outlines proposals to manage the increase in delivery and servicing requirements as the population grows, which may include the development of consolidation centres to limit the number of ‘last-mile’ trips made by larger goods vehicles with plans for higher use of smaller electric vans or cargo bikes for ‘last-mile’ deliveries in urban areas. As proposals for the above are at a pre-planning stage, it was not possible to account for them in the assessments and a worst-case assessment has been undertaken based on continued growth in goods traffic.

The goods vehicle emissions presented in the assessment assume no conversion to zero emission HGV vehicles by 2028 or 2043. This is considered a highly conservative assumption in order to assess a worst-case scenario for the purposes of assessment. In reality, a future HGV strategy, although not yet defined, will be implemented in order to realise the objectives for decarbonising HGVs as outlined in the 2023 Climate Action Plan (CAP) (DCCAE 2022). In using the highly conservative assumptions regarding HGV fleet it was noted that goods emissions account for the majority of residual emissions presented in the Design Year (2043). Goods emissions, however, are not an area that the Proposed Scheme can address. The 2023 Climate Action Plan (CAP) (DCCAE 2022) further recognises that the technology pathway for decarbonising HGVs is still developing. While battery operation of HGVs over long distances is not currently a viable solution, due to range limitations, hydrogen powered HGVs do represent a technically feasible solution. For this reason, the overall impact rating determined for climate through the impact assessment undertaken has been based on the GHG emission changes for car and bus modes. The emissions for goods vehicles require a technological solution that will be supported by Government for implementation as technological progress of a viable vehicle/fuel alternatives come to the market.

The design of the Proposed Scheme has evolved through comprehensive design iteration, with particular emphasis on minimising the potential for environmental impacts, where practicable, whilst ensuring the objectives of the Proposed Scheme are achieved. Significant design iterations were undertaken to mitigate against traffic re-distribution impacts and consequent increases in trip kilometres and in turn GHG emissions. In addition, feedback received from the comprehensive consultation programme undertaken throughout the option selection and design development process has been incorporated where appropriate.

8.3 Methodology

Guidance from the United Kingdom Highway Agency (UKHA) Design Manual for Roads and Bridges (DMRB) - LA 114 Climate (hereafter referred to as LA 114 Climate) (UKHA 2021) has been consulted as the most up-to-date guidance available. LA 114 Climate advises that the assessment of a Proposed Scheme should describe the likely significant effects on the environment resulting from both the:

- Impact of a project on climate (GHG emissions); and

- Vulnerability of a project to climate change (adaptation).

The assessment methodology has been derived with reference to the most appropriate guidance documents relating to climate which are set out in the following sections of this Chapter. An overview of the methodology undertaken for the climate impact assessment is outlined below:

- A detailed baseline review of GHG emissions has been undertaken in order to characterise the baseline environment. This has been undertaken through review of available published GHG emission data;
- A review of the most applicable guidelines for the assessment of GHG emissions has been reviewed in order to define the significance criteria for the Construction and Operational Phases of the Proposed Scheme in both the Opening Year (2028) and the Design Year (2043);
- Predictive calculations and impact assessments relating to the likely Construction Phase climatic impacts of the Proposed Scheme have been undertaken;
- Predictive calculations have been performed to assess the potential climatic impacts associated with the operation of the Proposed Scheme, including maintenance;
- An assessment of the vulnerability of the Proposed Scheme to climate change has been undertaken; and
- A schedule of mitigation measures has been incorporated, where required to reduce, where necessary, the identified potential climatic impacts associated with the Proposed Scheme.

8.3.1 Study Area

The Proposed Scheme will cover a 4.3-kilometre (km) study area from Ringsend to the City Centre. In terms of the climate study area, the assessment has taken into account the travel distances associated with the Construction Phase of the Proposed Scheme and, for the Operational Phase, changes to traffic flow due to the Proposed Scheme.

The direct and indirect impacts have been considered with reference to the following study area extents:

- **Direct Study Area** – The Proposed Scheme (i.e. the transport network within the red line boundary), and
- **Indirect Study Area** – This is the area of influence the Proposed Scheme has on changing traffic volumes above a defined threshold with reference to Transport infrastructure Ireland's (TII) Traffic and Transport Assessment Guidelines (TII 2014). Further details on the definition of the indirect study area can be found in Chapter 6 (Traffic & Transport).

The likely significant climatic impacts for the Construction and Operational Phases are discussed in Section 8.5. During the Construction Phase, the focus is on the enabling infrastructure provision, which forms the Proposed Scheme including utility diversions, road widening works / land take activities, road excavation works (where required), road reconfiguration and resurfacing works, and construction traffic emissions.

During the Operational Phase, the focus is on GHG emissions associated with the Proposed Scheme including GHG emissions due to changes to mobility demands, changes to modal split and changes in traffic along alternative routes within the study area. Potential impacts to climate relate to modal shifts towards more sustainable modes of transport, alterations to traffic patterns (e.g. introduction of a new bus lane, Bus Gates, and other traffic management measures), maintenance and changes to the number and type of traffic trips including public transport. The assessment of the Operational Phase also examines the vulnerability of the Proposed Scheme to climate change, including the risk of flooding and the potential increased frequency of storms and the measures that have been put in place to ensure the resilience of the Proposed Scheme to climate change.

8.3.2 Relevant Guidelines, Policy and Legislation

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

- Guidelines on the Information to be contained in Environmental Impact 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 impacts from road schemes. These are summarised below:

- Number 46 OF 2015 - Climate Action and Low Carbon Development Act 2015 (hereafter referred to as the Climate Act);
- Number 32 of 2021 - Climate Action and Low Carbon Development (Amendment) Act 2021 (hereafter referred to as the 2021 Climate Act);
- Department of Communications, Climate Action and Environment (DCCAE) National Adaptation Framework (hereafter referred to as the NAF) (DCCAE 2018);
- Climate Action Plan 2019 (hereafter referred to as the 2019 CAP) (DCCAE 2019);
- 2021 CAP (DCCAE 2021);
- 2023 CAP (DCCAE 2022);
- 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 (hereafter referred to as the DCC Climate Action Plan) (DCC and Codema 2019);
- South Dublin County Council (SDCC) Climate Change Action Plan 2019 – 2024 (hereafter referred to as the SDCC Climate Action Plan) (SDCC and Codema 2019);
- 2030 Climate and Energy Policy Framework (European Commission 2014);
- Transport Infrastructure Ireland (TII) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (hereafter referred to as the TII Air Quality Guidelines) (TII 2011);
- National Transport Authority (2016) Transport Strategy For The Greater Dublin Area 2016 – 2035 (NTA 2016);
- NTA (2022) Greater Dublin Area Transport Strategy 2022-2042;
- LA 114 Climate (UKHA 2021);
- IEMA EIA Guide to: Climate Change Resilience and Adaptation (IEMA 2020a);
- IEMA Greenhouse Gas Management Hierarchy (IEMA 2020b); and
- Institute of Environmental Management and Assessment (IEMA) Assessing Greenhouse Gas Emissions and Evaluating their Significance 2nd Edition (IEMA 2022).

8.3.2.1 International and National Guidelines, Policy and Legislation

Ireland is party to both the United Nations Framework Convention on Climate Change (UNFCCC) (UNFCCC 1992) and the Kyoto Protocol (UNFCCC 1997). The Paris Agreement (UNFCCC 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 (degrees Celsius) 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 as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to GHG emissions are 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. Adaptation refers to measures that can reduce the negative impact of climate change by, for example, ensuring a project is resilient to future increases in storm frequency and rainfall levels.

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 to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision 280/2004/EC (hereafter referred to as the GHG Regulation). The GHG 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 GHG Regulation is a 30% reduction in non-ETS GHG emissions by 2030 relative to its 2005 levels.

In 2015, the Climate 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*'. This is referred to in the Climate Act as the '*national transition objective*'.

The 2015 Climate Act made provision for a national mitigation plan (which was struck down by the Supreme Court on 31 July 2020). However, the 2021 Climate Act subsequently removed any reference to a national mitigation plan and instead refers to both the 2019 CAP (DCCAE 2019), as published in 2019, and a series of National Long Term Climate Action Strategies. The 2019 CAP was updated to the 2021 CAP in November 2021.

The 2021 Climate Act allows for the Minister to submit an adaptation framework referred to as the 'National Adaptation Framework', which is required to be submitted to Government for approval every five years. It 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; and
- Take into account any existing obligations of the State under the law of the EU or any international agreement.

In addition, the 2015 Climate 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 national mitigation and adaptation plans and compliance with existing climate obligations.

The 2021 CAP, 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 which includes the BusConnects Dublin – Core Bus Corridor Infrastructure Works (hereafter referred to as the CBC Infrastructure Works). 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, including a comprehensive cycling and walking network for metropolitan areas of Ireland. The Proposed Scheme will provide improved infrastructure for pedestrians and cyclists.

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;
- Procuring 1,500 low-emission buses for public transport in cities; and
- 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. Additional measures targeted at public fleets include the transition to low emission vehicles (LEVs)

for the urban public bus fleet with no diesel-only purchases already in place since July 2019 and a roadmap for all Public Service Obligation (PSO) Bus fleets to become LEVs by 2035.

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 GHG 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 modal 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 General Scheme in December 2019, followed by the publication of the 2021 Climate Bill in March 2021 and the 2021 Climate Act in July 2021.

The purpose of the 2021 Climate 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 also provided 'for carbon budgets and a sectoral emissions ceiling to apply to different sectors of the economy'. The 2021 Climate Act removes any reference to a national mitigation plan and instead refers to both the Climate Action Plan, as published in 2019, and a series of National Long Term Climate Action Strategies. In addition, the Environment Minister is required to request that each local authority prepare a 'local authority climate action plan' lasting five years and specifying the mitigation measures and the adaptation measures to be adopted by the local authority. The 2021 Climate Act has set a target of a 51% reduction in the total amount of greenhouse gases over the course of the first two carbon periods ending 31 December 2030 relative to 2018 annual emissions. The 2021 Climate Act defines the carbon budget as 'the total amount of greenhouse gas emissions that are permitted during the budget period'.

The 2021 Climate Act outlines a series of specific actions including:

- To make a strategy to be known as the 'National Long Term Climate Strategy' not less than once in every five-year period with the first to be published for the period 2021 to 2035 and with each subsequent Strategy covering the next three five-year carbon budgets and also include a longer term perspective of at least 30 years;
- To adopt a system of carbon budgets which will be determined as part of a grouping of three five-year periods calculated on an economy-wide basis, starting with the periods 2021 to 2025, 2026 to 2030, and 2031 to 2035;
- To introduce a requirement for Government to adopt "sectoral emission ceilings" for each relevant sector within the limits of each carbon budget;
- To request all local authorities to prepare climate action plans for the purpose of contributing to the national climate objective. These plans should contain mitigation and adaptation measures that the local authority intends to adopt;
- Increasing the power of the Advisory Council to recommend the appropriate climate budget and policies;
- Requiring the Minister to set out a roadmap of actions to include sector specific actions that are required to comply with the carbon budget and sectoral emissions ceiling for the period to which the plan relates; and
- Reporting progress with the CAP on an annual basis with progress including policies, mitigation measures and adaptation measures that have been adopted.

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 annual EPA GHG report;

- Compliance with the sectoral emissions ceiling and any measures envisaged to address any failures to comply with the target; and
- The implementation of adaptation policy measures and any adaptation policy measures envisaged, where a sectoral adaptation plan has been prepared.

As part of the preparation of a 'local authority climate action plan', 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.

In December 2022, 2023 CAP was published (DCCAE 2022). This is the first CAP since the publication of the carbon budgets and sectoral emissions ceilings, and it aims to implement the required changes to achieve a 51% reduction in carbon emissions by 2030. The 2023 CAP has six vital high impact sectors where the biggest savings can be made: renewable energy, energy efficiency of buildings, transport, sustainable farming, sustainable business and change of land-use. 2023 CAP confirms that since the publication of 2021 CAP several transport related measures have been implemented including the launch of Phase 2 of BusConnects Dublin Network Redesign.

Aims within 2023 CAP that have the potential to affect transport emissions include reducing the dependency on private cars and a target to reduce the overall total distance driven across all car journeys by 20%. In addition, 2023 CAP has a 2030 aim that 1 in 3 cars will be electric and that there would be an annual increase in the percentage of biofuel in fossil fuels (E10:B12 by 2025 and E10:B20 by 2030). E10 is unleaded petrol blended 10% ethanol, B20 is up to 20% biodiesel blended into diesel.

Within 2023 CAP, key transport actions are considered using a 'Avoid-Shift-Improve' framework:

- developing services, communities, and infrastructure in such a manner as to AVOID the need to travel as much as we do today;
- improving the relative attractiveness of sustainable travel modes such as Public Transport, Cycling and Walking, to SHIFT away from car use; this will facilitate increased use of lower-carbon modes and reduce the percentage of total journeys that are made by private car (modal share) from over 70% (today) to just over 50% in 2030; and
- complement these measures by increasing the proportion of EVs in our car fleet to 30% by 2030, which will IMPROVE the efficiency of the national car fleet; electrification of the freight and public transport sector will also be key.

As part of the Avoid-Shift policy, 2023 CAP highlights that the reallocation of existing road space towards public transport and active travel has been implemented including crucial elements of the BusConnects programme.

The first carbon budget programme proposed by the Climate Change Advisory Council was approved by Government and adopted by both Houses of the Oireachtas in April 2022. The carbon budgets comprise of three successive 5-year budgets. The total emissions allowed under each budget is set out below in Table 8.1 as well as the average annual reduction for each 5-year period.

Table 8.1: 2021 – 2035 Carbon Budgets

Period	Mt CO_2eq	Emission Reduction Target
2021-2025	295 Mt CO_2eq	Reduction in emissions of 4.8% per annum for the first budget period.
2026-2030	200 Mt CO_2eq	Reduction in emissions of 8.3% per annum for the second budget period.
2031-2035	151 Mt CO_2eq	Reduction in emissions of 3.5% per annum for the third provisional budget.

The 2023 CAP provides that the economy-wide carbon budgets will be supplemented by sectoral emissions ceilings, setting the maximum amount of GHG emissions that are permitted in a given sector of the economy during each five-year carbon budget. The Sectoral Emission Ceilings for each Sector, published in July 2022, is

shown in Table 8.2. It should be noted that 5.25 $MtCO_{2eq}$ of annual emissions reductions are currently unallocated on an economy-wide basis for the second carbon budget period (2026-2030). These will be allocated following a mid-term review and identification of additional abatement measures. The transport sector emitted approximately 12 $MtCO_{2eq}$ in 2018 and has a ceiling of 6 $MtCO_{2eq}$ in 2030 which is a 50% reduction over this period.

Table 8.2: Sectoral Emission Ceilings

Sector	Reduction Required	2018 Emissions ($MtCO_{2eq}$)	2030 Emission Ceiling ($MtCO_{2eq}$)
Electricity	75%	10.5	3
Transport	50%	12	6
Buildings (Commercial and Public)	45%	2	1
Buildings (Residential)	40%	7	4
Industry	35%	7	4
Agriculture	25%	23	17.25
Other**	50%	2	1

8.3.2.2 Regional Policy and Guidelines

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 (hereafter referred to as the 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 an individual climate change action plan. The individual plans were prepared having regard to A Strategy Towards Climate Change Action Plans for the Dublin Local Authorities (Codema 2017a), which includes aims such as aiding the local authorities in tackling climate change and setting a path to tackling the challenges related to the consequences of climate change. As the Proposed Scheme will pass predominantly through the DCC jurisdiction, a more detailed discussion on the DCC Climate Action Plan (DCC and Codema 2019) is outlined below.

The DCC Climate Action Plan outlines a number of goals and plans to prepare for and adapt to climate change. There are five key action areas within the DCC Climate Action 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 the 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, Irish Rail, Bus Éireann, the Road Safety Authority (RSA) and private operators to improve the connectivity of public transport systems. The DCC Climate 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 T51 of the DCC Climate Action Plan states DCC's support for developing bus routes. Actions T53 and T54 aim to increase the modal shift to public transport and provide increased bus priority on a core bus network (DCC and Codema 2019). It should be noted that the BusConnects Project is in compliance with the aims of actions T53 and T54 to increase modal shift to public transport and to provide increased bus priority on the core bus network.

8.3.3 Data Collection and Collation

8.3.3.1 Baseline Data Collection

As the climate impact assessment is desk-based, research data and relevant publications from the following organisations have been reviewed.

- DCC;
- DCCAE;
- EPA; and
- Sustainable Energy Authority Ireland (SEAI).

The data and research publications are discussed and referenced in Section 8.3.2.1, Section 8.3.2.2 and Section 8.3.3.2.

8.3.3.2 Impact Assessment Data Collection

The assessment of the Construction Phase embodied carbon was undertaken using the TII Carbon Assessment Tool (Version 2) (hereafter referred to as the TII Carbon Tool) (TII 2020) as detailed in Section 8.3.4.1.

Details of land use change (tree / vegetation felling and planting) associated with the Proposed Scheme is discussed in Section 8.3.4.1.2.

Detailed traffic data used in the assessment of the Construction and Operational Phases (Section 8.5) was supplied by the traffic consultants for the Proposed Scheme.

8.3.4 Appraisal Method for the Assessment of Impacts

LA 114 Climate (UKHA 2021) 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 8.3 (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 8.3.4.1 to Section 8.3.4.4.

8.3.4.1 Construction Phase Appraisal Method

8.3.4.1.1 Embodied Construction Emissions

Section 3.13 of LA 114 Climate (UKHA 2021) recommends, that when calculating GHG emissions for a project life cycle, '*an industry recognized carbon calculation tool(s)*' should be used. As noted in Section 8.3.2.2, the embodied construction emissions for the Proposed Scheme were calculated using the TII Carbon Tool (TII 2020). The TII Carbon Tool uses emission factors from recognised 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 Phase / Maintenance Phase. The tool has recently been used to assess the GHG emissions associated with the embodied construction emissions for the Foynes to Limerick Road (including Adare Bypass) scheme.

The assessment commences with 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 Scheme, 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 Scheme.

The Construction Phase of the Proposed Scheme will result in GHG emissions from various sources as outlined in Table 8.3. Embodied carbon refers to GHGs emitted during the manufacture, transport and construction of building materials, together with decommissioning emissions. As part of the Proposed Scheme, Construction Phase embodied GHG emissions are categorised under the following headings:

- Land clearance activities (including the removal of trees / vegetation);
- Manufacture of materials and transport to site;
- Construction works (including excavations, construction, water usage, personnel travel and project size); and
- Construction waste products (including transport off site).

Detailed information for the Proposed Scheme including predicted construction material volumes were provided by the design team for the Proposed Scheme. The road infrastructure associated with the Proposed Scheme is expected to have a Construction Phase of approximately 54 months and an expected operational lifespan of 60 years. Standard maintenance required during the operation of the Proposed Scheme has also been included as part of the embodied Construction Phase emissions including consideration of the maintenance cycles for

embodied carbon for road pavements. Given the extent of the Operational Phase, LA 114 Climate states that decommissioning should be excluded from the climate assessment.

Table 8.3: Sources and Life Cycle Stages for a Project's GHG Emissions (reproduced from Table 3.11.1 of LA 114 Climate (UKHA 2021))

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)	Use of infrastructure by the end-use (road user).	Vehicles using highways infrastructure.	Traffic count / speed by vehicle type for highway links.
	Operation and maintenance (including repair, replacement and refurbishment).	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.
	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 Scheme.

8.3.4.1.2 Land Use Change

The land use change associated with the Construction Phase of the Proposed Scheme has also been quantified using the approach outlined in Table 8.3. Trees are a natural carbon sink and absorb carbon dioxide (CO_2) from the atmosphere helping in the reduction of climate change. A default value for the amount of CO_2 which a mature tree can absorb is approximately 22 kg CO_{2eq}/annum (EEA 2011). Trees have the ability to sequester carbon with the peak CO_{2eq} (carbon dioxide equivalent) uptake rate for tree stands in the order of 5t CO_{2eq}/hectare/year (tonnes of carbon dioxide equivalent per hectare per year) to 20t CO_{2eq}/hectare/year with CO_{2eq} uptake rates declining with maturity and health (UK Forestry Commission 2012). Thus, based on these emission rates, a hectare will typically contain between 225 – 900 trees depending on tree type and maturity. Any felling of trees has the potential to result in a loss or reduction 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 Scheme, including the felling and planting of trees and vegetation, has been calculated using the methodology outlined in Chapter 4 (Forest Land) of the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (IPCC 2006). Land use change is also appropriately assessed using the same methodology.

8.3.4.2 Traffic Related Emissions

The change in GHG emissions due to Operational Phase traffic impacts of the Proposed Scheme have been assessed using the NTA Environmental Appraisal Module, which is based on the ENEVAL software. ENEVAL was developed by Systra Ltd in 2015 on behalf of the NTA. ENEVAL incorporates the official EU vehicle standard emission factor database, termed COPERT, and the emission data from the UK National Atmospheric Emissions Inventory (NAEI). Emissions from the zonal level ENEVAL tool can provide information on the CO_2 emissions for the different traffic scenarios on a regional basis. 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).

The TII Air Quality Guidelines (TII 2011) on regional assessments for climate impacts is based on the methodology provided in Annex 2 in the UK DMRB Volume 11, Section 3, Part 1 – HA207/07 (Document and Calculation Spreadsheet) (UKHA 2007). This methodology has historically been used routinely for the climate impact of road schemes in Ireland. However, the emission factors in the UK DMRB Volume 11, Section 3, Part 1 – HA207/07 (Document and Calculation Spreadsheet) are based on the COPERT III database with the DMRB last updated in 2007. The database does not take account for the recent advances in engine technology and thus would not be now viewed as appropriate for current use.

Section 3.16 of LA 114 Climate (UKHA 2021) appraisal guidance recommends that '*an appropriate validated traffic model shall be used to estimate operational road user GHG emissions*'. LA 114 Climate 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 annual average daily traffic (AADT);
- A change of more than 10% to the number of heavy-duty vehicles; and
- A change in daily average speed of more than 20km/hr (kilometres per hour).

Table 8.3 outlines the sources and activity classes for the Operational Phase of the Proposed Scheme including operational end-use (road user) and operation and maintenance. Modelling of the Construction Phase traffic movements are also modelled using the same approach.

8.3.4.3 Construction and Operational Phase Significance Criteria

LA 114 Climate (UKHA 2021) outlines a recommended approach for determining the significance of both the construction and operational phases of a road project. The approach is based on comparing the Do Something scenario and the net project GHG emissions (i.e. Do Something to Do Minimum) 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 were adopted in 2022 thus allowing a comparison with the net CO_2 project GHG emissions. When assessing significance, LA 114 Climate guidance 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*'.

The IEMA Guidance Note on Assessing Greenhouse Gas Emissions and Evaluating their Significance 2nd Edition (IEMA 2022) advises that in order to determine significance, the key test is *"whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050"*. The approach used to assess significance is based on the following principles:

- Is the project "business as usual" in terms of climate reduction? – major or moderate negative impact;
- Is the project compatible with net zero by 2050 and complies with "good practice" reduction measures? – minor adverse impact that is not significant.
- Does the project achieve emissions that go substantially beyond the reduction trajectory and has minimal residual emissions? – Negligible effect that is not significant.
- Does the project cause GHG emissions to be avoided or removed from the atmosphere? – beneficial effect that is significant. Only projects that reverse (rather than reduce) the risk of severe climate change can be judged as beneficial.

The EPA Guidelines (EPA 2022a) describe the quality of effects in terms of positive, neutral and negative where neutral is defined as effects that are imperceptible, within normal bounds of variation. Taking into account both the IEMA and EPA guidance approach, this chapter has assessed impacts as being either neutral or positively / negatively significant (ranging from minor, moderate to major) with neutral defined as a change in GHG emissions which is less than ±0.01% of the 2030 Transport Sectoral Emission Ceiling. Minor is determined to be an impact which is between ±0.01% and ±0.5% of the 2030 Transport Sectoral Emission Ceiling, moderate as being an impact which is between ±0.5% and ±1.0% of the 2030 Transport Sectoral Emission Ceiling whilst major is defined as being an impact which is greater than ±1.0% of the 2030 Transport Sectoral Emission Ceiling. In relation to the Construction Phase, the guiding principles outlined above are applied to determine the level of significance.

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 at 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. Any activities in these sectors are now considered significant if they lead to a significant increase in GHG emissions relative to their Sectoral Emission Ceiling.

A study in 2011 (Monahan 2011) found that the typical GHG emissions associated with the embodied carbon of a 3-bedroom house using traditional construction methods was typically around 50t CO_{2eq}. Each person in Ireland in currently responsible for a carbon footprint of 12.6t CO_{2eq} per year, based on 2018 data (CSO 2020). For context, the construction and operational phases GHG emissions have been compared to the equivalent number of houses built using traditional methods and / or the carbon footprint of the specified number of people.

8.3.4.4 Significance Criteria – Vulnerability of the Proposed Scheme to Climate Change

LA 114 Climate (UKHA 2021) outlines an approach for undertaking a risk assessment where there is a potentially significant impact on the Proposed Scheme receptors due to climate change. The risk assessment assesses the likelihood and consequence of the impact occurring, leading to the evaluation of the impact significance. This assessment approach is approved as an appropriate method in the IEMA EIA Guide to: Climate Change Resilience and Adaptation (IEMA 2020a). 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 8.4 and Table 8.5. The guidance advises that for the Construction Phase, a qualitative description of disruption risk should be reported.

Table 8.4: 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 four 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 8.5: Measure of Consequence

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

The likelihood and consequence of each impact is then combined in the form of a matrix to identify the significance of each impact as outlined in Table 8.6. The significance conclusions for each impact are based on and incorporate confirmed design and mitigation measures. Where the assessment concludes that the impact is significant, LA 114 Climate states that '*the design and mitigation hierarchy should be reassessed to reduce the significance of impacts to an acceptable level (not significant)'*.

Table 8.6: Significance Matrix

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

Note: NS = Not significant; S = Significant

8.4 Baseline Environment

8.4.1 Climate Pollutants

Climate is defined as the average weather over a period of time, 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 purpose 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 (hereafter referred to as the Renewable Energy Directive) for GHGs has been used. In Annex V, C. Methodology Point 5 of the Renewable Energy Directive the relevant GHGs are defined as CO_2, CH_4 and N_2O. CO_2 accounted for 61.0% of total GHG emissions in Ireland in 2021 while CH_4 and N_2O combined accounted for 37.8%. The main source of CH_4 and N_2O in Ireland is from the agricultural sector with transport accounting for less than 1% of the overall total CH_4 and N_2O emissions (EPA 2022b).

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 AR5 Synthesis Report: Climate Change 2014 of the Fifth Assessment Report (AR5) (IPCC 2015) sets out the global warming potential for a 100-year time period (GWP100) for CO_2 as the basic unit (GWP = 1) whereas CH_4 has a global warming potential equivalent to 28 units of CO_2 and N_2O has a GWP100 of 265.

8.4.2 Vulnerability of the Proposed Scheme to Climate Change

The Proposed Scheme has an overall length of approximately 4.3km (2 x 1.6km along the River Liffey Quays and 1.1km of cycle route through Ringsend and Irishtown to Sean Moore Road) between Talbot Memorial Bridge and Sean Moore Road in the area of Ringsend and Irishtown. LA 114 Climate (UKHA 2021) outlines that the study area for assessing a project's vulnerability to climate change should be based on the construction footprint / project boundary (including Construction 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 where the Proposed Scheme will be located (EPA 2017b). 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 Scheme:

- 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; and
- Changes in distribution of plant and animal species.

The historical regional weather data from the Met Éireann weather and climate monitoring station at Dublin Airport, County Dublin is considered representative of the current climate in the region of the Proposed Scheme and is shown in Table 8.7 (Met Éireann 2020). The region where the Proposed Scheme will be located has a temperate, oceanic climate, resulting in mild winters and cool summers. The weather station at Dublin Airport is located approximately 10km north of the Proposed Scheme at its closest point and has meteorological data recorded for the 30-year period from 1981 to 2010. This meteorological data indicates that the wettest months were August and October, and the driest month on average was February. July was the warmest month with a mean temperature of 15.6°C.

Table 8.7: 30-Year Historical Weather Data for Dublin Airport 1981 to 2010 (Met Éireann 2020[1])

Measurement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature (°C)													
Mean Daily Max	8.1	8.3	10.2	12.1	14.8	17.6	19.5	19.2	17.0	13.6	10.3	8.3	13.3
Mean Daily Min	2.4	2.3	3.4	4.6	6.9	9.6	11.7	11.5	9.8	7.3	4.5	2.8	6.4
Mean Temperature	5.3	5.3	6.8	8.3	10.9	13.6	15.6	15.3	13.4	10.5	7.4	5.6	9.8
Absolute Max.	16.5	16.2	17.2	20.5	23.5	25.7	27.6	28.7	24.6	21.0	18.0	16.2	28.7
Min. Maximum	-3.1	-0.1	2.4	4.5	6.6	10.4	11.7	11.9	11.2	5.3	-1.8	-4.7	-4.7
Max. Minimum	11.8	11.9	11.9	12.8	13.2	16.2	19.0	18.2	17.3	15.2	12.8	12.9	19.0
Absolute Min.	-9.5	-6.7	-7.9	-4.0	-1.6	2.1	4.6	2.4	1.2	-3.3	-8.4	-12.2	-12.2
Mean Num. of Days with Air Frost	6.4	6.5	3.8	2.4	0.3	0.0	0.0	0.0	0.0	0.5	3.0	6.4	29.4
Mean Num. of Days with Ground Frost	15.0	14.0	12.0	10.0	3.0	0.0	0.0	0.0	0.0	4.0	10.0	14.0	82.0
Mean 5cm Soil	3.8	3.8	5.4	8.2	12.2	15.2	16.7	15.8	13.1	9.4	6.2	4.5	9.5
Mean 10cm Soil	4.1	4.1	5.5	7.9	11.5	14.6	16.2	15.4	13.0	9.7	6.6	4.8	9.4
Mean 20cm Soil	4.6	4.7	6.1	8.4	11.7	14.8	16.5	16.0	13.7	10.5	7.3	5.3	10.0
Relative Humidity (%)													
Mean at 0900UTC	87.0	86.4	84.0	79.5	76.9	76.7	78.5	81.0	83.4	85.5	88.5	88.0	83.0
Mean at 1500UTC	80.6	75.7	71.0	68.3	68.0	68.3	69.0	69.3	71.5	75.1	80.3	83.1	73.3
Sunshine (hours)													
Mean Daily Duration	1.9	2.7	3.5	5.3	6.2	5.8	5.3	5.1	4.3	3.3	2.4	1.7	3.9
Greatest Daily Duration	8.1	9.8	11.9	13.3	15.4	15.9	15.6	14.2	12.4	10.2	8.8	7.3	15.9
Mean Num. of Days with No Sun	9.1	6.2	4.7	2.5	2.0	1.9	1.4	1.5	2.6	4.8	7.3	10.5	54.6
Rainfall (mm)													
Mean Monthly Total	62.6	48.8	52.7	54.1	59.5	66.7	56.2	73.3	59.5	79.0	72.9	72.7	758.0
Greatest Daily Total	27.1	28.1	35.8	30.4	42.1	73.9	39.2	72.2	40.6	53.2	62.8	42.4	73.9
Mean Num. of Days with >= 0.2mm	17	15	17	15	15	14	16	16	15	17	17	17	191
Mean Num. of Days with >= 1.0mm	12	10	11	10	11	10	10	11	10	11	11	12	129
Mean Num. of Days with >= 5.0mm	4	3	3	3	3	3	3	4	4	4	4	4	42

[1] According to Met Eireann, data for 1991-2020 is in the process of being quality assured and collated. These tables will be available on www.met.ie in 2023.

Measurement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Wind (knots)													
Mean Monthly Speed	12.5	12.0	11.6	9.9	9.2	8.6	8.7	8.7	9.2	10.4	11.0	11.3	10.3
Max. Gust	80	73	66	59	58	53	54	56	59	69	66	76	80
Max. Mean 10-Minute Speed	53	49	45	39	39	38	36	37	36	51	43	55	55
Mean Num. of Days with Gales	2.3	1.5	1.1	0.1	0.1	0.1	0.1	0.1	0.2	0.5	0.8	1.3	8.2
Weather (Mean No. of Days with.)													
Snow or Sleet	4.6	4.2	2.8	1.2	0.2	0.0	0.0	0.0	0.0	0.0	0.8	2.9	16.6
Snow Lying at 0900UTC	1.6	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.9	3.4
Hail	1.2	1.5	2.0	1.9	1.3	0.1	0.2	0.1	0.1	0.3	0.3	0.7	9.7

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 Dublin Airport for Storm Ophelia peaked at 104 km/hr with a 10-minute speed of 70 km/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 (GDA) on the 24 October 2011. The rainfall recorded on 24 October 2011 totalled 66.9mm over a nine-hour period at Dublin Airport, which has an annual probability of 1 in 100 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 are 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°C to 3°C will occur under RCP4.5 rising to 2°C to 4°C under RCP8.5. Warm extremes are expected to rise by 2°C to 3°C (RCP4.5) but by up to 5°C under RCP8.5.

Report No.159 – Ensemble of regional climate model projections for Ireland (EPA 2015b) 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, Report No.159 – Ensemble of regional climate model projections for Ireland (EPA 2015b) 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.

8.4.3 Existing GHG Emissions Baseline

LA 114 Climate (UKHA 2021) 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 Minimum 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 under the GHG Regulation, 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 2022 (EPA 2022b) predicts that Ireland will exceed its 2020 annual limit set under Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 (hereafter referred to as the Effort Sharing Decision (ESD)) by 6.75 million tonnes CO_2 equivalent (Mt CO_{2eq}). For 2020, total national emissions are estimated to be 57.716 Mt CO_{2eq} as shown in Table 8.8. The sector with the highest emissions is agriculture at 37.1% of the total, followed by transport at 17.8%. GHG emissions from the transport sector reduced by 15.7% in 2020 due to COVID restrictions. Private cars were responsible for 54% of road transport emissions in 2020.

In terms of modal split, private cars accounted for 73.7% of all road trips in 2019 whilst public transport accounted for 6.5% (DOT 2019). Compared to 2018, there was a 3% increase in the number of public transport passenger journeys in 2019 whilst the total kilometres driven by private cars reduced by 1.5% (DOT 2019). Private cars also remain the largest source of GHG emissions in the transport sector accounting for 57.4% of total transport emissions in Ireland.

Table 8.8: Total National GHG Emissions in 2020

Category	Kilotonnes (kt) CO_{2eq}	% of Total GHG Emissions
Waste	906	1.6%
Energy Industries	8,739	15.1%
Residential	7,115	12.3%
Manufacturing Combustion	4,521	7.8%
Commercial Services	938	1.6%
Public Services	896	1.6%
Transport	10,296	17.8%
Industrial Processes	2,111	3.7%
F-gases	784	1.4%
Agriculture	21,411	37.1%
Total	57,716	100%

In relation to transport GHG emissions, the dominant source in Ireland in 2020 is road transportation at 94.2% of total transport GHG emissions as shown in Table 8.9.

Table 8.9: Total Transport GHG Emissions In 2020

Category	Kilotonnes (t) CO_{2eq}	% of Total Transport GHG Emissions
Domestic Aviation	14	0.1%
Road Transportation	9,693	94.2%
Railways	108	1.1%
Domestic Navigation	322	3.1%
Other Transportation	148	1.4%
Total	10,285	100%

In relation to road transport GHG emissions (2020 data) in Ireland (EPA 2022c), the dominant source is cars at 54% of total road transport GHG emissions with heavy duty vehicles and buses accounting for 28% of total road transport GHG emissions as shown in Table 8.10.

Table 8.10: Total Road Transport GHG Emissions in 2020

Category	Kilotonnes (Kt) CO_{2eq}	% of Total GHG Emissions
Cars	5,234	54%
Light Duty Vehicles	1,745	18%
Heavy Duty Vehicles and Buses	2,617	28%
Motorcycles	10	0.1%
Total Road Transportation	9,693	100%

In 2028, the total projected GHG emissions for Ireland, with additional measures in place (including the implementation of the 2019 CAP (Government of Ireland 2019), is 46,858kt (kilotonnes) CO_{2eq} with road transport emissions accounting for 8,523kt CO_{2eq} or 17.8% of total emissions (EPA 2022b). The 2040 total projected GHG emissions for Ireland, with additional measures in place, are 35,643kt CO_{2eq}. Road transport emissions account for 4,481kt CO_{2eq} or 12.6% of the total (EPA 2022b). No data is available post-2040 and thus a comparison with the Design Year (2043) is not possible.

8.5 Potential Impacts

This Section presents potential impacts that may occur in the absence of mitigation, though takes account of measures embedded in the design of the Proposed Scheme. This assessment informs the need for any further mitigation or monitoring (refer to Section 8.7). Predicted 'residual' impacts taking into account any proposed mitigation are then presented in Section 8.8.

In the context of the Proposed Scheme, the potential climate impact on the surrounding environment must be considered for two distinct phases:

- Construction Phase; and
- Operational Phase.

8.5.1 Construction Phase

During the short-term Construction Phase of the Proposed Scheme, works will predominately involve minor utility diversions, road widening works, road excavation works (where required), road and junction reconfiguration and resurfacing works, urban realm improvements including landscaping, as well as construction access routes including movement of machinery and materials within and to and from the construction compounds associated with the Proposed Scheme.

Other works specific to the Proposed Scheme will include:

- Preparatory and site clearance works including ground investigations;
- The setting up of four Construction Compound.

During the Construction Phase, site clearance, landscaping, road and junction construction works all have the potential to generate GHG emissions on-site. Chapter 5 (Construction) provides a full description of the proposed construction phasing and works for the Proposed Scheme. For the purposes of the EIAR, six individual construction sections are set out. Sections may be completed simultaneously and combined in certain areas. Table 5.2 in Chapter 5 (Construction) includes a summary of each section with the estimated time for the completion of works in these areas.

The total Construction Phase for the overall Proposed Scheme is estimated at approximately 54 months. However, individual activities will have shorter durations. The programme identifies the estimated duration of works at each sub-section. Works are envisaged to proceed concurrently on multiple work-fronts to minimise the overall construction duration.

In general, road works are transient in nature as the works will progress along the length of the route of the Proposed Scheme. This includes excavation and fill works, structures, and road completion works. Construction Compounds will be set up typically at the commencement of the works and will remain in place until all construction in the area is completed.

8.5.1.1 Construction Phase Carbon Calculations

To quantify the Construction Phase embedded carbon, the assessment team utilised the TII Carbon Tool (TII 2020). The TII Carbon Tool has the ability to quantify carbon in infrastructure projects using Ireland-specific emission factors and data.

Detailed project information including tonnage of materials was used in the assessment of embodied carbon (refer to Appendix A8.1 Embodied Carbon in Volume 4 of this EIAR for inputs into the TII Carbon Tool). The Proposed Scheme is expected to have a Construction Phase of 54 months approximately. The predicted embodied carbon are averaged over the full Construction Phase to give the predicted annual emissions to allow for a direct comparison with annual emissions and targets. Construction Phase emissions have been compared against the total national GHG emissions in Ireland for 2020 (58,698 kt CO_{2eq}) (EPA 2022b) and against Ireland's non-ETS 2020 target of 37,942.7 kt CO_{2eq} (as set out in Commission Decision 2017/1471 of 10th August 2017 and amending decision 2013/162/EU to revise Member States' annual emissions allocations for the period from 2017 to 2020) and the 2030 Transport Emission Ceiling.

Based on the TII Carbon Tool, the breakdown of the activities between the different phases of the Proposed Scheme have been assessed. As shown in Table 8.11, the assessment indicates that the key phases of the GHG generation are the embodied carbon of the construction materials and the construction activities, which when combined, account for 94% of all carbon emissions. Pre-construction together with construction waste is expected to account for 6% of all emissions.

The Proposed Scheme is estimated to result in total Construction Phase CO_{2e} emissions of 12,771 tonnes embodied CO_2eq for materials over an 30-month period. The IEMA Guidance (IEMA 2022) states that "*Carbon budgets allow for continuing economic activity, including projects in the built environment, in a controlled manner*". Thus, projects which have a carbon footprint are not necessarily significant provided that the projects are compatible with net zero by 2050 and the full range of mitigation measures are employed to minimize the carbon footprint. Given that the construction of the Proposed Schemes itself will lead to operational GHG emission reductions overall then the construction phase should be viewed as compatible with net zero emission targets. Thus, the assessment of significance for the construction phase of the Proposed Scheme is deemed to have a minor adverse impact given that the construction phase emissions are equivalent to an annualised total of 0.008% of Ireland's non-ETS 2020 target and 0.047% of the 2030 Transport Emission Ceiling. The potential impact to climate due to embodied carbon emissions during the Construction Phase, prior to mitigation, will be Negative, Minor Adverse and Short-Term.

In order to place the emissions due to the total Construction Phase in context, the CO_{2e} emissions are equivalent to the construction of approximately 255 three-bedroom houses using traditional construction methods (Monahan 2011).

Table 8.11: Construction Phase CO_{2e} Emissions

Activity	Tonnes CO_{2eq} / Total	% Of Total
Pre-Construction	2.5	0.02%
Embodied Carbon	11,307	88.5%
Construction Activities	1,263	9.9%
Construction Waste	199	1.6%
All	12,771	100%

8.5.1.2 Construction Traffic

In addition to direct impacts from the construction works including the Construction Compounds, there is also the potential for GHG impacts from construction traffic along public roads.

A detailed analysis of construction traffic volumes has been conducted to determine the expected truck movements required to transport the materials extracted and delivered to site. It is proposed that construction vehicles moving to and from the Proposed Scheme will travel via the following road network.

The following National Roads and Regional Roads will be utilised as construction vehicle routes during the Construction Phase:

- National Road Network;
  - M1 Motorway / N1 National Road; and
  - M50 Motorway.

The following regional roads will be utilised as construction vehicle routes during the Construction Phase:

- Regional Road Network;
  - North and south quays (R148, R105, R138, R801, R813);
  - R105 Amiens Street; and
  - R131 East Wall Road.

Whilst the overall Construction Phase is forecast as 54 months, work will be transitory along the route and construction traffic movements are assumed to occur over a 12-month period along construction access routes accessing specific work zones as a worst-case. For National and Regional Roads serving multiple work zones, a Construction Phase of 54 months has been assumed.

Traffic volumes for the base scenario are based on the 2024 Do Minimum flows projected along the local road network. These are AADT flows with percentage HGVs. The additional goods vehicles (HGV and LGV) flows per day associated with construction traffic along each road including construction staff vehicles, deliveries and

earthworks material haulage are added to the base traffic volumes. The estimated construction traffic volumes incorporate a series of worst-case assumptions including concentrated construction periods at working areas and assumes that no delivery of materials will occur along the corridor of the Proposed Scheme which is worst-case. In reality, the Proposed Scheme will be constructed in phases and the corridor of the Proposed Scheme will be used for a large bulk of construction delivery vehicles along its route.

In order to determine the potential GHG impacts associated with additional construction traffic on the identified construction access routes, a comparison between GHG emissions during the 2024 Do Minimum scenario and the 2024 Do Something (construction) scenario were undertaken.

As shown in Table 8.12, a comparison between the Do Something and Do Minimum GHG traffic emissions in the Construction Year (2024) indicates that there is predicted to be an overall decrease of 0.25kt in CO2eq due to the Construction Phase of the Proposed Scheme. This is equivalent to a 0.23% decrease in CO2eq relative to the Construction Year (2024) Do Minimum estimates. To put these figures in context, approximately 10,870 kt CO2eq are projected to be emitted in Ireland by the road transport sector in 2024 (EPA 2022b). The predicted decrease is due to some trips avoiding entering the study area during the Construction Phase.

Table 8.12: Construction Phase CO_{2e} Traffic Emissions – Construction Year (2024)

Scenario	Vehicle Class	CO_{2eq} (kt CO_{2eq})
DM	Car	54.4
DS		54.4
Change		-0.03
% Change		-0.06%
DM	Goods	47.6
DS		47.2
Change		-0.41
% Change		-0.87%
DM	Urban Bus	6.1
DS		6.3
Change		0.20
% Change		3.30%
DM	**Total**	108.1
DS		107.8
Change		-0.25
% Change		-0.23%

The assessment of significance for the construction traffic during the Construction Phase, prior to mitigation, is deemed to be a minor beneficial impact given that the decreases in construction traffic emissions are equivalent to an annualised total of 0.0007% of Ireland's non-ETS 2020 target and 0.0042% of the 2030 Transport Emission Ceiling. The potential impact to climate due to construction traffic carbon emissions during the Construction Phase, prior to mitigation, will be Positive, Minor Beneficial and Short-Term.

8.5.1.3 Impact of Climate Change on the Proposed Scheme Construction Phase

Appropriate flood risk measures and extreme weather events have been considered as part of the Construction Phase. However, the potential for changes to long-term seasonal averages as a result of climate change is not considered to be as significant by the Construction Year (2024). Thus, in line with the methodology outlined in Table 8.4, Table 8.5 and Table 8.6, the likelihood of extreme weather and flooding in the year 2024 is assessed to be of medium likelihood and with a minor adverse effect leading to a finding of a Not Significant impact.

8.5.1.4 Land Use Change

The Construction Phase of the Proposed Scheme is predicted to result in the temporary removal of grassland to facilitate two of four Construction Compounds. However, overall, there will be a negligible impact on carbon sequestration as a result of the Construction Phase of the Proposed Scheme.

8.5.2 Operational Phase

8.5.2.1 Maintenance Phase Embodied Carbon

The Proposed Scheme is expected to have an expected operational lifespan of 60 years. The expected operational lifespan of 60 years is the default used in the TII Carbon Tool and is the default in LA 114 Climate (UKHA 2021) for the purposes of the calculation of maintenance emissions. In line with the approach recommended in the Common Appraisal Framework for Transport Projects and Programmes (CAF) (Government of Ireland 2021b) a 60-year expected operational lifespan has been assumed in recognition of the long term benefits that will be delivered by the Proposed Scheme. The predicted Maintenance Phase GHG emissions is averaged over the full expected lifespan of the Proposed Scheme to give the predicted annual emissions to allow for direct comparison with annual emissions and targets. Only GHG emissions generated from the areas where road widening and narrowing have taken place are considered in this assessment, as routine maintenance, and associated GHG emissions generated, would be carried out on the existing road infrastructure, irrespective of the Proposed Scheme.

The TII Carbon Tool (TII 2020) assesses on-going maintenance associated with the expected operational lifespan of the Proposed Scheme. For roads, it is generally assumed that decommissioning demolition is not relevant and thus there are no emissions associated with this stage.

The Proposed Scheme is estimated to result in total Maintenance Phase GHG emissions of 188 tonnes CO_{2eq} over the predicted 60-year lifespan. The annualised emissions due to the ongoing maintenance of the Proposed Scheme will reach, at most, 0.00001% of Ireland's non-ETS 2030 emissions target and 0.00005% of the 2030 Transport Emission Ceiling. The predicted impact to climate during the Maintenance Phase, prior to mitigation, will be Negligible and Permanent.

8.5.2.2 Impact of Climate Change on the Proposed Scheme 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 GHGs by implementing low-carbon energy options. Adaptation during the Operational Phase of the Proposed Scheme aims to ensure potential climate change impacts will not significantly impact the Operational Phase.

A risk assessment has been conducted for potentially significant impacts on the Proposed Scheme 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 8.3.4.4.

8.5.2.2.1 Flood Risk

Flooding of local transport infrastructure is a potential impact of climate change on the Proposed Scheme. A comprehensive flood risk assessment (FRA) has been carried out. Full details of the FRA can be found in Appendix A13.2 Site Specific Flood Impact Assessment in Volume 4 of this EIAR.

The assessment found that the primary source of flood risk is from fluvial and coastal flooding from the adjacent River Liffey / Dublin Bay. Sections of the Proposed Scheme have been identified to be within Flood Zone A, which is classified as having the highest probability of flooding from rivers and the sea, greater than 1% or 1 in 100 for river flooding, or 0.5% or 1 in 200 for coastal flooding. However, the assessment found that the Proposed Scheme will require minimal additional paved areas and will therefore have negligible impact on flooding and the surface water drainage network within the catchment. In addition, the drainage network will incorporate Sustainable Drainage Systems (SUDS), where appropriate, primarily regarding the Dodder Public Transport Opening Bridge (DPTOB). Groundwater flooding is not expected to increase in risk as most of the Proposed Scheme route will be on existing roads. A Stage 2 FRA is not required as the justification test has been passed for areas within Flood Zone B.

There will not be an increase in flood risk due to the Proposed Scheme. Thus, in line with the methodology outlined in Table 8.4, Table 8.5 and Table 8.6, the likelihood of flooding during operation is assessed to be of high likelihood and with a minor adverse effect leading to a finding of a Not Significant impact.

8.5.2.2.2 Increased Temperature and Extreme Weather

As outlined in Section 8.4.2, it is predicted that increases in temperature of between 1°C to 3°C will occur under RCP4.5 rising to 2°C to 4°C under RCP8.5. Warm extremes are expected to rise by 2°C to 3°C (RCP4.5) but by up to 5°C under RCP8.5.

These increased temperatures have the potential to cause the temperature of construction materials, such as asphalt / bitumen, to increase. However, based on an increase in temperature of between 1°C to 3°C under RCP4.5, it is considered that the impact of increased temperatures on construction materials will be Not Significant.

Thus, in line with the methodology outlined in Table 8.4, Table 8.5 and Table 8.6, the likelihood of increased temperatures impacting on the Proposed Scheme during the Operational Phase is assessed to be of high likelihood and with a negligible adverse effect, leading to a potential impact of Not Significant.

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 Scheme during operation is assessed to be of medium likelihood and with a minor adverse effect leading to a finding of a Not Significant impact.

8.5.2.3 Land Use Change

The Operational Phase of Proposed Scheme will not result in any significant changes to land use. Thus, there will be a Neutral impact on carbon sequestration as a result of the Operational Phase of the Proposed Scheme.

8.5.2.4 Direct Operational Phase Carbon Emissions

The Proposed Scheme will provide an attractive alternative to private car travel, encouraging more passenger travel by more sustainable modes. The Proposed Scheme will result in reductions in general car traffic flows along its route due to transfer from car to public transport, walking and cycling. The corresponding reductions in emissions along the corridor, termed ‘direct emissions’, are outlined below. The GHG emissions, due to trip redistribution outside of the corridor are captured under ‘indirect emissions’ in Section 8.5.2.5.

The potential changes in CO_{2eq} emissions due to the direct Operational Phase traffic impacts of the Proposed Scheme have been assessed using the Environmental Appraisal Module, which is based on the ENEVAL software.

As shown in Table 8.13 for the car and bus GHG emissions, a comparison between the Do Something and Do Minimum CO_{2eq} emissions in 2028 along the proposed corridor predicts a decrease of 0.35kt in $CO_{2eq;}$ this is equivalent to a 23.9% decrease in CO_{2eq} relative to the Opening Year Do Minimum estimates. For the overall scenario, including goods vehicles, a comparison between the Do Something and Do Minimum GHG emissions in 2028 along the proposed corridor predicts a decrease of 0.51kt in CO_{2eq}.

It should be noted that, for the purposes of this assessment, goods vehicles (HGVs and LGVs) continue to grow in line with forecasted economic activity with patterns of travel remaining the same. For example, the assessment assumes a 45% and 77% increase in goods traffic versus the base year in 2028 and 2043 respectively. However, the 2023 CAP (DCCAE 2022) recommends the development of a freight strategy for the region which will seek to further integrate smart technologies in logistics management and may include the regulation of delivery times as far as practicable to off-peak periods to limit traffic congestion in urban areas. Thus, this assessment should be viewed as a worst-case assessment.

The goods vehicle emissions presented in the assessment below assumes no conversion to zero emission HGV vehicles by 2028 or 2043. This is considered a conservative assumption in order to assess a reasonable worst-case. Goods emissions account for the majority of residual emissions presented in the Design Year (2043), however goods emissions are not an area that the Proposed Scheme can address. The 2023 CAP recognises that the technology pathway for decarbonising HGVs is still developing.

Table 8.13: Direct Operational Phase CO_{2eq} Emissions – Opening Year (2028)

Scenario	Vehicle Class	CO_{2eq} (kt CO_{2eq})
DM	Car	1.3
DS		1.1
Change		-0.22
% Change		-17.3%
DM	Goods	2.3
DS		2.2
Change		-0.15
% Change		-6.7%
DM	Urban Bus	0.2
DS		0.0
Change		-0.13
% Change		-72.4%
DM	**Total**	3.8
DS		3.3
Change		-0.51
% Change		-13.4%
DM	**Total (Car & Bus)**	1.5
DS		1.1
Change		-0.35
% Change		-23.9%

As shown in Table 8.14 for the car and bus CO_{2eq} emissions, a comparison between the direct Do Something and Do Minimum GHG emissions in the Design Year (2043) indicates that there is predicted to be an overall increase of 0.02kt in CO_{2eq}. This is equivalent to a 3.2% increase in CO_{2eq}. For the overall scenario, including goods vehicles, a comparison between the Do Something and Do Minimum GHG emissions in 2043 along the proposed corridor predicts a decrease of 0.59kt in CO_{2eq} which aligns with the Proposed Scheme objectives. This is equivalent to a 27.4% decrease in CO_{2eq} relative to the Design Year Do Minimum estimates. Relative to 2028, there is a large percentage reduction in both the Do Minimum and Do Something scenarios in 2043. This highlights the effective implementation of a range of traffic measures which will lead to a large reduction in direct CO_{2eq} emissions along the corridor.

Table 8.14: Direct Operational Phase CO_{2eq} Emissions – Design Year (2043)

Scenario	Vehicle Class	CO_{2eq} (kt CO_{2eq})
DM	Car	0.5
DS		0.5
Change		0.02
% Change		3.2%
DM	Goods	1.5
DS		1.0
Change		-0.47
% Change		-31.3%
DM	Urban Bus	0.0
DS		0.0
Change		0.00
% Change		0.0%
DM	**Total**	2.1
DS		1.6
Change		-0.59
% Change		-27.4%
DM	**Total (Car & Bus)**	0.5
DS		0.5
Change		0.02
% Change		3.2%

8.5.2.5 Indirect Operational Phase Carbon Emissions

The Proposed Scheme will provide an attractive alternative to the private car and promote a modal shift to public transport, walking and cycling. It is, however, recognised that there will be an overall reduction in operational capacity for general traffic along the direct study area given the proposed changes to the road layout and the rebalancing of priority to walking, cycling and the bus. This reduction in operational capacity for general traffic along the Proposed Scheme is likely to create some level of trip redistribution onto the surrounding road network, in the absence of wider region-wide demand management measures (outside the scope of the Proposed Scheme).

The potential changes in CO_{2eq} emissions due to the indirect Operational Phase traffic impacts of the Proposed Scheme have been assessed using the NTA Environmental Appraisal Module, which is based on the ENEVAL software.

As shown in Table 8.15 for the car and bus CO_{2eq} emissions, a comparison between the indirect Do Something and Do Minimum GHG emissions in 2028 indicates that there is predicted to be an overall decrease of 0.02kt in CO_{2eq} due to the indirect impact of the Proposed Scheme. This is equivalent to a 0.02% decrease in CO_{2eq} relative to the Opening Year Do Minimum estimates. For the overall scenario, including goods vehicles, a comparison between the Do Something and Do Minimum CO_{2eq} emissions in 2028 due to the indirect impact of the Proposed Scheme predicts an increase of 0.02kt in CO_{2eq}. This is equivalent to a 0.01% increase in CO_{2eq} relative to the Opening Year Do Minimum estimates.

Table 8.15: Indirect Operational Phase CO_{2eq} Emissions – Opening Year (2028)

Scenario	Vehicle Class	CO_{2eq} (kt CO_{2eq})
DM	Car	101.7
DS		101.6
Change		-0.06
% Change		-0.06%
DM	Goods	82.8
DS		82.8
Change		0.04
% Change		0.05%
DM	Urban Bus	8.0
DS		8.1
Change		0.05
% Change		0.58%
DM	**Total**	192.5
DS		192.5
Change		0.02
% Change		0.01%
DM	**Total (Car & Bus)**	109.7
DS		109.7
Change		-0.02
% Change		-0.02%

As shown in Table 8.16 for the car and bus CO_{2eq} emissions, a comparison between the indirect Do Something and Do Minimum GHG emissions in the Design Year (2043) indicates that there is predicted to be an overall decrease of 0.36kt in CO_{2eq}. This is estimated to be equivalent to a 0.80% decrease in CO_{2eq} relative to the Design Year Do Minimum estimates. For the overall scenario, including goods vehicles, a comparison between the Do Something and Do Minimum CO_{2eq} emissions in 2043 due to the indirect impact of the Proposed Scheme predicts a decrease of 1.27kt in CO_{2eq}. This is estimated to be equivalent to a 0.95% decrease in CO_{2eq} relative to the Design Year Do Minimum estimates.

Table 8.16: Indirect Operational Phase CO_{2eq} Emissions – Design Year (2043)

Scenario	Vehicle Class	CO_{2eq} (kt CO_{2eq})
DM	Car	44.9
DS		44.6
Change		-0.36
% Change		-0.80%
DM	Goods	88.6
DS		87.6
Change		-1.05
% Change		-1.18%
DM	0.0%	0.0
DS		0.0
Change		0.00
% Change		0.00%
DM	**Total**	133.4
DS		132.1
Change		-1.27
% Change		-0.95%
DM	**Total (Car & Bus)**	44.9
DS		44.6
Change		-0.36
% Change		-0.80%

8.5.2.6 Overall Operational Phase Carbon Emissions

The potential changes in CO_{2eq} emissions due to the combined direct and indirect Operational Phase traffic impacts of the Proposed Scheme have been assessed.

As shown in Table 8.17 for the car and bus GHG emissions, a comparison between the Do Something and Do Minimum GHG emissions in the Opening Year (2028) indicates that there is predicted to be a decrease of 0.37kt in CO_{2eq}. This is equivalent to a 0.33% decrease in CO_{2eq} relative to the Opening Year Do Minimum estimates. For the overall scenario, including goods vehicles, a comparison between the Do Something and Do Minimum CO_{2eq} emissions in the Opening Year (2028) indicates that there is predicted to be a decrease of 0.49kt in CO_{2eq}. This is equivalent to a 0.25% decrease in CO_{2eq} relative to the Opening Year Do Minimum estimates.

Table 8.17: Combined Direct and Indirect Operational Phase CO_{2eq} Emissions – Opening Year (2028)

Scenario	Vehicle Class	CO_{2eq} (kt CO_{2eq})
DM	Car	103.0
DS		102.7
Change		-0.29
% Change		-0.28%
DM	Goods	85.1
DS		85.0
Change		-0.12
% Change		-0.14%
DM	Urban Bus	8.2
DS		8.1
Change		-0.08
% Change		-0.98%
DM	**Total**	196.3
DS		195.8
Change		-0.49
% Change		-0.25%
DM	**Total (Car & Bus)**	111.2
DS		110.8
Change		-0.37
% Change		-0.33%
% Change Relative To Transport Emission Ceiling		-0.006%

As shown in Table 8.18 for the car and bus GHG emissions, a comparison between the Do Something and Do Minimum CO_{2eq} emissions in the Design Year (2043) indicates that there is predicted to be a decrease of 0.34kt in CO_{2eq}. This is equivalent to a 0.76% decrease in CO_{2eq} relative to the Design Year Do Minimum estimates. For the overall scenario, including goods vehicles, a comparison between the Do Something and Do Minimum GHG emissions in the Design Year (2043) indicates that there is predicted to be a decrease of 1.86kt in CO_{2eq}. This is equivalent to a 1.37% decrease in CO_{2eq} relative to the Opening Year Do Minimum estimates.

Both the Do Minimum and Do Something will benefit from predicted increases in electric car usage and further electrification of the bus fleet. LGVs and HGVs are estimated to contribute the majority of CO_2 emissions in 2043, reflecting the technical challenges in converting particularly the HGV fleet to electric vehicles.

Table 8.18: Combined Direct and Indirect Operational Phase CO_{2eq} Emissions – Design Year (2043)

Scenario	Vehicle Class	CO_{2eq} (kt CO_{2eq})
DM	Car	45.4
DS		45.1
Change		-0.34
% Change		-0.76%
DM	Goods	90.1
DS		88.6
Change		-1.52
% Change		-1.68%
DM	Urban Bus	0.0
DS		0.0
Change		0.00
% Change		0.00%
DM	**Total**	135.5
DS		133.7
Change		-1.86
% Change		-1.37%
DM	**Total (Car & Bus)**	45.4
DS		45.1
Change		-0.34
% Change		-0.76%

Applying the significance criteria outlined in Section 8.3.4.3 for the 2028 scenario, the potential impact to climate during the Operational Phase of the Proposed Scheme, prior to mitigation, will be Negligible and Permanent, as it falls below ±0.01% of the Transport Emissions Ceiling. As the Transport Emissions Ceiling only extends to 2030, a comparison with a 2043 ceiling cannot be made, however, a similar level of impact is expected in 2043.

For context, the reduction in GHG emissions in the core assessment for 2028 and 2043 respectively, is equivalent to the removal of approximately 969 and 2,514 car trips per weekday from the road network in 2028 and 2043 respectively. The Climate Action Plan (CAP) 2023 (Department of Communications, Climate Action and Environment (DCCAE) 2023) includes an additional 125,000 sustainable journeys and a 50% increase in daily active travel journeys as a 2025 target.

The Proposed Scheme will also support the delivery of government strategies outlined in the 2023 CAP and the 2021 Climate Act by enabling sustainable mobility and delivering a sustainable transport system. Its aim is to provide enhanced walking, cycling and bus infrastructure on this key access corridors in the Dublin Region. This will subsequently enable and deliver integrated sustainable transport movement along these corridors. The Proposed Scheme will provide connectivity and integration with other public transport services leading to more people availing of public transport, helping to further reduce CO_{2eq} emissions.

In terms of policy measures, CO_2 emissions for the average new car fleet will reduce from 130g/km (grams per kilometre) over the period 2015 to 2019 to 95g/km in 2021 (European Commission 2020). In addition, from 2025 the average emissions from new car fleet are required to reduce by 15% relative to 2021 levels and, by 2030, the average emissions from new car fleet are required to reduce by 37.5% relative to 2021 levels as outlined in Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO_2 emission performance standards for new passenger cars and for new light commercial vehicles, and repealing Regulations (EC) No 443/2009 and (EU) No 510/2011.

In relation to decarbonising the transport sector, the 2021 CAP has set a target that all new cars and vans sold in Ireland will be zero carbon emissions or zero emission capable by 2030. Targets are also included for public transport buses and trains. The realisation of these targets will ensure that GHGs from transport will decrease significantly in line with the projections outlined in the CAP.

8.5.2.7 Other Considerations - Traffic Signal Optimisation

The transport modelling undertaken, as described in Chapter 6 (Traffic & Transport), included for changes associated with the Proposed Scheme infrastructure including changes to traffic signal arrangements in the direct study area only. There were no corresponding changes in the traffic signal arrangements (i.e. green times, cycle times etc.) at signalised junctions in the indirect study area of the Proposed Scheme in response to changes in traffic flows resulting from the Proposed Scheme. This approach was taken to ensure that the Proposed Scheme effects could be assessed in isolation from any other changes on the surrounding road network and is considered a reasonable worst-case. From a climate perspective, however, this means that the assessment effectively includes potential delays, reduced speeds and longer journey lengths due to assumed un-optimised junctions in the indirect study area (i.e. that have not been adjusted to account for the changing traffic conditions) which contributes to the predicted GHG emissions.

Traffic signals on the Proposed Scheme and in the indirect study area, are controlled by the DCC Sydney Coordinated Adaptive Traffic System (SCATS) system. The SCATS system is designed to react to changing traffic flows on a continuous basis with stage lengths, cycle times and offsets adjusted to limit overall delays at particular junctions or across a region of combined junctions.

To establish this effect, a scenario has been run whereby junctions within the indirect study area have been allowed to re-optimise to limit overall delays at junctions in response to the changes in traffic flows. This has the effect of reducing the level of overcapacity queueing that occurs at these junctions as well as reducing the level of trip kilometres that can occur due to general traffic avoiding delays at overcapacity junctions. The results of this assessment are outlined in Table 8.19 and Table 8.20.

Table 8.19: Combined Direct and Indirect Operational Phase CO_{2eq} Emissions with Traffic Signal Optimisation – Opening Year (2028)

Traffic Signal Optimisation Scenario	Vehicle Class	CO_{2eq} (kt CO_{2eq})
DM	Car	103.0
DS		102.4
Change		-0.6
% Change		-0.6%
DM	Goods	85.1
DS		84.4
Change		-0.7
% Change		-0.8%
DM	Urban Bus	8.2
DS		7.8
Change		-0.3
% Change		0.0%
DM	**Total**	196.3
DS		194.6
Change		-1.7
% Change		-0.9%
DM	**Total (Car & Bus)**	111.2
DS		110.2
Change		-1.0
% Change		-0.9%

As shown in Table 8.19 for the car & bus CO_{2eq} emissions, a comparison between the Do Something and Do Minimum CO_{2eq} emissions in the Opening Year (2028) indicates that there is predicted to be a decrease of 1.0kt in CO_{2eq}. This is equivalent to a 0.9% decrease in CO_{2eq} relative to the Opening Year Do Minimum estimates. The assessment for the Opening Year (2028) shows the positive impact of signal optimisation in the indirect study area on CO_{2eq} emissions.

Table 8.20: Combined Direct and Indirect Operational Phase GHG Emissions with Traffic Signal Optimisation – Design Year (2043)

Traffic Signal Optimisation Scenario	Vehicle Class	CO_{2eq} (kt CO_{2eq})
DM	Car	45.4
DS		44.9
Change		-0.5
% Change		-1.2%
DM	Goods	90.1
DS		88.3
Change		-1.8
% Change		-2.0%
DM	Urban Bus	0.0
DS		0.0
Change		0.0
% Change		0.0%
DM	**Total**	135.5
DS		133.2
Change		-2.3
% Change		-1.7%
DM	**Total (Car & Bus)**	45.4
DS		44.9
Change		-0.5
% Change		-1.2%

As shown in Table 8.20 for the car and bus GHG emissions, a comparison between the Do Something and Do Minimum GHG emissions in the Design Year (2043) indicates that with re-optimised traffic signal arrangements in both the direct and indirect study areas, there is predicted to be a decrease of 0.5kt in CO_{2eq}. This is equivalent to a 1.2% decrease in CO_{2eq} relative to the Design Year Do Minimum estimates. The assessment for the Design Year (2043) shows the positive impact of signal optimisation in the indirect study area on CO_{2eq} emissions.

Both the Do Minimum and Do Something scenarios will benefit from predicted increases in electric car usage and further electrification of the bus fleet. Goods vehicles are estimated to contribute the majority of CO_2 emissions in 2043, reflecting the technical challenges in converting particularly the HGV fleet to electric vehicles. The results of the above assessment indicate that, in a scenario whereby traffic signals in the indirect study area re-optimise in response to the change in traffic flows resulting from the Proposed Scheme, further reductions in transport CO_{2eq} emissions are achieved with the Proposed Scheme in place.

8.5.2.8 Climate Impact Summary

The Proposed Scheme achieves the project objectives in supporting the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets. The Proposed Scheme has the potential to reduce GHG emissions equivalent to the removal of approximately 16,330 and 18,790 car trips per weekday from the road network in 2028 and 2043 respectively. This has the effect of a reduction in total vehicle kilometres, a reduction in fuel usage, and increases to sustainable transport trips and modal share in accordance with the 2023 Climate Action Plan (CAP) (DCCAE 2022).

It is concluded that the Proposed Scheme will make a significant contribution to reduction in carbon emissions.

8.6 Sensitivity Analysis

8.6.1 Introduction

As described in Section 8.1, the Proposed Scheme aims to provide an attractive alternative to the private car and promote a modal shift to public transport, walking and cycling. It is, however, recognised that there will be an

overall reduction in operational capacity for general traffic along the direct study area given the proposed changes to the road layout and the rebalancing of priority to walking, cycling and bus. This reduction in operational capacity for general traffic along the Proposed Scheme is likely to create some level of trip redistribution onto the surrounding road network, in the absence of wider regional wide demand management measures (outside the scope of the Proposed Scheme).

The Do Minimum and Do Something scenarios are based on the assumption that travel behaviour will remain broadly consistent over time and that car demand, used for this assessment, represents a reasonable worst-case scenario. However, it is anticipated that societal trends in the medium to long term may reduce car demand further due to the ongoing changes to travel behaviours and further shifts towards sustainable travel, flexibility in working arrangements brought on following Covid-19 restrictions, and delayed car ownership trends that are emerging. Due to the uncertainties around how travel behaviours may change in the future, it was considered prudent to assess a worst-case scenario based on current trends for the core scenario. As such, the analysis set out above identifies the minimum GHG emission reduction that will occur and it is reasonably expected that the reduction in emissions will be greater.

8.6.2 Sensitivity Test

To fully understand the benefits that the Proposed Scheme could provide in relation to carbon reduction, a further sensitivity analysis has been undertaken to consider the potential the Proposed Scheme may have in supporting an increase in cycle mode share and in supporting traffic demand management measures. The sensitivity test undertaken relates to:

- An increased Bus Frequency Resilience Scenario.

Further to this sensitivity test, consideration has also been given to the potential enabling effects that the Proposed Scheme may have in supporting an increase in cycle mode share and in supporting traffic demand management measures.

8.6.2.1 Increased Bus Frequency Resilience Scenario

As described in Chapter 6 (Traffic & Transport), for the purposes of this EIAR and the transport modelling undertaken in support of the EIAR, no increase in bus service frequency beyond that planned under the current Bus Connects Network redesign proposals was assessed. The bus frequencies used in the modelling are based on the proposed service rollout as part of the BusConnects Network Redesign and are the same in both the Do Minimum and Do Something scenarios. This rollout is currently underway. The rationale for undertaking this approach was that the planning consent being sought and which this EIAR supports is solely for the infrastructural improvements associated with providing bus priority along the Proposed Scheme.

This analysis, however, is highly conservative as the bus priority infrastructure improvements and the level of protection it will provide to bus journey time consistency and reliability will provide a significant level of resilience for bus services that will use the Proposed Scheme from implementation into the future. This resilience will allow the service pattern and frequency of bus services to be increased into the future to accommodate additional demand without having a significant negative impact on bus journey time reliability or the operation of cycle and pedestrian facilities. In order to assess this resilience and the potential impacts of this resilience on carbon emissions, an additional analysis has been undertaken, which is detailed in Chapter 6 (Traffic & Transport).

This assessment shows that the Proposed Scheme can accommodate higher levels of bus frequency whilst maintaining journey time reductions and reliability. A key benefit of the provision of a resilient BusConnects Service network, one which can provide reliable and consistent journey times, is that it has potential to cater for further significant transfer from private car travel to more sustainable and environmentally friendly travel via public transport.

Following on from the analysis in Chapter 6 (Traffic & Transport), an additional climate scenario assessment was undertaken to estimate the potential carbon emission savings that could be achieved if the additional residual capacity, facilitated by the Proposed Scheme, were to be utilised by a shift from car to bus. To undertake this assessment a carbon calculator was developed to account for the potential per person carbon emissions savings

for each car removed from the network and absorbed by the additional residual capacity provided by increased bus frequency. The calculator included the following assumptions:

- Bus design capacity of 90 people;
- Additional bus frequency of 10 buses per hour;
- Average emissions per car – 120 / 55 g CO_2 / km (Source: ENEVAL software (2028 / 2043));
- Average emissions per bus (average across fleet) – 422 / 0 g CO_2 / km (Source: ENEVAL software (2028 / 2043));
- Annualisation factor – 251 (i.e., weekdays only (excluding bank holidays)); and
- Average trip length of 9.9km (Source: NTA Regional Modelling System).

To account for the uncertainty associated with future carbon policies (i.e. beyond the current planned increase in the carbon tax to €100 per tonne by 2030) that will be imposed by the Government aimed at reducing carbon emissions, the assessment examined the impact of a notional 100%, 75% and 50% transfer from car-based travel to public transport with the uplifted bus service frequency along the Proposed Scheme corridor in place. Table 8.21 and Table 8.22 below outline the results of the sensitivity analysis.

Table 8.21: Combined Direct and Indirect Operational Phase CO_2 Emissions with Additional Service Frequency – Opening Year (2028)

Additional Service Frequency Scenario	Vehicle Class	Core Scenario CO_2 (kt CO_2)	100% Uptake of residual capacity from Car	75% Uptake of residual capacity from Car	50% Uptake of residual capacity from Car
			CO_2 (kt CO_2)	CO_2 (kt CO_2)	CO_2 (kt CO_2)
DM	Car	102.90	102.90	102.90	102.90
DS		102.61	98.03	98.80	99.58
Change		-0.29	-4.87	-4.10	-3.32
% Change		-0.28%	-4.7%	-4.0%	-3.2%

Table 8.22: Combined Direct and Indirect Operational Phase CO_2 Emissions with Additional Service Frequency – Design Year (2043)

Additional Service Frequency Scenario	Vehicle Class	Core Scenario CO_2 (kt CO_2)	100% Uptake of residual capacity from Car	75% Uptake of residual capacity from Car	50% Uptake of residual capacity from Car
			CO_2 (kt CO_2)	CO_2 (kt CO_2)	CO_2 (kt CO_2)
DM	Car	45.34	45.34	45.34	45.34
DS		45.00	42.79	43.16	43.52
Change		-0.34	-2.56	-2.19	-1.82
% Change		-0.8%	-5.6%	-4.8%	-4.0%

The analysis shows that, should a portion of the drivers currently modelled as redistributed general traffic make the decision to make their journeys by public transport, the impact of this shift in transport mode would result in a further significant reduction in CO_{2eq}. emissions compared to the core scenario. The core scenario assumes no additional frequency beyond that planned under the current BusConnects Network Redesign proposals. Even if an uptake of only 50% of the residual capacity was achieved by a transfer from car, a 3.2% and 4.0% reduction in CO_2 emissions across the study area could potentially be achieved in 2028 and 2043 respectively.

For context, the 4.9kt and 2.6kt reduction in CO_2 emissions in 2028 and 2043 respectively, achieved by a 100% uptake of residual capacity, is equivalent to the removal of approximately 16,330 and 18,790 car trips per weekday from the road network in 2028 and 2043. With a 50% uptake of residual capacity, the equivalent reduction in weekday car trips would be 11,140 and 13,670 in 2028 and 2043 respectively. This has the effect of a reduction in total vehicle kilometres, a reduction in fuel usage, and increases to sustainable transport trips and modal share in accordance with the 2023 Climate Action Plan (CAP) (DCCAE 2022).

8.6.2.2 Future Growth in Cycling

The Proposed Scheme will facilitate a step change in the level of segregated cycling provision in comparison with existing conditions along the entire length of the corridor. The representation of improvements to cycling infrastructure in the transport models follows a standard approach and are appropriate for the strategic nature of the model. It is applied by way of an increase in cycling speed on the network where the improvements have been made, as well as new connectivity by way of new links as part of the Proposed Scheme. Modelling cycling infrastructure improvements using speeds is a standard approach that means an increase in cycling mode share can be obtained through a reduction in the modelled cost of a journey by bicycle relative to other modes. This has been applied as part of the modelling of the Proposed Scheme to represent improvements with a cycling mode share of approximately 6% achieved. The transport modelling undertaken, is therefore conservative in terms of the predicted cycling mode share. This has the effect that predicted traffic levels are on the higher and conservative side in relation to a potential future receiving environment. This is appropriate for EIAR purposes as a 'reasonable worst case' has been assessed in terms of traffic levels on the road network.

It should be noted, however, that the Proposed Scheme has been designed to cater for much higher levels of cycling uptake and includes significant segregation and safety improvements to walking and cycling infrastructure. This will provide the opportunity for a significant increase in the movement of people travelling sustainably along the corridor and will therefore cater for higher levels of future population and employment growth and support higher cycling mode share levels, which would otherwise not be achieved in the absence of the Proposed Scheme. The background environment changes with regards to cycling segregation and safety improvements will encourage more people to cycle in greater numbers. The Proposed Scheme will provide the capacity to facilitate a greater uptake in cycling than what has been predicted in the core assessment and will facilitate the opportunity for further reductions in CO_{2e} emissions, beyond those reported in this Chapter.

8.6.2.3 Demand Management

The GDA Transport Strategy (NTA 2016), of which the Proposed Scheme is a key element, aims to provide for the efficient, effective and sustainable movement of people and goods and to accommodate future travel growth in a managed and balanced way. Increased public transport provision, coupled with enhanced cycling and walking facilities in urban areas, will enable a transition to more sustainable travel modes for many people in addition to providing the means to cater for much of the increased travel demand. However, without complementary demand management measures the full benefits of the Strategy will not be achieved.

The Proposed Scheme will be an enabler to allow for further reductions in car mode share with corresponding transfer to public transport, walking and cycling modes. Sustainable modes capacity is significantly enhanced by the Proposed Scheme which in turn will support demand management measures which could be applied to meet climate emission targets. This growth in sustainable mode share cannot be accommodated in the absence of the Proposed Scheme. A greater increase in sustainable mode share can be accommodated by the Proposed Scheme which would in turn lead to further reductions in GHG emissions, beyond those reported in this Chapter.

8.7 Mitigation and Monitoring Measures

A schedule of mitigation measures has been formulated for the Construction and Operational Phases of the Proposed Scheme.

8.7.1 Construction Phase

Construction traffic and the embodied energy of construction materials will be the dominant source of GHG emissions as a result of the Construction Phase of the Proposed Scheme. Construction vehicles, generators etc., may give rise to some CO_2 and N_2O emissions.

8.7.1.1 Construction Phase Embodied Carbon Mitigation

A series of mitigation measures have been incorporated into the Proposed Scheme with the goal of reducing the embodied carbon associated with the Construction Phase. These mitigation measures include:

- The replacement, where feasible, of concrete containing Portland cement with concrete containing ground granulated blast furnace slag (GGBFS);
- Where practicable, materials will be reused within the extent of the Proposed Scheme; and
- Where practicable, materials will be sourced locally to reduce the embodied emissions associated with transport.

8.7.1.2 Construction Phase Traffic Emissions Mitigation

The construction traffic GHG emissions associated with the Construction Phase of the Proposed Scheme will be short-term and temporary in nature. The appointed contractor will finalise the Construction Traffic Management Plan (CTMP) to manage traffic during the Construction Phase. A CTMP is included as part of the Construction Environmental Management Plan (Appendix A5.1 in Volume 4 of this EIAR).

Table 8.23: Summary of Predicted Construction Phase Impacts Following the Implementation of Mitigation and Monitoring Measures

Assessment Topic	Potential Impact (Pre-Mitigation and Monitoring)	Predicted Impact (Post Mitigation and Monitoring)
Embodied Carbon	Negative, Minor Adverse and Short-Term	Negative, Minor Adverse and Short-Term
Construction Traffic	Positive, Minor Beneficial and Short-Term	Positive, Minor Beneficial and Short-Term
Combined Construction Phase	Negative, Minor Adverse and Short-Term	Negative, Minor Adverse and Short-Term

8.7.2 Operational Phase

8.7.2.1 Maintenance Phase Embodied Carbon Mitigation

The maintenance phase GHG emissions will primarily consist of bitumen containing material due to maintenance of road pavement. Bitumen containing material will be reused within new carriageway construction, in as far as practicable, reducing the amount of waste which will be disposed of to landfill. The embodied carbon emissions associated with the Maintenance Phase of the Proposed Scheme will be long-term and the mitigation measure, as outlined above will be implemented. The impact on GHG emissions, after mitigation, as outlined in Table 8.24, due to the embodied carbon associated with the Maintenance Phase of the Operational Phase of the Proposed Scheme will be Negligible and Permanent.

The impact of the Operational Phase traffic of the Proposed Scheme, as outlined in Table 8.24, is predicted to be Negligible and Permanent. Thus, the predicted impact to climate due to Operational Phase traffic as a result of the Proposed Scheme, after mitigation, will be Negligible and Permanent.

Table 8.24: Summary of Predicted Operational Phase Impacts Following the Implementation of Mitigation and Monitoring Measures

Assessment Topic	Potential Impact (Pre-Mitigation and Monitoring)	Predicted Impact (Post Mitigation and Monitoring)
Maintenance	Negligible and Permanent	Negligible and Permanent
Operational Traffic	Negligible and Permanent	Negligible and Permanent
Combined Operational Phase	Negligible and Permanent	Negligible and Permanent

As outlined above, the Proposed Scheme will support the delivery of government strategies outlined in the 2023 CAP (DCCAE 2022) and the 2021 Climate Bill by enabling sustainable mobility and delivering a sustainable transport system. Its aim is to provide enhanced walking, cycling and bus infrastructure on key access corridors in the Dublin Region. This will subsequently enable and deliver an integrated sustainable transport movement along these corridors.

8.8 Residual Impacts

8.8.1 Construction Phase

The Proposed Scheme is estimated to result in total Construction Phase GHG emissions of 12,771 tonnes embodied CO_2eq for materials over a 54-month period, equivalent to an annualised total of 0.008% of Ireland's non-ETS 2020 target and 0.047% of the 2030 Transport Emission Ceiling. The embodied carbon emissions associated with the Construction Phase of the Proposed Scheme will be short-term and temporary in nature. The impact on CO_{2e} emissions, after mitigation, as outlined in Table 8.23, due to the embodied carbon associated with the Construction Phase of the Proposed Scheme will be Negative, Minor Adverse and Short-Term. Although the impact rating post-mitigation is the same as pre-mitigation, the mitigation measures proposed will have the effect of reducing carbon emissions during the Construction Phase.

A comparison between the Do Something and Do Minimum CO_{2e} traffic emissions in the Construction Year (2024) indicates that there is predicted to be an overall decrease of 0.25kt in CO_{2eq} due to the Construction Phase of the Proposed Scheme. This is equivalent to a 0.23% decrease in CO_{2eq} relative to the Construction Year (2024) Do Minimum estimates.

8.8.2 Operational Phase

The maintenance CO_{2e} emissions associated with the Operational Phase of the Proposed Scheme, after mitigation, is predicted to be Negligible and Permanent. The operational traffic CO_{2e} emissions associated with the Operational Phase of the Proposed Scheme are predicted to be Negligible and Permanent. Overall, when the carbon emissions associated with the maintenance phase and the Operational Phase are combined, the net GHG emissions will be Negligible and Permanent. Thus, the residual impact from Operational Phase traffic as a result of the Proposed Scheme will be Negligible and Permanent.

The Proposed Scheme will also support the delivery of government strategies outlined in the 2021 CAP (DCCAE 2021) and the 2021 Climate Act by enabling sustainable mobility and delivering a sustainable transport system. The Proposed Scheme will provide connectivity and integration with other public transport services leading to more people availing of public transport, helping to further reduce GHG emissions.

Based on the analysis outlined above, it is concluded that the Proposed Scheme will achieve the Proposed Scheme objectives in supporting the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets. The Proposed Scheme has the potential to reduce CO_{2e} emissions equivalent to the removal of approximately 16,330 and 18,790 car trips per weekday from the road network in 2028 and 2043 respectively. This This has the effect of a reduction in total vehicle kilometres, a reduction in fuel usage, and increases to sustainable transport trips and modal share in accordance with the 2023 Climate Action Plan (CAP) (DCCAE 2022).

It is concluded that, the Proposed Scheme will make a significant contribution to reduction in carbon emissions.

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