
Chapter 25

Interactions

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25. Interactions and Inter-relationships of Impacts

25.1. Introduction

The potential for interaction of environmental effects has been assessed throughout this EIAR, as part of the impact assessment process of the individual environmental factors in Chapters 6 to 24. These previous chapters have identified, described and assessed the relevant interactions arising between one or more of the individual environmental factors. This chapter of the EIAR presents a summary of those potential interactions. Close co-ordination and discussion between the wider EIA team has informed the assessment of interactions and the preparation of this chapter to ensure that interactions identified have been adequately assessed and where necessary mitigation proposed.

25.2. Legislation, Policy and Guidance

25.2.1. Legislation

The consideration of interactions derives from the provisions of the Transport (Railway Infrastructure) Act 2001 (as amended) and Article 3(1)(e) of the EIA Directive 2011/92/EU as amended by Directive 2014/52/EU ('the EIA Directive'). The Transport (Railway Infrastructure) Act 2001 (as amended) provides for the making of a Railway Order application (also referred to herein as "the proposed Project") by Córas Iompair Éireann (CIÉ) to An Bord Pleanála. The European Union (Railway Orders) (Environmental Impact Assessment) (Amendment) Regulations 2021 (S.I. No. 743 of 2021) gives further effect to the transposition of the EIA Directive (EU Directive 2011/92/EU as amended by Directive 2014/52/EU) on the assessment of the effects of certain public private projects on the environment by amending the Transport (Railway Infrastructure) Act 2001 ('the 2001 Act'). Accordingly, an examination, analysis and evaluation is carried out by An Bord Pleanála in order to identify, describe and assess, in the light of each individual case, the direct and indirect significant effects of the proposed project (comprising *inter alia* railway works), including significant effects derived from the vulnerability of the activity to risks of major accidents and disasters relevant to it, on: population, human health; biodiversity, with particular attention to species and habitats protected under the Habitats and Birds Directives; land, soil, water, air, climate, material assets, cultural heritage and the landscape, and the interaction between the above factors. In a similar vein, Article 3(1)(e) of the EIA Directive which requires *inter alia* that the EIAR shall identify, describe and assess in an appropriate manner, the direct and indirect significant effects of a project including the interaction of environmental factors.

25.2.2. Guidance

This Chapter has been prepared with reference to the following guidance documents:

- Guidelines on the information to be Contained in Environmental Impact Assessment Reports (EPA, 2022); and

- Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions European Commission (European Commission 1999).

25.3. Methodology

The assessment of interactive effects has considered likely significant effects arising from impact interactions that may occur during construction, operational and maintenance phases of the proposed Project. The approach has aligned with the above guidance and that described in Chapter 1: Introduction.

The study area is defined by the study areas of each of the individual environmental topic assessments, which are discussed in the relevant topic EIAR Chapters 6 – 24. The approach taken has been to:

- Identify the potential for interactions between different environmental topics over the life cycle of the project in matrix format, including consideration in terms of cumulative effects. The determination of interactions was facilitated through an iterative design process that included consultation between designers, environmental specialists and technical specialists. It also considers the potential for mitigation measures prescribed in respect of one particular environmental factor to give rise to unintended negative impacts in respect of one or more other factor, as appropriate; and
- Prepare a summary of the interactions between different environmental topics which have been identified and addressed in this EIAR.

25.3.1. Consultation

The EIAR coordination team consulted with the relevant specialists to inform the assessment of interactive effects. This included the facilitation of data exchange and coordination of relevant specialist's input into the assessment of potential interactions between environmental factors (addressed in more detail within the applicable chapters of the EIAR and mitigation measures identified to address such interactions). This was undertaken throughout the specialist impact assessment process.

25.3.2. Difficulties Encountered / Limitations

This chapter of the EIAR has been prepared with reference to current best practice and relevant guidelines. There were no difficulties encountered in preparing the assessment of interactions and inter-relationships of impacts.

25.4. Potential Impacts

25.4.1. Interaction Matrix

The potential impact interactions between factors are identified in Table 25.1. The effects matrix identifies the factors in the left-hand column, which have the potential to impact on other factors listed in the top row of the matrix. Where a tick '✓' exists, this indicates that the proposed Project has potential

to result in an interaction between the two factors. Where there is no potential for an interaction between factors, this is indicated by a hyphen 'x' in the matrix.

The purpose of the matrix is to identify the likely interactive effects of significance. A description of the interactive effect is provided in Section 25.4.2 along with a reference to where the assessment has been completed in Chapters 6 – 24.

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Table 25.1: Interactive Effects Summary Matrix Identifying Interactions Between Factors

	Traffic & Transport		Population		Biodiversity		Land & Soils		Water		Hydrogeology		Air Quality & Climate		Noise & Vibration		Landscape & Visual		Ag and Non-ag		Utilities, Resource & Waste Mngt		Built Heritage		EMF		Human Health	
	C ¹	O ²	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O
Traffic & Transport																												
Population	✓	✓																										
Biodiversity	✓	✓	X	X																								
Land & Soils	X	X	X	X	X	X																						
Water	✓	✓	X	X	✓	✓	✓	✓																				
Hydrogeology	X	X	X	X	✓	✓	✓	✓	✓	✓																		
Air Quality & Climate	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X																
Noise & Vibration	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X														
Landscape & Visual	✓	✓	X	X	✓	✓	X	X	X	X	X	X	X	X	X	X												
Ag & Non-ag	X	X	X	X	✓	✓	X	X	X	X	X	X	X	X	X	X	✓	✓										
Utilities, Resource & Waste Mngt	✓	✓	X	X	X	X	✓	X	X	X	X	X	X	X	X	X	✓	X	X	X								
Built Heritage	X	X	X	X	✓	X	X	X	X	X	X	X	X	X	X	X	✓	✓	X	X	X	X						
EMF	X	X	X	X	X	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓	X	X					
Human Health	✓	✓	✓	✓	X	X	X	X	X	X	X	X	✓	✓	✓	✓	X	X	X	X	X	X	X	X	✓	✓		

¹ C = Construction

² O = Operation

25.4.2. Description of Interactions

25.4.2.1. Traffic and Transport

As identified in Table 25.1, interactions between Traffic and Transport and the following factors have been identified and assessed: Population; Biodiversity; Water; Air Quality and Climate; Noise and Vibration; Landscape and Visual; Material Assets – Utilities, Resource and Waste Management; and Human Health. There is also potential for these interactions to go beyond the proposed Project in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 of this EIAR.

Population: The construction of proposed Project will result in increased construction traffic (including but not limited to HGV) using the national road network, particularly in the vicinity of construction compounds and along designated haulage routes along the proposed Project. This will likely impact on the journey characteristics and journey amenities of road users (motorised vehicles, cyclists, and pedestrians). While construction traffic will initially use national/ regional routes for access to the local area, construction traffic will be routed through existing urban and/ or rural areas to gain local access and this will include residential, community, educational, medical, and commercial areas. Access to community infrastructure and amenities will be maintained as far as practicable during construction however, there is a potential for impacts to occur due to an increase in traffic during both daytime and night-time construction works.

Delays and longer commute times for some road traffic, particularly in the Dublin city area are anticipated due to increased traffic levels. A number of road closures and traffic diversions will be required over the course of the 50-month construction period. This includes closures at specific key junctions of South Circular Road Bridge (OBC1A) and St John's Road Bridge (OBC0A), Memorial Road Bridge (OBC3), Sarsfield Road Bridge (UBC4), Kylemore Road Bridge (OBC5A), Le Fanu Road Bridge (OBC7) and Glasnevin Cemetery Bridge (OBO10). These closures will impact on the resident communities and also on commuters (other public transport, car, pedestrian and cyclist) that need to access the construction impact zone to commute to work and services. Impacts will include delays, congestion, increased traffic volumes on diversion routes as well as limitations on space for vulnerable road users. Increased noise and reduced air quality are also likely.

Additionally, there will be disruption of the rail services associated with construction works where track possession is required during operational hours. This will include weekend possessions and longer duration shutdowns (i.e. for works on the Phoenix Park Tunnel and Great South Western Railway) which will interrupt commuter services.

During the operation phase of the proposed Project, traffic and transport will interact with population in relation to changes to public transport routes on some surface roads which will cause inconvenience for some on a long-term basis leading to negative impacts.

The traffic and transport factors will interact to give rise to cumulative positive effects also, notably enhanced multimodal connectivity through interchanges with other public transport networks i.e. the

Luas at Heuston Station, linking with the Maynooth Line at Glasnevin interchange (via the Phoenix Park Tunnel Branch Line), BusConnects and proposed Metrolink.

Chapter 7: Population, assesses impacts on Population from traffic and transport proposals. Mitigation measures are proposed to minimise effects of traffic and transport on population as relevant.

Biodiversity: The construction phase of the proposed Project will result in increased traffic and transportation within the study area. These increases have the potential to negatively impact on biodiversity through temporary habitat fragmentation, increased noise and light disturbance, pollution, and mortality. Construction traffic and other related construction activities such as watercourse crossings can present as a temporary barrier and/ or hazard to mobile species such as otter, bats, badger, and fish. Construction vehicles produce sediment runoff through potential spillage of hydrocarbons and other materials with potential to impact on water quality, which may subsequently have negative impacts for aquatic species. Furthermore, the transport of machinery, equipment and material during the construction phase can facilitate the introduction and/ or spread of invasive species.

During the operational phase, there is potential for collision of birds and bats with electrification infrastructure. There is also the potential for long-term habitat fragmentation where linear features and stepping stones are not reinstated. This is particularly the case in the urban environment where alternatives are limited.

Chapter 8: Biodiversity, assesses impacts from traffic and transport proposals on the biodiversity along the route. Mitigation measures are proposed to minimise the effects of traffic and transport on sensitive ecological features including bats.

Water: There is a potential for contaminated run off from the machinery on site during construction. The increased traffic and transportation levels associated with the proposed works increase the risk of hydrological contamination via diffuse and point sources such as road runoff or oil/ fuel spills. Any such spills have the potential to negatively impact water quality in the surrounding hydrological regimes. This potential interaction is more likely during the construction stage.

During the operation phase, water quality can be impacted with any accidental release of oils, fuels, and chemicals, hydraulic fluids etc. from road service vehicles, trains etc.

Chapter 10: Water, assesses impacts from traffic and transport proposals. Mitigation measures are proposed to minimise effects of traffic and transport on the receiving water environment.

Air Quality & Climate: The generation of road traffic due to construction phase deliveries of materials, removal of waste and redistribution of other road users has the potential to impact air quality including an increase in the emissions of particulate matter, nitrogen oxides and GHG. This will be particularly the case where road closures and diversions lead to localised congestion during the construction stage and resultant increase in pollution and emissions for the duration of the closure/ diversion. HGV traffic leaving construction sites has also the potential to generate dust emissions due to track-out of dust

from the vehicle wheels to public roads. This will have negative, short-term impacts during the construction phase.

The impact on the air quality and climate during the operation phase will be broadly beneficial as the electrification of the lines will facilitate a shift toward EMU and away from a reliance on a diesel fleet in terms of rail transport and a modal shift away from motor vehicles for road transport with long term positive effects for air quality and climate.

Chapter 12: Air Quality, assesses impacts from traffic and transport proposals. Mitigation measures are proposed to minimise effects of traffic and transport on sensitive receptors as relevant. Chapter 13: Climate, assesses impacts from traffic and transport emissions. Mitigation measures are proposed to minimise effects of traffic and transport on achievement of climate related targets.

Noise and Vibration: The construction of proposed Project will result in an increase in the traffic volumes on local roads due to road closures and diversions and an increase in HGV movements around construction compounds and along haul routes. The movements will contribute to increased noise levels. Works are likely to take place at day and night time and will have an impact on the baseline noise levels. However, these impacts are short-term and mitigation measures will include best practice noise control measures, appropriate hours of operation and scheduling of works. This will ensure noise impacts are controlled as far as practicable during the construction phase. Vibration impacts relating to construction traffic will be limited given the low generation of vibration from vehicles along well-maintained roads.

During the operational phase, there will be increased noise associated with the enhanced service and frequency of trains (both the electrified and diesel fleet). There is a potential for a reduction in road traffic noise over the long-term where a modal shift away from motor cars can be achieved.

Chapter 14: Noise and Vibration, assesses impacts from traffic and transport proposals. Mitigation measures are proposed to minimise effects of traffic and transport on sensitive noise receptors as relevant.

Landscape and Visual: During the construction phase, construction compounds and associated HGV movements along haulage routes to and from construction sites are likely to have temporary visual impacts on visual receptors.

During the operation phase, there will be permanent change to visual amenity due to the introduction of new bridges, crossings, etc along with increased frequency of passing rail traffic. The introduction of the Heuston West Station will also change the character of the local visual envelope as it becomes a focal point for passenger access.

Chapter 15: Landscape and Visual, assesses impacts from traffic and transport proposals. Mitigation measures are proposed to minimise effects of traffic and transport on sensitive receptors as relevant.

Material Assets (Utilities and Resource and Waste Management): There will be temporary diversions or repositioning and specification for permanent reinstatement of utility services during the construction period. During the operation phase, there will be permanent alterations to utility services and track drainage network.

Chapter 18: Material Assets- Utilities, assesses impacts from traffic and transport proposals on utilities including built services. Mitigation measures are proposed to minimise effects of traffic and transport on these receptors as relevant.

During the construction phase there is potential for direct and indirect interaction between resource management and construction of the proposed Project. Resources are required to deliver the project including electrification infrastructure, track infrastructure, concrete, rebar for bridge replacements etc. This material will have to be transported by road to site. Similarly, materials arising from construction of the proposed Project, e.g. excavated spoils, concrete, glass, bricks, wood etc from demolitions, which cannot be reused on site will require transport off site to suitable recovery, recycling, treatment and disposal facilities. This will require truck and HGV movements, resulting in construction traffic on the local road network.

During operations, there will be generation of waste from the passenger trains and track maintenance. This is anticipated to be limited in nature and will be included in existing transport arrangements for disposal of materials arising at all Iarnród Éireann services.

Chapter 19: Material Assets - Resource and Waste Management assesses impacts from traffic and transport proposals on materials and waste. Mitigation measures are proposed to minimise effects of traffic and transport on these receptors as relevant.

Human Health: The increased traffic during the construction and operation phase will result in indirect impacts related to air quality and noise levels on the human health. The changes in traffic flow rate and risks of accidents/ injuries can also have a negative impact on health across the community. However, the opportunities for income and employment generation will have the possibility to affect human health positively through the delivery of the proposed Project.

There is a potential of benefits during the operation phase including improved air quality due to electrification of the rail fleet and overall increased capacity of the rail services. Opportunities for a modal shift to public transport and active travel options will also benefit human health.

Chapter 23: Human Health, assesses impacts from traffic and transport proposals. Mitigation measures are proposed to minimise effects of traffic and transport on sensitive receptors as relevant.

25.4.2.2. Population

As identified in Table 25.1, interactions between Population and the following factors have been identified and assessed: Traffic and Transport; Air Quality, Climate, Noise and Vibration and Human Health. There is also potential for these interactions to go beyond the proposed Project in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 of this EIAR.

Traffic and Transport: See section 25.4.2.1 above.

Air Quality and Climate: Related to traffic and transport emissions. See section 25.4.2.1 above.

Noise and Vibration: The increased noise and vibration levels during the construction works will emanate from traffic and transport sources (See section 25.4.2.1 above) and from construction activities such as demolitions, excavations, piling and soil nailing. These high noise and vibration activities will cause disturbance to local populations in the surrounding areas of the proposed Project, negatively impacting on enjoyment of indoor and outdoor spaces including residential, recreational areas and public spaces in the surrounding areas due to exposure to increased noise levels.

During the operational phase, the populations along the proposed Project will experience changes in noise and vibration character as a result of higher frequency of trains (both diesel and EMU), modifications to track alignments with EMU using the northern lines and diesel trains moving to the southern tracks, substation noise, station noise from the new Heuston Station West. At the operational phase, positive impacts on noise levels are also predicted from the modal shift away from motor vehicles toward active and public transport options reducing road traffic noise in the longer term

Chapter 14: Noise and Vibration, assesses impacts on noise sensitive receptors in the receiving environment. Mitigation measures are proposed to minimise effects on these noise sensitive receptors as relevant.

Human Health: Interactions between population and human health are via the impact pathways of emissions to air and noise arising from traffic and transport and construction activities as discussed above in this section and in Section 25.4.2.1 above.

25.4.2.3. Biodiversity

As identified in Table 25.1, interactions between Biodiversity and the following factors have been identified and assessed: Traffic and Transport; Water and Hydrogeology, Air Quality, Climate, Noise and Vibration; Landscape and Visual; Material Assets Agriculture/ Non-agriculture; Built Heritage and EMF. There is also potential for these interactions to go beyond the proposed Project in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 of this EIAR.

Traffic and Transport: See section 25.4.2.1 above.

Water and Hydrogeology: There is a potential for interaction between water and biodiversity during the construction and operation of the proposed Project. During the construction phase, there is a potential for release of suspended solids and other polluting substances from construction traffic and other construction activities such as earthworks, to waterbodies resulting in negative effects for water quality. Pollution control measures have been integrated in the design to address this.

During the operational phase of the proposed Project, there is potential for pollution impacts on water quality from ongoing operational activities, which may in turn impact upon biodiversity. During the operational phase of the proposed Project, inspection and maintenance will occur to ensure that the

drainage features such as attenuation tanks operate as intended for the design life of the railway to prevent pollution of water courses.

Chapter 10: Water, assessed impacts on the receiving water environment including drainage and flooding. Mitigation measures are proposed in Chapter 8 Biodiversity and in Chapter 10 Water to minimise effects on biodiversity as a result of interactions with this factor as relevant.

Chapter 11: Hydrogeology, assessed impacts on the receiving hydrogeological environment. Mitigation measures are proposed in Chapter 8 Biodiversity and in Chapter 11 Hydrogeology to minimise effects on biodiversity as a result of interactions with this factor as relevant.

Air Quality and Climate: There is potential for interactions between Air Quality, Climate and Biodiversity at the construction and operational phase, related to emissions of nitrogen oxides and dust settling on vegetation which can hamper growth. This can be generated by construction and operational traffic. Mitigation measures are proposed in Chapter 12: Air Quality and in Chapter 13: Climate to minimise effects on air quality and climate as a result of interactions with this factor as relevant.

Noise and Vibration: There is potential for interactions between Noise and Vibration and Biodiversity at the construction and operational phase, related to disturbance from construction traffic, demolitions, earthworks, piling, and soil nailing and ongoing disturbance during operation from road, rail and passenger traffic associated with the proposed Project. Construction works in particular will result in disturbance to fauna in the areas within and in proximity to the Project boundary, including birds and bats. This ongoing noise and vibration disturbance may result in reduction or limitations to available feeding, resting, nesting, and breeding areas.

During the operational phase, noise emissions will be of a different nature, typically associated with road traffic, passing EMU and diesel trains and people accessing stations.

Chapter 14 Noise and Vibration, assesses impacts on the receiving environment. Mitigation measures are proposed in Chapter 8 Biodiversity to minimise effects on biodiversity as a result of interactions with noise and vibration.

Landscape and Visual: There is potential for interactions between Landscape & Visual and Biodiversity at the construction and operational phase. Construction works including site clearances and earthworks will involve permanent severance of some hedgerows and removal of trees. This has the potential to subsequently lead to permanent changes to the existing habitats and thereby landscape and amenity of the area of the proposed project. There is also a potential that development of new lighting and infrastructure which will cause disturbance to bird or bat species present in the area.

At operation, interactions relate to the landscape design elements used in the project. The proposed mitigation to address landscape and visual impacts arising from the proposed Project have the potential for interaction with biodiversity by way of the nature and extent of planting proposed. To support biodiversity and contribute to maintenance of the ecological network, appropriate planning will be

required in the landscape design. The choice of species and the extent of planting will have operational interactions with potential for positive effects. Mitigation measures are proposed in Chapter 15 Landscape and Visual to minimise effects on biodiversity as a result of interactions with this factor as relevant.

Built Heritage (including Archaeology, Architecture and Cultural Heritage): During pre-construction site enabling, archaeological testing will be undertaken along the proposed Project. This has the potential to result in disturbance and mortality to habitats and species encountered prior to ecological resolution on site, e.g. relocation of badger setts, fencing of invasive species etc. It is essential that the sequence of enabling works permits the advanced survey work necessary to secure all biodiversity receptors in advance topsoil stripping. Similarly, prior to interference with any features identified as ecological receptors, notably bridges, Signal Box at the Inchicore Works and the Phoenix Park Tunnel, resolution of bat issues must precede any works on these features. A Project Ecologist will be essential to inform the sequencing. No interactions are anticipated at operation stage subject to resolution of issues at pre-construction.

Chapter 20 Archaeology and Chapter 21 Architectural Heritage, assess impacts on built heritage. Mitigation measures are proposed in Chapter 8 Biodiversity to minimise effects on biodiversity as a result of interactions with this factor as relevant.

Agricultural and Non-Agricultural Material Assets: There is potential for interactions between Agricultural, Non-agricultural Material Assets and Biodiversity at both construction and operational phase, related to land use change. During site clearance, lands required to construct and operate the proposed Project will be cleared. This includes topsoil stripping, demolition of upstanding features, including three derelict properties at Hazelhatch, bridges and existing boundary walls. These features all have potential to directly and indirectly support biodiversity. Bats have been identified in the properties at Hazelhatch and among trees and other structures which will be removed to facilitate the proposed Project. Other mobile species use existing features as linear cover to move along and between territories. Other non-mobile plant and animal species rely on the walls and land as substrate to grow. This has the potential to result in disturbance and mortality to habitats and species encountered prior to ecological resolution on site, e.g. relocation of badger setts, fencing of invasive species etc. It is essential that the sequence of enabling works permits the advanced survey work necessary to secure all biodiversity receptors in advance topsoil stripping. Similarly, prior to interference with any features identified as ecological receptors, notably bridges, Signal Box at the Inchicore Works and the Phoenix Park Tunnel, resolution of bat issues must precede any works on these features. A Project Ecologist will be essential to inform the sequencing. No interactions are anticipated at operation stage subject to resolution of issues at pre-construction. While the main interaction will be at construction when these features are removed, there will be a permanent long term loss of habitat and a long term land use change as a result.

Chapter 16 Agricultural Material Assets and Chapter 17 Non-agricultural Material Assets, assess impacts on land. Mitigation measures are proposed in Chapter 8 Biodiversity to minimise effects on biodiversity as a result of interactions with this factor as relevant.

EMF: Electromagnetic interference has potential to disrupt flight paths. During operation of the Dart, potential for interactions between EMF and biodiversity, notably birds and bats has been considered in Chapter 8 Biodiversity.

25.4.2.4. Land and Soils

As identified in Table 25.1, interactions between Land and Soils with the following factors have been identified and assessed: Water and Hydrology, and Material Assets Utilities, Resources and Waste Management. There is also potential for these interactions to go beyond the proposed Project in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 of this EIA.

Water and Hydrogeology: There is potential for interactions between Land and Soils and Water during the construction and operation of the proposed Project. This arises from the accidental emissions and release of potentially hazardous substances to surface and groundwater leading to a deterioration in water quality. The source of pollution during construction may include contaminated soils, fuels, concrete and other construction materials. Accidental spillages of fuels, chemicals or other contaminants during construction works may also result in localised contamination of soils/ subsoils underlying the site which may act as a conduit for groundwater contamination.

Large-scale and widespread excavation and removal of topsoil, subsoil and bedrock during construction may also result in loss of suspended solids to surface water leading to localised deterioration in water quality with potential for ongoing erosion of soils along the length of the proposed Project.

During operation this is related to accidental spillages of fuels, chemicals or other contaminants during operation and maintenance activities which may result in localised contamination of soils.

Chapter 9: Land and Soils assesses the impacts to the receiving geological environment. This impact has also been considered in Chapter 10: Water (including Hydrology and Flood Risk) and Chapter 13: Hydrogeology. Mitigation measures are proposed in both chapters to minimise effects on water as a result of interactions with these factors, as relevant.

Material Assets (Utilities, Resource and Waste Management): There is potential for interactions between Land and Soils and Materials Assets, notably waste management as a result of the excavated materials which will be generated during construction and the potential for excavation of contaminated soils during construction and generation of contaminated material, e.g. ballast during operation and maintenance. Chapter 19 assesses the impact on resource and waste management and considers the nature and quantity of materials arising from the construction and operation of the proposed Project. Mitigation measures are proposed to minimise effects on waste management as a result of interactions with this factor, as relevant.

25.4.2.5. Water (including hydrology and flooding)

As identified in Table 25.1, interactions between Water (including hydrology and flooding) and the following factors have been identified and assessed: Traffic and Transport, Biodiversity, Land and Soils and Hydrogeology. There is also potential for these interactions to go beyond the proposed Project in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 of this EIAR.

Traffic and Transport: See section 25.4.2.1 above.

Biodiversity: See section 25.4.2.3 above.

Land and Soils: See section 25.4.2.4 above.

Hydrogeology: There is potential for interactions between Water and Hydrogeology during the construction and operation of the proposed Project. This arises from the accidental emissions and release of potentially hazardous substances to groundwater leading to a deterioration in groundwater quality. The source of pollution during construction may include contaminated soils, fuels, concrete and other construction materials. Accidental spillages of fuels, chemicals or other contaminants during construction works may also result in localised contamination of soils/ subsoils underlying the site which may act as a conduit for groundwater contamination.

During operation this is related to accidental spillages of fuels, chemicals or other contaminants during operation and maintenance activities which may result in localised groundwater contamination.

Chapter 10 assess impacts to Water. This has been considered in the Chapter 11 assessment of Hydrogeology and mitigation measures are proposed to minimise effects on Water as a result of interactions with this factor, as relevant.

25.4.2.6. Hydrogeology

As identified in Table 25.1, interactions between hydrogeology (and the following factors have been identified and assessed: Biodiversity, Land and Soils and Water (including hydrology and flooding). There is also potential for these interactions to go beyond the proposed Project in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 of this EIAR.

Biodiversity: See section 25.4.2.3 above.

Land and Soils: See section 25.4.2.4 above.

Water (including hydrology and flooding): See section 25.4.2.5 above.

25.4.2.7. Air Quality and Climate

As identified in Table 25.1, interactions between Air and Climate and the following factors have been identified and assessed: Traffic and Transport, Population, Biodiversity and Human Health. There is also potential for these interactions to go beyond the proposed Project in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 of this EIAR.

Traffic and Transport: See section 25.4.2.1 above.

Population: See section 25.4.2.2 above.

Biodiversity: See section 25.4.2.3 above.

Human Health: There is a potential for interaction between air quality and human health during both the construction and operational phases of the proposed Project. The generation of road traffic due to construction phase has the potential to impact air quality including an increase in the emissions of particulate matter and nitrogen oxides and GHG giving rise to potential for local air quality impacts for residents located along the roads proposed as diversionary routes and haul routes. Where traffic levels are in excess of 10% of the baseline, there is a potential for significant effect on air quality for these residents. The routes where the greatest changes to road traffic as a result of the diversions and/ or construction traffic have been assessed for local impact. Levels are compared against statutory limits and WHO guidelines for exposure. The greatest potential impact on air quality during the construction phase is from construction dust emissions and the potential for nuisance dust. Potential impacts generally occur within 350m of the route used by construction vehicles on the public road, up to 500m from the site entrance.

The impact on the air quality and climate during the operation phase will be broadly beneficial as the electrification of the lines will facilitate a shift toward EMU and away from a reliance on a diesel fleet in terms of rail transport and a modal shift away from motor vehicles for road transport with long term positive effects for air quality and climate and indirectly for human health.

Chapter 12 Air Quality assesses the impacts of the proposed Project on air quality having regard to statutory emission limits set for the protection of human health.

25.4.2.8. Noise and Vibration

As identified in Table 25.1, interactions between Noise and Vibration and the following factors have been identified and assessed: Traffic and Transport, Population, Biodiversity and Human Health. There is also potential for these interactions to go beyond the proposed Project in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 of this EIAR.

Traffic and Transport: See section 25.4.2.1 above.

Population: See section 25.4.2.2 above.

Biodiversity: See section 25.4.2.3 above.

Human Health: There is potential for interactions between noise and vibration and human health particularly during the construction of the proposed Project. A key feature of the construction works relevant to proposed Project is the proximity of works to noise sensitive receptors at locations such as Landen Road and the nature, duration and extent of noise generating activities proposed. These include noise emissions from construction traffic along haul routes, enhanced road traffic movements associated with road closures, diversions, machinery used for demolition and excavations, machinery used for construction and significant noise generation activities such as piling and soil nailing. All of these activities will be carried out in close proximity to residences, schools, medical facilities, commercial and recreational facilities. These activities will also take place during both daytime and nighttime hours and on weekends. Sensitive noise receptors are expected to experience significant noise and vibration over the construction phase with potential for negative effects on human health on the short term.

Chapter 22 Human Health assesses the impacts of the proposed Project on people having regard to emission limits set for the protection of human health.

25.4.2.9. Landscape and Visual

As identified in Table 25.1, interactions between Landscape and Visual and the following factors have been identified and assessed: Traffic and Transport, Biodiversity, Material Assets Agricultural, Non-agricultural Properties, Utilities, Resource & Waste Management and Built Heritage. There is also potential for these interactions to go beyond the proposed Project in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 of this EIAR.

Traffic and Transport: See section 25.4.2.1 above.

Biodiversity: See section 25.4.2.3 above.

Material Assets (Agriculture and Non-Agricultural): Potential for interactions between Landscape and Visual and Material Assets Agricultural and Non-agricultural properties has been noted for both the construction and operational phases. Land use change required to deliver the proposed Project will result in a change to the landscape character along the route, albeit recognising that several areas are identified for development in relevant land use plans. Notwithstanding this, CIE lands and 3rd party lands will be required for works associated with construction which will necessitate demolition of buildings, boundary walls and bridges and the use of small to medium sized open space and industrial areas for construction compounds. The latter will be reinstated following construction. The long term will see altered land use patterns associated with substations and track widening to facilitate 4 tracking and Heuston West Station.

Chapters 16 and 17 assess the impacts of the proposed Project on agricultural and non-agricultural material assets having regard to lands within CIE ownership, private lands and also the requirements of the compulsory purchase order for the proposed Project.

Material Assets (Utilities, Resource and Waste Management): Potential for interactions between Landscape and Visual and Material Assets Utilities, Resources and Waste Management have been noted for construction phase. This relates to the potential for re-use of materials arising on site for landscaping to achieve a better materials balance.

Chapters 18 and 19 assess the impacts of the proposed Project on Utilities and Resource and Waste Management having regard to options for reuse.

Built heritage: Interaction with the built heritage is anticipated at both construction and operation phases. The proposed Project will be delivered within a living heritage feature – the railway with potential to change the nature and setting of associated features notably bridges and boundary walls along the length of the proposed Project. Several heritage bridges and one heritage feature will be directly impacted by the proposed Project, permanently altering the historic landscape. Potential visual impacts on archaeological and cultural heritage features during the operational phase will be incurred as a result of changes in the character of the receiving historic environment. The route also passes through the Dublin City zone of archaeological potential.

Chapters 20 and 21 assess the impacts of the proposed Project on Built Heritage having regard to statutory heritage designations and associated legal protections.

25.4.3. Material Assets - Agriculture and Non- Agriculture

As identified in Table 25.1, interactions between Material Assets Agriculture and Non-agricultural Properties and the following factors have been identified and assessed: Biodiversity and Landscape and Visual. There is also potential for these interactions to go beyond the proposed Project in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 of this EIAR.

Biodiversity: See section 25.4.3 above.

Landscape and Visual: See section 25.4.2.9 above.

25.4.4. Material Assets – Utilities, Resources and Waste

As identified in Table 25.1, interactions between Material Assets including Utilities, Resources and Waste Management the following factors have been identified and assessed: Traffic and Transport, Land and Soils, and Landscape and Visual and EMF. There is also potential for these interactions to go beyond the proposed Project in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 of this EIAR.

Traffic and Transport: See section 25.4.2.1 above.

Land and Soils: See section 25.4.2.4 above.

Landscape and Visual: See section 25.4.2.9 above.

EMF: Interaction with EMF is possible primarily in relation to utilities during the operational phase of the project. Stray current has the potential to cause accelerated decay of certain types of material used in built services such as water mains, gas pipelines etc. unless protection distances are maintained. Similarly, interference can occur with other services where stray current may cause impact such as railway signalling. Chapter 23 assesses the impacts of the proposed Project in terms of EMF having regard both to impacts on the rail system and impacts from the rail system. Mitigation and embedded design measures are proposed to ensure separation/ protection distances are maintained.

25.4.5. Built Heritage

As identified in Table 25.1, interactions between Built Heritage and the following factors have been identified and assessed: Biodiversity and Landscape and Visual. There is also potential for these interactions to go beyond the proposed Project in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 of this EIA.

Biodiversity: See section 25.4.2.3 above.

Landscape and Visual: See section 25.4.2.9 above.

25.4.5.1. EMF

As identified in Table 25.1, interactions between EMF and the following factors have been identified and assessed: Biodiversity, Material Assets (including Utilities, Resources and Waste Management) and Human Health. There is also potential for these interactions to go beyond the proposed Project in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 of this EIA.

Biodiversity: See section 25.4.2.3 above.

Material Assets (including Utilities, Resources and Waste Management): See section 25.4.4 above.

Human Health: There is potential for interaction between EMF and human health during the operational phase of the proposed Project. International guidelines for limits on the levels of EMF required to protect the public and workers from established acute adverse health effects are published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The guidelines establish basic restrictions on exposure based on a systematic review of all available scientific evidence regarding health effects due to EMFs. The guidelines also provide reference levels on easily measured or estimated characteristics of EMFs that guarantee that the basic restrictions are satisfied if the reference levels are not exceeded. The ICNIRP limits have been adopted by the European Commission for the public and occupational exposure within EU Recommendation 1999/519/EC and the EMF Directive respectively. Exposure assessments have been made against the reference levels. Chapter 23 assesses the impacts of the proposed Project in terms of Human Health. Mitigation and embedded design measures are proposed to ensure protection of human health.

25.4.5.2. Human Health

As identified in Table 25.1, interactions between Human Health and the following factors have been identified and assessed: Traffic and Transport, Population, Air and Climate, Noise and Vibration and EMF. There is also potential for these interactions to go beyond the proposed Project in cumulation with other projects. The cumulative impact assessment is presented in Chapter 26 of this EIAR.

Traffic and Transport: See section 25.4.2.1 above.

Population: See section 25.4.2.2 above.

Air Quality: See section 25.4.2.7 above.

Noise and Vibration: See section 25.4.2.8 above.

EMF: See section 25.4.5.1 above.

25.5. References

EPA (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports.

European Commission (2009) Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions, EC DG X1 Environment, Nuclear Safety and Civil Protection.