Chapter 23
Human Health

Contents

23 Human Health

23.1 Introduction

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').

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 and human health; biodiversity, with particular attention to species and habitats protected under the Habitats and Birds Directives; land, soil, water, air and climate; material assets, cultural heritage and the landscape, and the interaction between the above factors.

This chapter of the Environmental Impact Assessment Report (EIAR) addresses the potential human health impacts relating to the construction and operation of the proposed DART+ South West Project.

The primary function of transport is the movement of people and goods between places, enabling access to employment, economic, and social opportunities as well as to essential services. Transport which is affordable and accessible may be viewed as an important determinant of health by facilitating access to key socio-economic opportunities. Inadequate transport provision may add to social exclusion among already vulnerable groups (Thomson, et al., 2008).

The proposed project represents a key opportunity for improving population health outcomes for the people of Dublin and those visiting the area. This aligns with the Healthy Ireland policy position to improve people's health and wellbeing (Department of Health, 2013). It also aligns with the National Planning Framework (NPF) Section 6.2 on healthy communities and Section 9.4 on creating a clean environment for a healthy society (Government of Ireland, 2018). The NPF states:

"*Our health and our environment are inextricably linked. Specific health risks that can be influenced by spatial planning include heart disease, respiratory disease, mental health, obesity and injuries. By taking a whole-system approach to addressing the many factors that impact on health and wellbeing and which contribute to health inequalities, and by empowering and enabling individuals and communities to make healthier choices, it will be possible to improve health outcomes, particularly for the next generation of citizens*."

Key features of the proposed Project that support population health are the more accessible and frequent public transport services, as well as the improvements in air quality and reduction in adverse health effects of climate change inherent to the electrification of the railway line. Challenges to public health are considered, including temporary construction disruption to the road, pedestrian and cycle network, and the potential for increased disturbance from more frequent rail services.

The chapter follows guidance and good practice, giving the public health perspective of impacts. In so doing, the chapter:

- Takes a population health approach to assessing physical and mental health outcomes;
- Considers the wider determinants of health, that may be significantly affected directly or indirectly;
- Assesses the potential for health inequalities to vulnerable groups; and
- Considers opportunities to improve the proposed Project to further benefit population health.

The potential for the proposed Project to change population health outcomes may arise from various health pathways. The effects on physical and mental health link to impacts are discussed throughout this EIAR. This chapter should be read in conjunction with the following chapters:

- Chapter 4 Project Description;
- Chapter 5 Construction Strategy;
- Chapter 6 Traffic and Transportation;
- Chapter 7 Population;
- Chapter 12 Air Quality;
- Chapter 13 Climate;
- Chapter 14 Noise and Vibration; and
- Chapter 22 EMF and Stray Current.

The health assessment takes as its input the residual effect conclusions of other EIA technical topic chapters (Chapters 6, 7, 12, 13, 14 and 22). In this regard the health assessment relies on the mitigation measures set out in those chapters and does not repeat them. This avoids duplication and keeps the assessment proportionate.

23.2 Legislation, Policy and Guidance

The key legislation and guidance referenced in the preparation of the EIAR is outlined in Chapter 1: Introduction (Sections 1.5, 1.6 and 1.7). Specific to human health, the following legislation, policy and relevant guidance has informed the assessment as outlined below.

23.2.1 Legislation

The human health assessment has been undertaken in accordance, inter alia, with the 2001 Act and the EIA Directive which address population and human health and conditions relating to same.

The following national legislation is relevant to the assessment of the effects on human health.

- As stated, 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 further amending the Transport (Railway Infrastructure) Act 2001;
- The Safety, Health and Welfare at Work etc Act 2005 (as amended);
- The Environmental Protection Agency Act 1992 (as amended);

- Environmental Noise Regulations 2018 (as amended).

A brief summary of the relevant legislation is provided below.

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 further amending the Transport (Railway Infrastructure) Act 2001 and addresses human health.

The Safety, Health and Welfare at Work etc Act 2005 (as amended) sets out the general duties on employers, including ensuring, so far as is reasonably practicable, that employees and individuals at the place of work who are not employees are not exposed to risks to their safety, health or welfare.

The Environmental Protection Agency Act 1992 (as amended) governs environmental exposures, including provisions in relation to nuisance.

The Air Quality Standards Regulations 2011 sets the regulatory thresholds for air quality. These are the standards considered acceptable in terms of public health protection in the Republic of Ireland.

The Environmental Noise Regulations 2018 (as amended) sets a common approach to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise.

23.2.2 Policy

The assessment has had due regard to relevant policy that include the following as outlined below.

- National Planning Framework 2040;
- National Development Plan (2021 – 2030);
- Smarter Travel - A Sustainable Transport Future (2009-2020);
- National Investment Framework for Transport in Ireland (2021);
- Healthy Ireland Framework 2019 – 2025 (HIF);
- Local Link Rural Transport Programme 2018 – 2022;
- Roadmap for Social Inclusion 2020 – 2025;
- Eastern and Midland Regional Spatial & Economic Strategy (2019-2031);
- Transport Strategy for the Greater Dublin Area (2016-2035);
- Dublin City Development Plan (2022-2028);
- South Dublin County Development Plan (2022-2028);
- The Kildare County Development Plan 2017-2023; and
- The Draft Kildare County Development Plan (2023-2029).

Further information on Health Policy Context is provided in Volume 4, Appendix 23.1 of this EIAR.

23.2.3 Guidance

The assessment has had due regard to relevant guidelines that include the following:

- Environmental Protection Agency (2022). Guidelines on the information to be contained in Environmental Impact Assessment Reports;
- Institute of Public Health (2021), Guidance, Standalone Health Impact Assessment and health in environmental assessment;
- Winkler, et al. (2021). International Association for Impact Assessment. Health Impact Assessment International Best Practice Principles, Special Publication Series No. 5, April 2021;
- International Association for Impact Assessment and European Public Health Association (2020). Human health: Ensuring a high level of protection. A reference paper on addressing Human Health in Environmental Impact Assessment as per EU Directive 2011/92/EU amended by 2014/52/EU;
- European Commission (2017). Environmental Impact Assessment of Projects: Guidance on Scoping (Directive 2011/92/EU as amended by 2014/52/EU); and
- Institute of Environmental Management and Assessment and the Faculty of Public Health (2017). Health in Environmental Impact Assessment: A Primer for a Proportionate Approach.

23.3 Methodology

23.3.1 Study Area

In the absence of any specific guidance, the study area has been defined in accordance with professional judgement.

Environmental health determinants (such as changes to air quality and noise exposure) typically have a local level impact where potential change in hazard exposure is limited by physical dispersion characteristics; as a result, a localised study area is reasonable. While socio-economic determinants of health have a potentially wider distribution.

On this basis, the study area for baseline data collection is made up of all Local Electoral Areas (LEAs) located within 250m of the proposed Project. Deprivation has been based off POBAL Ireland 2016 data in Small Areas.

The study area defining the relevant sensitive receptors identified for assessment purposes remains consistent with the inter-related technical disciplines assessed within the EIAR (e.g. air quality, noise, transport) to which the human health topic draws from and builds upon.

The proposed Project has been divided into four distinct geographic zones along the length of the corridor (Zones A to D) as outlined in Chapter 4 Project Description and summarised below. The proposed Project is described from west to east along the railway corridor.

- Zone A - Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station (refer to Section 4.6). This is Rural and Peri-Urban;
- Zone B - Park West & Cherry Orchard Station to Heuston Station (incorporating Inchicore Works) (refer to Section 4.7). This is Dense Urban;

- Zone C – Heuston Yard & Station (incorporating New Heuston West Station) (refer to Section 4.8). This is Dense Urban;
- Zone D - Liffey Bridge to Glasnevin Junction (Phoenix Park Tunnel Branch Line) (refer to Section 4.9). This is Dense Urban.

The following study areas are used in the health assessment:

- The 'site-specific' areas are the population close to the works within Zones A to D as outlined above. Indicatively these relate to Local Electoral Areas (LEAs) located within 250m of the proposed Project. These are: North Inner City, Ballymun, Crumlin-Kimmage, Cabra-Finglas, Ballyfermot-Drimnagh, Lucan, Clondalkin and Celbridge-Leixlip;
- The 'local' area is the local authority areas of Dublin City (most relevant to Zones B, C and D), South Dublin (Zone A) and Kildare (Zone A);
- The 'regional' area is the province of Leinster; and
- The 'national' area is Republic of Ireland (and beyond for global climate change effects).

As study areas do not necessarily define the boundaries of potential health effects, particularly mental health effects, the health chapter uses study areas to broadly define representative population groups, including in relation to sensitivity, rather than to set boundaries on the extent of potential effects.

The health assessment has regard to the zones of influence defined by other EIAR chapters that are inter-related technical disciplines for the health assessment. Those chapters provide data inputs to the health assessment. Those zones of influence are relevant and inform the health chapter's consideration of effect magnitude.

23.3.2 Survey Methodology

23.3.2.1 Desk Surveys

The following data sources have informed the health baseline assessment:

- CSO (CSO) Small Area Population Statistics (SAPS) Interactive Mapping Tool (CSO, 2016);
- CSO StatBank (CSO, n.d.); and
- Pobal HP Deprivation Index (Pobal, 2016).

23.3.2.2 Field Surveys

Data from the surveys undertaken as part of the inter-related technical disciplines have been used to inform the health assessment. These surveys inform the health assessment by identifying potentially sensitive receptors and community assets for these disciplines, such as schools, hospitals, residential properties, tourism and recreational amenities. No separate health field surveys have been undertaken.

23.3.3 Models / Tools Used in Assessment

No quantitative models/tools were used in the human health assessment. A qualitative assessment framework has been used to inform the professional judgments of health significance (Institute of Public Health, 2021).

23.3.4 Key Parameters for Assessment

A proportionate and evidence-based approach to the EIA health chapter scoping was undertaken. Scoping has had regard to the IPH list of determinants of health and population groups (Institute of Public Health, 2021).

This chapter covers the following issues.

Construction Phase health determinants:

- Transport: The potential health effect from changes to traffic nature and flow rate (active travel behaviour, access to services and road safety);
- Air quality: The potential health effect from changes in air quality (including PM_{10}, NO_2 and nuisance from dust);
- Noise: The potential health effect from changes in noise and vibration exposure; and
- Socio-economic status: The potential health benefits due to socio-economic factors (income and employment).

Operation Phase health determinants:

- Transport: The potential health effect due to improved operating capacity of rail services and improved active travel infrastructure;
- Air quality: The potential health effect from changes in air quality associated with electrification of a large proportion of the rail fleet and additional rail movements;
- Noise: The potential health effect from changes in noise and vibration exposure;
- Socio-economic status: The potential health benefits due to socio-economic factors (income and employment); and
- Electro-magnetic fields: The potential health effect due to EMF exposure.

23.3.5 Assessment Criteria and Significance

23.3.5.1 General Approach

This section sets out the methods for assessment of any likely significant population health effects of the proposed Project.

Regard has been had to the EPA (2022) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. The guidelines provide generic definitions for significance, but also note that when more specific definitions exist within a specialised factor or topic, these should be used in preference to the generalised definitions. In the case of Human Health, specific definitions are set out by IPH (2021). This assessment follows the IPH (2021) definitions and

approach relevant to determining health sensitivity, health magnitude and health significance in an EIA context.

The methodology outlined in this section follows the IPH 2021 guidance, which sets out best practice for the consideration of health in EIA. The IPH guidance was informed by the international consensus publication between impact assessment and public health practitioners, the IAIA/EUPHA Reference Paper 2020.

Where significant adverse population health effects are identified, including for vulnerable groups, then mitigation has been proposed to avoid or reduce the effects. Mitigation is secured as part of the proposed Project design or development consent. In line with good practice the proposed Project takes a proportionate approach to identifying opportunities to enhance beneficial population health effects, including for vulnerable groups.

Cumulative effects are considered, including inter-related effects of the proposed Project. This analysis considers how the same geographic or vulnerable group populations may be affected by more than one change in relevant health determinants, for example the combined effects of changes in air quality and noise on population health outcomes.

Where proportionate, the need for monitoring has been considered, including relevant governance.

23.3.5.2 Determinants of health, risk factors and health outcomes

The chapter uses the World Health Organization (WHO) definition of health, which states that health is a "*state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity*" (World Health Organization, 1948).

The chapter also uses the WHO definition for mental health, which is a "*state in which every individual realises his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community*" (World Health Organization, 2022).

Health and wellbeing are influenced by a range of factors, termed the 'wider determinants of health'. Determinants of health span environmental, social, behavioural, economic and institutional factors. Determinants therefore reflect a mix of influences from society and environment on population and individual health.

Impacts of the proposed Project that result in a change in determinants have the potential to cause beneficial or adverse effects on health, either directly or indirectly. The degree to which these determinants influence health varies, given the degree of personal choice, location, mobility and exposure.

A change in a determinant of health affects does not equate directly to a change in population health. Rather the change in a determinant alters risk factors for certain health outcomes. The assessment considers the degree and distribution of change in these pathways. The analysis of health pathways focuses on the risk factors and health outcomes that are most relevant to the determinants of health affected by the proposed Project. As there are both complex and wide-ranging links between determinants of health, risk factors and health outcomes, it would not be proportionate or informative for an assessment to consider every interaction.

Typically, the change in a risk factor may need to be large, sustained and widespread within a population for there to be a significant influence on public health outcomes.

23.3.5.3 Population Health Approach and Vulnerable Groups

In line with IPH guidance a population health approach has been taken, informed by discussion of receptors within the other technical chapters of the EIAR.

For each determinant of health, the human health chapter identifies relevant inequalities through consideration of the differential effect to the 'general population' of the relevant study area and effects to the 'vulnerable population group' of that study area. The vulnerable population group being comprised of relevant sensitivities for that determinant of health. The following population groups have been considered:

- The 'general population' including residents, visitors, workers, service providers, and service users; and
- The 'vulnerable group population'.

The methods draw on the list of vulnerable population groups set out in IPH Part 3, Table 09. The following six broad population groups are used to inform a consistent narrative on potential health inequalities across the assessment, people falling into more than one group may be especially sensitive:

- Young age: Children and young people (including pregnant women and unborn children).
- Old age: Older people (particularly frail elderly).
- Low income: People on low income, who are economically inactive or unemployed/workless.
- Poor health: People with existing poor health; those with existing long-term physical or mental health conditions or disability that substantially affects their ability to carry out normal day-to-day activities.
- Social disadvantage: People who suffer discrimination or other social disadvantage, including relevant protected characteristics under the Irish Human Rights and Equality Commission Act 2014[1] or groups who may experience low social status or social isolation for other reasons.
- Access and geographical factors: People experiencing barriers in access to services, amenities and facilities and people living in areas known to exhibit high deprivation or poor economic and/or health indicators.

The following general characterisations of how the 'general population' may differ from 'vulnerable group populations' were considered when scoring sensitivity. These statements are not duplicated in each assessment and apply (as relevant) to the issues discussed for both construction and operation.

- In terms of life stage, the general population can be characterised as including a high proportion of people who are independent, as well as those who are providing some care. By

[1] For example, disadvantage by reference to the following factors: gender; civil status; family status; sexual orientation; religious belief; age; disability; race, including colour, nationality, ethnic or national origin; or membership of the Traveller community.

contrast, the vulnerable group population can be characterised as including a high proportion of people who are providing a lot of care, as well as those who are dependant.

- The general population can be characterised as experiencing low deprivation. However, the professional judgment is that the vulnerable group population experiences high deprivation (including where this is due to pockets of higher deprivation within low deprivation areas).
- The general population can be characterised as broadly comprised of people with good health status. Vulnerable groups, however, tend to include those parts of the population reporting bad or very bad health status.
- The general population tends to include a large majority of people who characterise their day-to-day activities as not limited. The vulnerable group population tends to represent those who rate their day-to-day activities as limited a little or limited a lot.
- Based on a professional judgement the general population's resilience (capacity to adapt to change) can be characterised as high whilst the vulnerable group population can be characterised as having limited resilience.
- Regarding the usage of affected infrastructure or facilities, the professional judgement is that the general population are more likely to have many alternatives to resources shared with the proposed Project. For the vulnerable group population, the professional judgement is that they are more likely to have a reliance on shared resources.

23.3.5.4 Temporal Scope

The temporal scope of the assessment is consistent with the period over which the proposed Project will be carried out and therefore covers the construction and operational periods. It is anticipated that construction activity will take place over an approximate 50 month construction period (refer to Section 5.8 of Chapter 5 of this EIAR). The assessment does not place an end date on the operations of the proposed Project.

The following temporal scope definitions set out in the EPA (2022) guidelines provide consistency of terminology:

- Momentary Effects are those lasting from seconds to minutes.
- Brief Effects are those lasting less than a day.
- Temporary Effects are those lasting less than a year.
- Short-term Effects are those lasting one to seven years.
- Medium-term Effects are those lasting seven to fifteen years.
- Long-term Effects are those lasting fifteen to sixty years.
- Permanent Effects are those lasting over sixty years.

23.3.5.5 Determining Effect Significance

The assessment of EIA health significance is an informed expert judgement about what is important, desirable or acceptable for public health with regards to changes triggered by the proposed Project. These judgements are: value dependant (underpinned by scientific data, but also informed by

professional perspectives); and are context-dependent (judgements reflect relevant social, economic and political factors for the population). This is consistent with current best practice guidance (European Commission, 2017).

The determination of significance has two stages:

- Firstly, the sensitivity of the receptor affected, and the magnitude of the effect upon it are characterised. This establishes whether there is a relevant population and a relevant change to consider; and
- Secondly, a professional judgement is made as to whether the expected change in a population's health outcomes would be significant in public health terms. This judgement is explained using an evidence-based narrative setting out reasoned conclusions.

Table 23.3 and Table 23.4 together summarise the assessment methodology that have been adopted. This approach shows how the general EIA methods of using sensitivity and magnitude to inform a judgement of significance, are applied for human health. The approach uses professional judgement, drawing on consistent and transparency criteria for sensitivity and magnitude. It also references relevant contextual evidence to explain what significance means in public health terms.

The EIA human health assessment uses qualitative analysis following the IPH 2021 guidance approach. This draws on qualitative and quantitative inputs from other EIAR topic chapters. This is considered the most appropriate methodology for assessing wider determinants of health proportionately, consistently and transparently. The IPH 2021 approach is presented in a tabulated format for consistency with other EIA topics.

The EIA health chapter conclusions are both EIA scores, such as major, moderate, minor or negligible; and a narrative explaining this score with reference to evidence, local context and any inequalities.

Table 23.1: Health Sensitivity Methodology Criteria

Category/ Score	Indicative Criteria (judgment based on most relevant criteria, it is likely in any given analysis that some criteria will span score categories) The narrative explains that the population or sub-population's sensitivity is driven by (select as appropriate):
High	**High** levels of deprivation (including pockets of deprivation); **reliance** on resources shared (between the population and the project); existing **wide** inequalities between the most and least healthy; a community whose outlook is predominantly anxiety or **concern**; people who are **prevented** from undertaking daily activities; **dependants**; people with **very poor** health status; and/or people with a **very low** capacity to adapt.
Medium	**Moderate** levels of deprivation; **few alternatives** to shared resources; existing **widening** inequalities between the most and least healthy; a community whose outlook is predominantly **uncertainty** with some concern; people who are **highly limited** from undertaking daily activities; people providing or requiring **a lot of care**; people with **poor** health status; and/or people with a **limited** capacity to adapt.
Low	**Low** levels of deprivation; **many alternatives** to shared resources; existing **narrowing** inequalities between the most and least healthy; a community whose outlook is predominantly **ambivalence** with some concern; people who are **slightly limited** from undertaking daily activities; people providing or requiring **some care**; people with **fair** health status; and/or people with a **high** capacity to adapt.
Negligible	**Very low** levels of deprivation; **no** shared resources; existing **narrow** inequalities between the most and least healthy; a community whose outlook is predominantly **support** with some concern; people who are **not limited** from undertaking daily activities; people who are independent (not a carer or dependant); people with **good** health status; and/or people with a **very high** capacity to adapt.

Table 23.2: Health Magnitude Methodology Criteria

Category/ Score	Indicative Criteria (judgment based on most relevant criteria, it is likely in any given analysis that some criteria will span score categories) The narrative explains that the project change has (select as appropriate):
High	**High** exposure or scale; **long-term** duration; **continuous** frequency; severity predominantly related to **mortality** or changes in morbidity (physical or mental health) for very severe illness/injury outcomes; **majority** of population affected; **permanent** change; **substantial** service quality implications.
Medium	**Low** exposure or **medium** scale; **medium-term** duration; **frequent** events; severity predominantly related to moderate changes in **morbidity** or major change in quality-of-life; **large minority** of population affected; **gradual** reversal; **small** service quality implications.
Low	**Very low** exposure or **small** scale; **short-term** duration; **occasional** events; severity predominantly related to minor change in **morbidity** or moderate change in quality-of-life; **small minority** of population affected; **rapid** reversal; **slight** service quality implications.
Negligible	**Negligible** exposure or scale; **very short-term** duration; **one-off** frequency; severity predominantly relates to a minor change in **quality-of-life**; very few people affected; immediate reversal once activity complete; no service quality implication.

Table 23.3: Assessment Matrix (Indicative)

Sensitivity	Magnitude of Impact			
	Negligible	**Low**	**Medium**	**High**
Negligible	Negligible	Negligible or minor	Negligible or minor	Minor
Low	Negligible or minor	Negligible or minor	Minor	Minor or moderate
Medium	Negligible or minor	Minor	Moderate	Moderate or major
High	Minor	Minor or moderate	Moderate or major	Major

Where the matrix offers more than one significance option, professional judgement is used to decide which option is most appropriate.

Table 23.4: Health Significance Methodology Criteria

Category/ Score	Indicative criteria (judgment based on most relevant criteria, it is likely in any given analysis that some criteria will span score categories) The narrative explains that this is significant for public health because (most relevant statements used as appropriate):
Major	• Changes, due to the project, have a **substantial** effect on the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by referencing relevant policy and effect size (magnitude and sensitivity scores), and as informed by consultation themes among stakeholders, particularly public health stakeholders, that show **consensus** on the importance of the effect. • Change, due to the project, could result in a regulatory threshold or standard being **crossed** (if applicable). • There is likely to be a **substantial** change in the health baseline of the population, including as evidenced by the effect size and scientific literature showing there is a **causal** relationship between changes that would result from the project and changes to health outcomes. • In addition, health priorities for the relevant study area are of **specific** relevance to the determinant of health or population group affected by the project.
Moderate	• Changes, due to the project, have an **influential** effect on the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by referencing relevant policy and effect size, and as informed by consultation themes among stakeholders, which may show **mixed views**. • Change, due to the project, could result in a regulatory threshold or standard being **approached** (if applicable). • There is likely to be a **small** change in the health baseline of the population, including as evidenced by the effect size and scientific literature showing there is a **clear** relationship between changes that would result from the project and changes to health outcomes. • In addition, health priorities for the relevant study area are of **general** relevance to the determinant of health or population group affected by the project.
Minor	• Changes, due to the project, have a **marginal** effect on the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by effect size of limited policy influence and/or that **no** relevant consultation themes emerge among stakeholders. • Change, due to the project, would be **well within** a regulatory threshold or standard (if applicable). • There is likely to be a **slight** change in the health baseline of the population, including

Category/ Score	Indicative criteria (judgment based on most relevant criteria, it is likely in any given analysis that some criteria will span score categories) The narrative explains that this is significant for public health because (most relevant statements used as appropriate):
	as evidenced by the effect size and/or scientific literature showing there is only a **suggestive** relationship between changes that would result from the project and changes to health outcomes. • In addition, health priorities for the relevant study area are of **low** relevance to the determinant of health or population group affected by the project.
Negligible	• Changes, due to the project, are **not related** to the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by effect size or lack of relevant policy, and as informed by the project having **no responses** on this issue among stakeholders. • Change, due to the project, would **not affect** a regulatory threshold or standard (if applicable). • There is likely to be a **very limited** change in the health baseline of the population, including as evidenced by the effect size and/or scientific literature showing there is an **unsupported** relationship between changes that would result from the project and changes to health outcomes. • In addition, health priorities for the relevant study area are **not** relevant to the determinant of health or population group affected by the project.

Population Health Effects that are scored Major or Moderate are considered significant in terms of the EIA Regulations.

Ultimately a likely significant health effect is one that should be brought to the attention of the determining authority, as the effect of the proposed Project is judged to provide, or be contrary to providing, a high level of protection to population health. This may include reasoned conclusions in relation to health protection, health improvement and/or improving services.

Where significant adverse effects are identified, mitigation is considered to reduce the significance of such effects. Similarly, enhancements are considered where significant and proportionate opportunities to benefit population health are identified.

23.3.6 Consultation

The overall project stakeholder and public consultation undertaken in respect of the Project is set out in the Public Consultation No. 1 Findings Report (for PC1) and Public Consultation No. 2 Findings Report (for PC2) which are included in Volume 4, Appendix 1.3 and 1.4. All feedback was collated, including feedback specific to the EIAR topic 'Human Health'. This feedback has informed this chapter including the baseline and impact assessment presented.

Specific consultation was also undertaken with key stakeholders in relation to EIA Scoping. A summary of the issues raised in relation to the scope of the EIA is included in Volume 4, Appendix 1.2. Feedback on the scope and level of detail of the assessment, data sources and methodologies as they pertain to the EIAR topic 'Human Health' have been reviewed and have influenced this chapter of the EIAR.

Specific consultation was also undertaken with representatives of various Departments in Kildare, South Dublin and Dublin City Councils. This included a combination of presentations, workshops and meetings to discuss the project, technical design issues and environment and planning matters.

Nine pre-application meetings were held with ABP to explain the project and present technical and environmental information. A summary of the information presented and the environmental issues discussed at the nine meetings is provided in Volume 4, Appendix 1.6. Feedback relevant to the topic 'Human Health' has been reviewed and has influenced this chapter of the EIAR.

23.3.7 Difficulties Encountered / Limitations

This assessment is based on publicly available statistics and evidence sources. No new primary research or bespoke analysis of non-public data was undertaken for the assessment.

Health and wellbeing data provided by the Institute of Public Health Community Profile Tool has been unavailable throughout 2022 due to ongoing updates to their database. Available statistics from other sources have been collected and presented.

Such limitations do not affect the robustness of the assessment for EIA purposes.

23.4 Receiving Environment

23.4.1 Introduction

Different communities have varying susceptibilities to health impacts and benefits as a result of social and demographic structure, behaviour and relative economic circumstances.

The aim of the following information, which summarises the more detailed health and wellbeing baseline information provided in Volume 4, Appendix 23.2 of this EIAR, is primarily to put into context the local health circumstance of the communities along the proposed Project route, drawing from available statistics. Where possible, data has been collected for relevant Local Electoral Areas, to compare against the national (Ireland) average. Where Local Electoral Area-level information is not available, county and/or regional data has been collected as these are considered representative alternative geographies.

This is then applied in identifying, informing and refining health supporting design features tailored to support local community health needs, and the delivery of public health objectives/priorities.

It should be noted that the description of the whole population, and the populations within the local and wider study area, does not exclude the probability that there will be some individuals or groups of people who do not conform to the overall profile.

Note: *The Institute of Public Health Community Profile Tool is currently unavailable (at the time of finalising this report) due to ongoing updates to the database. Therefore, the data from Appendix 23.2 (collected in early 2021) has been incorporated and summarised below.*

23.4.2 Nearby Sensitive Receptors

Consistent with guidance for the assessment of human health in EIA (Institute of Public Health, 2021; International Association for Impact Assessment and European Public Health Association, 2020), the human health chapter takes a population health approach. The receptors for the assessment are therefore the population groups described in Section 23.3.5.3. In considering how these populations, particularly vulnerable groups, may be affected, regard has been had to specific built environment or community asset receptors (e.g. dwellings, schools or healthcare facilities). These are set out in other relevant EIAR chapters, for example see: Chapter 7 Population Section 7.4.4; Chapter 12 Air quality

Section 12.4; and Chapter 14 Noise Section 14.4. The health assessment references such individual receptors where appropriate, e.g. St. James Hospital or St. Patrick's University Hospital, but reaches conclusions on the implications for population health. All community locations are assumed to include vulnerable population groups.

23.4.3 Population, Socio-Economic Circumstance and Deprivation

The study area population is more youthful than the national average, with a higher proportion of 20 – 39 year olds. In terms of socio-economic circumstance, there is a slightly higher proportion of people within the study area who are employed than nationally, however unemployment is also slightly higher in the study area compared to the national average.

Income within the study area has consistently been higher than the national average (since 2011), and has been gradually increasing, following the national trend. In terms of occupation, the majority of the study area population work in the "commerce and trade" industry, closely followed by "professional services" and "other" industries.

Deprivation within the study area Electoral Divisions is relatively low, with the majority (45%) of the population categorised as "marginally above average". However, it is worth noting that 29% of the study area population are categorised as "disadvantaged".

23.4.4 Life Expectancy and Physical Health

Male and female life expectancy within the study area has been increasing since 2002, following the national trend. Male life expectancy has consistently been similar to or slightly higher than the national average, and female life expectancy has fluctuated slightly below or above the national average.

The majority (55%) of people living with the study area have rated their health as "very good", which is slightly lower than the national average (59%). The proportion of the population living within the study area who rate their health as "bad" (2%) is slightly higher than the national average (2%). Regarding disability prevalence, there is a slightly higher proportion of the population in the study area with a disability when compared to Ireland.

Mortality from all causes as well as cancer mortality have been relatively static over the years, and both consistently lower than the national average. Mortality from circulatory and respiratory diseases have both also been consistently lower than the national average, with the former being mostly static, and the latter showing an increasing trend overall since 2013.

Hospital admissions for all causes have been generally increasing since 2011 but has consistently been lower than the national average. Hospital admissions for respiratory disease has also been increasing since 2011, with figures very similar to the national average and following a similar trend. Circulatory disease admissions, however, show a decreasing trend overall with a sharp decline in figures since 2014, and are also consistently lower than the national average.

23.4.5 Mental Health

Hospital admissions for anxiety and depression were static and very similar to the national trend until 2014, after which they show a sharp increase from 1.6 to 16.8 per 100,000 population in 2015. Despite this, the proportion of the population receiving benefits for anxiety and/or depression has

been decreasing between 2011 and 2015 (although it has consistently been slightly higher than the national average).

Mortality from suicide and intentional self-harm has been decreasing within the study area since 2010 and has consistently been below the national average.

23.4.6 Lifestyle and Behavioural Risk Factors

Drug and alcohol related hospital admissions in the study area have both been consistently higher than the national average and have been increasing overall between 2010 and 2015. Conversely, mortality from smoking and alcohol-related causes has been consistently lower than the national average, with the former being relatively static over the years, and the latter showing a decreasing trend overall.

The 33% of the population within the study area are classified as overweight, which is slightly lower than the national average (35%). The proportion of the population who are classified as obese within the study area is the same as that across Ireland (18%).

23.4.7 Local Health Priorities

Local health priorities for Dublin South, Kildare & West Wicklow (HSE, 2019) include:

- To complete the implementation of the Healthy Ireland Plan which outlines actions to be taken locally to improve the health and wellbeing of service users, staff and local communities;
- To continue to improve services offered within:
    - Primary care;
    - Mental health;
    - Disability services; and
    - Older persons services.

23.5 Evolution of the Environment in the Absence of the Project (Do Nothing)

Annex IV of the EIA Directive sets out the information required to be included in an EIAR. This includes "*a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the Proposed Development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge*".

In the event that the proposed Project does not proceed, an assessment of the future baseline conditions has been carried out and is described within this section.

Longer term trends and interventions in population health may influence the future baseline. Health and social care, public health initiatives and government policies aim to reduce inequalities and improve quality of life. The historic success of such interventions is increasingly challenged by national trends such as an aging population, rising levels of obesity and the COVID-19 pandemic. The implications of COVID-19 for public health will take years to be reflected within statistical data

releases, but it is expected that the pandemic will have exacerbated public health challenges. The pandemic disproportionately affected vulnerable groups, including due to age and ill-health.

Climate change may also exacerbate physical and mental health risk factors, particularly around flooding and extremes of temperature. Typically, low resource groups, e.g. in areas of high deprivation, are most sensitive to the adverse health effects of climate change.

To reflect these trends the assessment scores all vulnerable groups as having high sensitivity for all determinants of health. This appropriately captures any increase sensitivity within the future baseline.

It would not be proportionate (or consistent with the qualitative assessment approach taken) to quantitatively model the population's future health. This reflects the complexities of interactions between the wider determinants of health, as well as the potential for macro-economic changes in the next decade that are hard to predict. Any prediction would have such wide error margins that it would greatly limit the value of the exercise.

23.6 Description of Potential Impacts

23.6.1 Potential Construction Impacts

23.6.1.1 Transport

This section of the health assessment draws on inputs from Chapter 6 Traffic and Transportation and Chapter 7 Population. See Chapter 6 Traffic and Transportation for the conclusions of the transport assessment and for the embedded mitigation measures taken into consideration during this assessment of effects on human health. Also see Chapter 7 Population (Section 7.4.4.6, including Figure 7-7) for the locations of healthcare facilities, including general practice surgeries and hospitals.

This section considers the health implications of changes in road traffic and road works affecting road safety, travel times, accessibility and active/sustainable travel for community residents and emergency services. In relation to the latter, St. James Hospital (including A&E) is located within c. 790m from Heuston Station and St. Patrick's University Hospital (including mental health services) is located within c. 520m from Heuston Station, (both relate to Zone B).

The construction stage for the proposed Project is in total expected to take place over approximately 50 months. The construction activities comprise a number of distinct activities. Some of these activities are sequential and some are concurrent. The effects at any given location are therefore typically of a much shorter duration.

A key feature of the construction works relevant to transport impacts are the bridge works (see Chapter 6, Figure 6-3 for their locations and Table 6.26 for anticipated duration of closure). These works involve a number of diversions whilst bridges are replaced. The four bridges being fully replaced are Le Fanu Road Bridge, Kylemore Road Bridge, Khyber Pass Footbridge and Memorial Road Bridge. Additionally, the Sarsfield Road Bridge will require a replacement deck. All of these bridges are located in Zone B: Park West & Cherry Orchard Station to Heuston Station. The Glasnevin Cemetery Road Bridge will require a replacement deck. This is located within Zone D: Liffey Bridge to Glasnevin Junction (Phoenix Park Tunnel Branch Line).

There will also be a single lane closure at the South Circular Road junction where construction works will occur in two phases, and the layout of the junction will be modified at each phase such that there will be an alteration to traffic movements.

The diversions have the potential to impact on population health through a number of pathways, including:

- Active travel behavioural change, which may occur where pedestrian and cycle routes are not available for a period of time or the amenity of available routes is adversely affected;
- Journey time and accessibility of healthcare facilities, which may affect routine care and emergency care. Journey times to other social infrastructure, such as education, social care or shops providing affordable heathy foods may also be affected; and
- Road safety, which may be affected by a change in traffic volumes or speeds.

For active travel, health effects may relate to physical health (e.g. cardiovascular health) and mental health conditions (e.g. stress, anxiety or depression) associated with obesity and levels of physical activity. For accessibility, health effects may be associated with emergency response times or non-emergency treatment outcomes associated with delays or non-attendance. For road safety, health effects may be associated with the severity or frequency of road traffic incidents.

The potential health effect is considered likely because there is a plausible source-pathway-receptor relationship:

- The source is vehicles on the road network or changes in routes that link community residential, commercial or amenity services;
- The pathway is changes in access or journey time, as well as in accidents or safety; and
- Receptors are local road users, including those using motor vehicles, pedestrians and cyclists, and emergency services.

Furthermore, the potential effect is probable as no highly unusual conditions are required for the source-pathway-receptor linkage.

The scientific literature indicates that there is an association between the transport changes and road safety, travel times, accessibility and active travel. The literature does not identify particular thresholds for effects. The assessment has had regard to the population groups identified in the literature that may be particularly sensitive. For example, children, pregnant women and cyclists (particularly older cyclists) are generally more vulnerable in terms of road safety. Older people may particularly benefit from staying physically active. People with lower socio-economic status typically face more transportation barriers in accessing health care.

The population groups relevant to this assessment are:

- The ‘site-specific’ geographic population affected by diversions in Zones B and D;
- The ‘local’ population of Dublin City (most relevant to bridge work diversions in Zones B and D);
- The sub-population vulnerable due to:

- Young age vulnerability (children and young people as potentially more vulnerable road users);
- Old age vulnerability (older people as potentially more vulnerable road users);
- Low income vulnerability (people living in deprivation, including those on low incomes for who travel costs or alternatives may be limiting);
- Poor health vulnerability (people with existing poor physical and mental health in relation to health trip journey times); and
- Access and geographical vulnerability (people who experience existing access barriers or for whom close proximity to project change increases sensitivity).

The assessment covers these populations within two groups. The general population for the geographic area, notably Dublin City Council residents and visitors, and the vulnerable group population for the area. The latter is a sub-population comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

The sensitivity of the general population is low. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in Section 23.3.5.3. The general population comprise those members of the community in good physical and mental health and with greater resources to respond to change. This reflects that most people in the site-specific areas of Zone B and D and local area (Dublin City) would only make occasional use of the affected road network. The score also reflects the ability to adapt to changes in traffic conditions during the bridge works. Whilst the road network represents a shared resource with the proposed Project, the network by nature enables alternative routes to be used.

The sensitivity of the vulnerable group population is high. Vulnerability in this case is linked to mode of travel, including pedestrians and cyclists; age (young people and older people); frequent use of services accessed on affected sections of the highway network (e.g. traveling to schools); and deprivation. Deprived populations may already face more access barriers compared to the general population and therefore be more sensitive to access changes. Low incomes may compound access barriers by restricting adaptive response. Vulnerability also includes those accessing health services (emergency or non-emergency) at times and locations where there may be some increase in congestion. This sub-population may have fewer resources and less capacity to adapt to changes. The population may therefore be more reliant on the affected routes with greater likelihood that any disruption or disturbance could affect health outcomes.

23.6.1.1.1 Key Findings

This section summaries the key findings from Chapter 6 and reflects on various health considerations and implications

Chapter 6 provides a residual effect conclusion for the construction stage that the overall impact for each of the diversions is considered to be temporary but significant.

In relation to active travel, Chapter 6 finds that for pedestrians, cyclists and mobility impaired, in the majority of cases journey times are reported as only having a slight negative effect (see Table 6.37). This reflects provision of temporary bridge crossings. In a few cases effects are greater. The Khyber

Pass Footbridge (OBC5) has a long diversion for an extended period without a temporary crossing option. This is a private footbridge for Iarnród Éireann employees (not general public use) to access the Inchicore Works / depot complex from the north of the railway. This is rated as a significant negative effect and is expected to result in a modal shift for staff. The Sarsfield Road Bridge (UBC4) closure (5-7) days is also rated as a significant as the diversion is longer and along the Chapelizod dual carriageway, which may discourage less confident cyclists.

In relation to journey time delay, significant negative effects are expected for all diversions and the single lane closure at South Circular Road junction (see Tables 6.29, 6.31, 6.33 and 6.36). This is discussed further in Chapter 6, including expectations that effects will reduce over time as people avoid the more congested routes.

For vehicular road safety, prior to mitigation, the Chapter 6 assessment identifies slight negative effects for the diversions associated with lack of familiarity or frustration with delays (see Tables 6.29, 6.31, 6.33 and 6.36).

For pedestrian and cyclist road safety (see Table 6.37), prior to mitigation, Chapter 6 identifies predominantly slight negative effects. Moderate negative effects are predicted for the Sarsfield Road Bridge (UBC4) closure (5-7 days) and the temporary junction modifications at South Circular Road (OBC1) interchange due to new or additional crossing points. A slight positive effect is expected at the Le Fanu Road Bridge (OBC7) temporary diversion as a segregated crossing is provided where segregation was not previously provided.

Chapter 7 notes the potential construction stage effect on local services is negative, indirect, slight to moderate, temporary to short-term.

23.6.1.1.2 Assessment of Impacts

In relation to active travel, for the health assessment these conclusions indicate that the scale of change is in most cases small and temporary. The Sarsfield Road Bridge (UBC4) closure of 5-7 days is not expected to be sufficiently long to change active travel behaviours in the local population. In contrast the longer duration of the Khyber Pass Footbridge (OBC5) closure (approximately 3 years), is likely result in behavioural change for staff away from pedestrian use. It is a positive feature of the proposed Project that in many cases there are temporary bridge replacements, and these provide alternative crossing suitable for pedestrians, cyclists and mobility impaired. These temporary accesses mitigate against many changes to active travel behaviours and in some cases may encourage increased active travel given the alternative of longer car journey times. In terms of severity, there may be a minor change in quality-of-life and morbidity (e.g. burden of cardiovascular disease and/or mental health) for a small minority of the local population associated with some discouragement of physical activity. Outcome reversal would likely be rapid for temporary disruption to active travel behaviour but may persist for longer duration effects that establish new modal behaviours.

In relation to health-related travel times and accessibility the scale of change in delays could be medium to high, albeit temporary. The frequency with which health related journeys may be affected is likely to be occasional for most people; though for a few people, severity could relate to a small change in risk for morbidity or mortality associated with time critical treatment. Ambulance services (and the recipients of their care) are particularly sensitive to delays in response times (time taken to arrive and stabilise the patient). Even with the delays described in Chapter 6, the priority given to

ambulances travelling under blue lights would be expected to reduce any changes in journey times. Given the location of general practice surgeries in areas expected to experience increased journey times, as well as St. James Hospital and St. Patrick's University Hospital (east of the bridges, on the south side of the railway line), there are potentially some implications for healthcare services. Mitigation in terms of early and ongoing information sharing with healthcare services are discussed in Section 23.7.1.1. Due to the temporary nature of the work and ability for people to adapt to known planned roadworks, the delays are not expected to significantly change population health outcomes from accessing other social infrastructure such as outdoor spaces, shops, employment and educational facilities.

In relation to road safety the scale of change in accidents would be small to negligible, with the duration of such change short-term. The frequency of any incidents would be one-off or occasional, with severity related to a very minor change in risk of injury or mortality (though with outcome reversal gradual or permanent). The very short duration of the Sarsfield Road Bridge (UBC4) closure limits the potential for the increased risk to result in actual injury. Mitigation for this crossing and the South Circular Road (OBC1) interchange works are discussed in Section 23.7.1.1. The expectation is that very few people would be affected, with no or slight implications for healthcare services.

Based on the above points, it is concluded for the health assessment that the magnitude of the change due to the proposed Project is medium.

The significance of the population health effect for this determinant of health is moderate adverse (significant). The professional judgment is that there may be a small, albeit temporary, change in the health baseline due to some localised effects around: active travel discouragement, particularly at the Kyber Pass bridge; healthcare journey time delays, including for hospitals; and road safety, including at South Circular Road interchange. Such changes have the potential to widen inequalities, particularly for site-specific populations close to the bridge closures who already experience high levels of deprivation. This conclusion reflects that scientific literature of clear associations between health outcomes and active travel, healthcare access and road safety. Furthermore, there is a policy context of promoting community health and reducing health inequalities, the delivery of which may be influenced, albeit in a localised and temporary way, by the proposed Project's construction.

23.6.1.2 Air Quality

This section of the health assessment draws on inputs from Chapter 12 Air Quality. See Chapter 12 Air Quality for the conclusions of the air quality assessment and for the embedded mitigation measures taken into consideration during this assessment of effects on human health.

This section considers construction related emissions, including dust and road traffic emissions. The latter relate to changes due to diversions affecting the distribution of traffic, as well as construction traffic movements for the workforce and materials. Dust effects relate to both construction compounds and activities such as the demolition and reconstruction of Le Fanu Road Bridge (OBC7), Kylemore Road Bridge (OBC5A) and Memorial Road Bridge (OBC3).

The Chapter 12 Air Quality assessment has regard to the statutory air quality limit values set in the Air Quality Regulations (S.I. No. 180 of 2011) for health protection, but also discusses the context of World Health Organization (WHO) guideline values. The WHO aspirational values are much lower and are not met by the baseline conditions. The changes due to the proposed Project in relation to both measures are very small.

For construction dusts (predominantly relevant to discussion of PM_{10}), the main health outcomes are likely to relate to exacerbation of existing conditions, such as asthma or chronic obstructive pulmonary disease (COPD) i.e. airway inflammation by coarse Particulate Matter (PM) and to reductions in wellbeing associated with annoyance or reduced amenity. Whilst other outcomes (e.g. cardiovascular events) may be relevant in the event of short-term high concentrations, such elevated exposures are expected to be avoided though the embedded standard good practice mitigation described in Chapter 12.

For transport combustion engine emissions (predominantly relevant to discussion of NO_2 and $PM_{2.5}$), the main health outcomes are likely to relate to increased risk of cardiovascular and respiratory related conditions or events (including reduced lung function, hypertension and myocardial infraction) i.e. due to fine PM and NO_2 interacting within the body, as well as general measures of population mortality and hospital service use (e.g. emergency department visits). Such outcomes relate generally to long-term ambient exposure, but may also be affected by short-term exposure peaks, e.g. due to meteorological conditions reducing normal levels of pollutant dispersion. For both $PM_{2.5}$ and NO_2 there is no identifiable threshold below which there is no risk to health (WHO Regional Office for Europe, 2013; COMEAP, 2011).

The potential effect is considered likely because there is a plausible source-pathway-receptor relationship:

- Sources: dust mobilised by construction activities, as well as combustion related particulates and emissions from vehicles;
- The pathway: dispersion through the air; and
- Receptors: people living and working close to the construction activities.

Furthermore, the potential effect is probable as no highly unusual conditions are required for the source-pathway-receptor linkage.

The population groups relevant to this assessment, due to either proximity or other sensitivity are:

- The ‘site-specific’ geographic population affected by diversions, proximity to construction works or construction compounds in Zones A to D;
- The sub-population vulnerable due to:
    - Young age vulnerability (children and young people);
    - Old age vulnerability (older people);
    - Poor health vulnerability (people with existing poor physical or mental health); and
    - Access and geographical vulnerability (people for whom close proximity to project change increases sensitivity).

The assessment covers these populations within two groups. The general population for the geographic area, notably site-specific residents, and the vulnerable group population for the area. The latter is a sub-population comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

The scientific literature indicates that there is an association between air quality emissions and health and wellbeing effects. The link is primarily between PM and health effects (particularly for $PM_{2.5}$). Exposures relating to NO_2 are also relevant. Whilst the literature supports there being thresholds set for health protection purposes, it also acknowledges that for PM and NO_2 there are non-threshold health effects (i.e. when there is no known exposure threshold level below which adverse health effects may not occur). The assessment has identified population groups that may be particularly sensitive to air quality effects. For example, young children are particularly susceptible to air pollution because of their developing lungs, high breathing rates per bodyweight, and amount of time spent exercising outdoors. Other vulnerable groups include the sick (e.g. people with type 2 diabetes), the elderly, and pregnant women.

The sensitivity of the general population is considered to be low. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in Section 23.3.5.3. Most people live, work or study at a distance from the construction areas, or sections of the road network affected by diversions and construction transport, at which dust and traffic emissions would benefit from high levels of dispersion and deposition, reducing exposure. Furthermore, most people enjoy good respiratory health (e.g. are not asthmatic) and are not at a life stage (e.g. infant or frail elderly) for which lower levels of emissions could be of concern. This group also includes those visitors and other people in good health who have a transitory, brief or momentary, level of exposure.

The sensitivity of vulnerable groups is considered high. This reflects the presence of populations (residents) who are likely to spend extended periods of time while at work or at home near to construction activities or parts of the road network affected by diversions. It also reflects the generally higher sensitivity of children and older people to air pollution. Within these groups people with existing respiratory conditions, such as asthma or COPD may be particularly sensitive.

23.6.1.2.1 Key Findings

This section summarises the key findings from Chapter 12 Air Quality and reflects on various health considerations and implications.

Chapter 12 sets out standard good practice mitigation measures and explains that the residual dust effects are not significant and pose no nuisance or human health risk to nearby receptors. Furthermore, the assessment of residual traffic air quality impacts, concludes that both the diversion and construction vehicles emissions changes are negligible. The overall construction phase air quality impacts are characterised as short-term and not significant.

23.6.1.2.2 Assessment of Impacts

For both the general population and for the vulnerable group sub-population, the magnitude of change due to the project is low. Levels of exposure can be characterised as *frequent*, but *very low* and over the *short-term*. The population health effect from dusts is likely to be a *very small* change in quality-of-life and a *very minor* exacerbation of existing respiratory conditions, affecting only a *very small minority* of the population. Most effects would rapidly reverse, with a negligible implication for healthcare services. The potential for non-threshold effects of NO_2 and $PM_{2.5}$ to population health is noted and has been taken into account. This type of health effect is relatively common where transport infrastructure and communities exist in close proximity. Any health effect would relate to a very low level of exposure to air pollutants over the short-term. Additional exposure due to the

proposed Project would represent an incremental addition to the existing baseline conditions resulting in a *very minor* change in morbidity related population health risk, e.g. of respiratory and cardiovascular health outcomes, for a *very small minority* of the population. Any change due to the construction of the proposed Project is unlikely to be discernible. The effect on routine health service planning is likely negligible.

The significance of the population health effect is minor adverse (not significant). The conclusion reflects the *slight* change from baseline air quality conditions well within the limits of the Air Quality Regulations. It also reflects the Government view that compliance with Air Quality Regulations demonstrates an acceptable level of health protection and that these air quality protection measures are produced in the knowledge that particular groups within a population will have particular health vulnerabilities. The minor adverse (rather than negligible) score represents a conservative assessment finding on the basis of scientific uncertainty (and emerging evidence) about non-threshold health effects of NO_2 and $PM_{2.5}$. This is a public health acknowledgement of the incremental contribution to air pollution that the proposed Project's construction would make, but also recognition that at the project level this should not be considered a significant effect on population health.

23.6.1.3 Noise

This section discusses changes in noise and vibration exposure during construction of the proposed Project particularly night-time noise that may be detrimental to population health where sleep is disturbed to a high degree. Changes in the distribution of day-time noise are also considered. The latter may include the potential to change levels of construction activity and traffic noise near to schools or healthcare facilities.

This section has been informed by Chapter 14 Noise & Vibration, which sets out relevant assessment findings and mitigation measures that have been taken into account.

Chapter 14 Noise & Vibration concludes that construction noise will have some significant residual effects at the closest receptors. These would be addressed by offering temporary rehousing to eligible owners/occupiers (e.g. an overnight stay in a hotel). In this chapter the public health implications are considered.

Potential effects on human health are considered likely because there is a plausible source-pathway-receptor relationship:

- The source is noise and vibration generated by construction activities and diverted traffic.
- The pathway is pressure waves through the air.
- Receptors are residents and long-term occupiers of nearby properties and community buildings.

Furthermore, the potential effect is probable as no highly unusual conditions are required for the source-pathway-receptor linkage.

The population groups relevant to this assessment are:

- The 'site-specific' geographic population affected by diversions, proximity to construction works or construction compounds in Zones A to D;

- The sub-population vulnerable due to:
    - Young age vulnerability (children and young people);
    - Old age vulnerability (older people);
    - Poor health vulnerability (people with existing poor physical or mental health);
    - Low-income vulnerability (people living in deprivation, including those on low incomes may have fewer resources to adapt, e.g. seek respite or install insulation furthermore, those who are economically inactive may spend more time in affected dwellings); and
    - Access and geographical vulnerability (people for whom close proximity to the proposed changes increases sensitivity).

The assessment covers these populations within two groups. The general population of each section study area and the vulnerable sub-population for this area. The latter is a comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

During construction, there is potential for noise and vibration to temporarily arise from construction works (including piling and the use of heavy construction equipment), diverted traffic and movement of construction related vehicles.

The literature highlights cardiovascular effects, annoyance and sleep disturbance (and consequences arising from inadequate rest) as being the main pathways by which population health may be affected. The literature also notes the potential for chronic noise to have a detrimental effect on learning outcomes (e.g. noise distracting and affecting communication within classrooms). Whilst the literature supports there being thresholds at which effects (such as annoyance and sleep disturbance) are likely, it also acknowledges the subjective nature of responses to noise. In this regard noise effects can be considered to have non-threshold effects, with characteristics other than sound levels also determining the influence on health outcomes. The assessment had regard to the population groups identified in the literature that may be particularly sensitive. For example, children, the elderly, the chronically ill, people with a hearing impairment, shift-workers and people with mental illness (e.g., schizophrenia or autism).

23.6.1.3.1 Assessment of Impacts

The sensitivity of the general population is low. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in Section 23.3.5.3. The general population comprise those members of the community in *good* physical and mental health and with resources that enable a *high* capacity to adapt to change. Additionally, most people live, work or study at a distance from the affected parts of the local road network and construction locations where construction noise and vibration would be unlikely to be a source of concern.

The sensitivity of the vulnerable group population is high. This reflects that the sub-population includes a high representation of *dependants*, both children, elderly and those receiving care due to poor health. This sub-population may experience existing *widening* inequalities due to living in areas with increasing noise and *moderate* deprivation, with *limited* capacity to adapt to changes. Vulnerability particularly relates to those living close to the construction activities, diversion routes

and construction compounds, including those spending more time in affected dwellings, e.g. due to low economic activity, shift work or *poor* health. People who are *concerned* or have high degrees of *uncertainty* about construction noise or vibration may be more sensitive to changes.

As reported in Chapter 14 Noise & Vibration, construction of the proposed Project will involve construction noise that could exceed applicable threshold limits at a number of residential and other properties. This has the potential to result in significant changes to health outcomes.

The overall magnitude of change due to the proposed construction works is low. This reflects two issues:

- Firstly, there is a *small* scale of change in noise levels for a small minority of the community populations along the railway section upgrades and areas affected by diversions. This predominantly relate to a *minor* change in quality of life and/or cardiovascular and mental wellbeing morbidity. A small scale of impact at healthcare and educational receptors is also anticipated.
- Secondly, there would be a *large* scale of change for *very few* people due to highly localised temporary construction activities at some locations. As noted, Chapter 14 proposes to offer temporary rehousing to eligible owners/occupiers to mitigate individual level effects where there may be a high change in quality of life, or a moderate change in risk for morbidity outcomes.

In both cases, the changes in night-time and daytime disruption would be of *short-term* duration and relate to *frequent* construction related noise and vibration exposures.

Construction noise impacts of the proposed Project are considered to result in a minor adverse (not significant) effect on population health. This assessment conclusion reflects that although the scientific literature indicates a *clear association* between elevated and sustained noise disturbance and reduced health outcome, the changes would result in a *very limited* effect in the population health baseline. In line with IEMA and IPH guidance, the individual level effects to a very few people are noted, and are appropriately targeted for mitigation, but would not result in a population health effect. Mitigation described in Chapter 14 is given weight in concluding that the temporary and localised construction noise effects would not significantly affect health inequalities.

23.6.1.4 Socio-Economic Status

This section has been informed by Chapter 7 Population. This section considers the health implications of increased employment and economic impacts during construction.

Employment is an important determinant of health and well-being both directly and indirectly by making health-promoting resources available to an employee and any dependants. The socio-economic benefits associated with employment are improved living conditions and the potential to make healthier choices, e.g. eating a healthier diet and undertaking more physical activity. If members of the community are employed, this can also generate indirect economic activity.

The potential health effect is considered likely because there is a plausible source-pathway-receptor relationship:

- Source: direct and indirect job creation and economic activity;
- Pathway: level of income and employment linked to spend on health supporting resources; and

- Receptor: people of working age (and their dependants).

Furthermore, the potential effect is probable as no highly unusual conditions are required for the source-pathway-receptor linkage.

The population groups relevant to this assessment are:

- The 'site-specific' geographic population associated with employment and economic activity in Zones A to D;
- The 'local' population of Dublin City, South Dublin and Kildare;
- The sub-population vulnerable due to:
    - Young age vulnerability (young adults as employees or apprentices, and children and young people as dependants);
    - Old age vulnerability (older people as dependants);
    - Low income vulnerability (people living in deprivation, including those on low incomes for who good quality employment may be particularly beneficial); and
    - Poor health vulnerability (people with existing poor physical or mental health, including as dependants).

The assessment covers these populations within two groups. The general population for the geographic area, notably local residents, and the vulnerable group population for the area. The latter is a sub-population comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

The scientific literature indicates that there is a clear association between employment opportunities and health and wellbeing outcomes. The literature does not identify particular thresholds for effects. The assessment has had regard to the population groups identified in the literature that may be particularly sensitive. For example, those who are unemployed, on low incomes or have low job security, including where children are consequently socioeconomically deprived.

23.6.1.4.1 Key Findings

Chapter 7 concludes that during construction the proposed Project is likely to have a positive, direct and indirect, moderate to significant, short-term effect on employment. Furthermore, the effect on the wider economy from construction procurement is likely to have a positive, indirect, moderate and short-term effect.

Chapter 7 also notes some localised effects, with some negative, indirect, moderate and temporary to short-term effect on the tourist and local businesses due to the diversions affecting journey times and construction effects on general amenity.

23.6.1.4.2 Assessment of Impacts

The sensitivity of the general population is low. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in Section 23.3.5.3. This reflects that most people would already be within stable employment that would be unaffected by the proposed Project (or being a dependant of such a person).

The sensitivity of the vulnerable sub-population is high. The health of vulnerable groups is particularly sensitive to employment. Vulnerability in this case relates to people and their dependants who are on low incomes or who are unemployed. Young people, including leaving education or early in their careers may have the most to gain from an increase in good quality job opportunities. Future young or older people may also come to rely on those employed.

For both the general population and for the vulnerable group sub-population, the magnitude of change due to the project is low. The scale of change is considered to be small and predominantly relates in maintaining people in existing construction related jobs over the short-term. The benefits of good quality employment contribute to quality-of-life, as well as being protective against adverse changes in morbidity (i.e. avoiding economic hardship or unemployment which are associated with poor physical and mental health outcomes). Effects are likely to relate to minor changes that would be experienced by a small minority of the local population (including through indirect benefits to dependants). Whilst the benefits may gradually diminish or reverse after construction is completed, the experience and upskilling during this time is likely to lead to a continuity of employment that would maintain the health benefits. This would be important particularly for young adults starting their careers, including those on apprentice schemes. Whilst construction activities have inherent occupational risks, the operation of appropriate health and safety practices means that it is unlikely that there would be an impact on healthcare services.

The significance of the population health effect for this determinant of health is minor positive (not significant). The professional judgment is that there would be a slight beneficial change in the health baseline for the local population. This conclusion reflects that the scientific literature establishes a clear relationship between good quality employment and factors that promote health or are protective against poor health, particularly mental health. The scale and nature of employment is not expected to widen existing health inequalities.

23.6.2 Potential Operational Impacts

23.6.2.1 Transport

This section of the health assessment draws on inputs from Chapter 6 Traffic and Transportation. See Chapter 6 Traffic and Transport for the conclusions of the operational benefits of the proposed Project for transport infrastructure. The benefits include: targeted improvements at upgraded bridges in relation to active travel infrastructure; New Heuston West Station (in Zone C); and the upgraded railway lines themselves which support a significant beneficial improvement for public transport frequency and capacity. The latter supporting multi-modal travel (combined active travel and public transport use). This section considers the health implications of these changes.

The potential health effect is considered likely because there is a plausible source-pathway-receptor relationship:

- The source is active travel and public transport infrastructure that link community residential, commercial or amenity services;
- The pathway is changes in access or journey time, as well as level of physical activity; and
- Receptors are communities both local and regional using the transport network.

Furthermore, the potential effect is probable as no highly unusual conditions are required for the source-pathway-receptor linkage.

The population groups relevant to this assessment are:

- The 'local' population of Dublin City, South Dublin and Kildare;
- The 'regional' area is the province of Leinster; and
- The sub-population vulnerable due to:
    - Young age vulnerability (children and young people as potentially more vulnerable road users);
    - Old age vulnerability (older people as potentially more vulnerable road users);
    - Low income vulnerability (people living in deprivation, including those on low incomes for who travel costs or alternatives may be limiting); and
    - Access and geographical vulnerability (people who experience existing access barriers or for whom close proximity to project change increases sensitivity).

The assessment covers these populations within two groups. The general population for the geographic area, notably local and regional residents and visitors, and the vulnerable group population for the area. The latter is a sub-population comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

23.6.2.1.1 Assessment of Impacts

The sensitivity of the general population is low. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in Section 23.3.5.3. The general population comprise those members of the community in good physical and mental health and with greater resources to respond to change. This reflects that most people in the local and regional area would only make occasional use of the upgraded rail and active travel infrastructure.

The sensitivity of the vulnerable group population is high. Vulnerability in this case is linked to mode of travel, including pedestrians and cyclists; age (young people and older people); frequent use of rail services; and deprivation. Deprived populations may already face more access barriers compared to the general population and therefore be more sensitive to access changes. Low incomes may compound access barriers making affordable public transport particularly beneficial in accessing employment, education and amenities, as well as goods and services that support health.

The magnitude of change is medium. This is driven by a medium scale of change in available public transport. This change would be long-term, with frequent rail services. The services are likely to be accessed by a large minority of the local and regional population, with a consequent moderate beneficial effect on morbidity outcomes associated with equitable access to health promoting opportunities, goods and services. There would also be benefits to physical activity and mental health not only from active and multi-modal travel, but also from providing better access to rural areas for the urban population.

The significance of the population health effect for this determinant of health is moderate positive (significant). The professional judgment is that there may be a small sustained beneficial change in the health baseline due to improved accessibility and less reliance on private cars. Such changes have the potential to narrow inequalities, particularly for deprived populations with existing poor access or fewer resources. This conclusion reflects that scientific literature of clear associations between health outcomes and access to employment, education, affordable healthy food, open space and physical activity opportunity. The proposed Project aligns with supporting delivery of the policy context of promoting community health and reducing health inequalities.

23.6.2.2 Air Quality

This section of the health assessment draws on inputs from Chapter 12 Air Quality. See Chapter 12 Air Quality for the conclusions of the air quality assessment.

This section considers operational air pollutant emissions. These relate to the emission from the trains. As no additional parking or other infrastructure that affects traffic patterns or traffic growth is included in the proposed Project, Chapter 12 does not anticipate a change in operational road transport that would warrant assessment. The proposed electrification results in an increase in electric trains and a decrease in diesel trains.

For transport combustion engine emissions (predominantly relevant to discussion of NO_2 and $PM_{2.5}$), the main health outcomes are likely to relate to risk of cardiovascular and respiratory related conditions or events (including reduced lung function, hypertension and myocardial infraction) (i.e. due to fine PM and NO_2 interacting within the body), as well as general measures of population mortality and hospital service use (e.g. emergency department visits).

The potential effect is considered likely because there is a plausible source-pathway-receptor relationship:

- Sources: combustion engine related particulates and emissions from rail services;
- The pathway: dispersion through the air; and
- Receptors: people living and working close to the railway lines.

Furthermore, the potential effect is probable as no highly unusual conditions are required for the source-pathway-receptor linkage.

The population groups relevant to this assessment, due to either proximity or other sensitivity are:

- The ‘site-specific’ geographic population close to the railways line in Zones A to D;
- The ‘local’ population of Dublin City, South Dublin and Kildare;
- The sub-population vulnerable due to:
    - Young age vulnerability (children and young people);
    - Old age vulnerability (older people);
    - Low income vulnerability (people living in deprivation, including those on low incomes);
    - Poor health vulnerability (people with existing poor physical or mental health); and

- Access and geographical vulnerability (people for whom close proximity to project change increases sensitivity).

The assessment covers these populations within two groups. The general population for the geographic area, and the vulnerable group population for the area. The latter is a sub-population comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

The sensitivity of the general population is considered to be low. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in section 23.3.5.3. Most people live, work or study at a distance from the railway line where a change in railway engine emissions would have limited impact due to existing high levels of dispersion and deposition, reducing baseline exposure. Furthermore, most people enjoy good respiratory health (e.g. are not asthmatic) and are not at a life stage (e.g. infant or frail elderly) for which lower levels of emissions could be of concern.

The sensitivity of vulnerable groups is considered high. This reflects the presence of populations (site specific and local residents) who are likely to spend extended periods of time while at work or at home near to the rail network affected by the proposed Project. It also reflects the generally higher sensitivity of children and older people to air pollution. Within these groups people with existing respiratory conditions, such as asthma or COPD may be particularly sensitive, including to beneficial effects.

23.6.2.2.1 Key Findings

Chapter 12 predicts that during operation, the use of a greater proportion of electrically powered trains, coupled with the reduction of diesel-powered trains, will result in an overall reduction in air pollutant emissions. Chapter 12 concludes that the residual effect of train movements is a slight beneficial effect. Chapter 12 also notes that there is potential for a modal shift away from car use, which although not quantifiable, may also result in a long-term indirect slight positive impact for air quality.

23.6.2.2.2 Assessment of Impacts

For both the general population and for the vulnerable group sub-population, the magnitude of change due to the project is low. The electrification supports more electric trains, with their co-benefit to health of a reduction in exposure to air pollutants and associated reduction in climate altering pollutant emissions. The air quality chapter also assesses the circa 7% decrease in diesel trains, which will have localised positive effects on air quality. The level of change in exposure is likely to be low, *frequent* and *long-term* for a *small minority* of the population. Such a change is likely to have a minor beneficial effect (not significant) on morbidity for cardiovascular and respiratory outcomes.

The significance of the population health effect is minor beneficial (not significant). The slight improvement in air quality within these locations may have a *marginal* effect on reducing inequalities, driven by people experiencing higher baseline air quality being exposed to less air pollution. These changes are supportive of delivering health-related planning policy.

23.6.2.3 Noise

This section discusses changes in rail noise and vibration exposure during operation of the proposed Project. Changes in the both day-time and night-time noise are considered important to public health, with increasing evidence of the long-term chronic effects of transport noise on population health. The proposed Project results in additional rail movements and closer proximity to dwellings at some locations due to new or relocated tracks.

This section has been informed by Chapter 14 Noise & Vibration, which sets out relevant assessment findings and mitigation measures that have been taken into account.

Chapter 14 Noise & Vibration concludes that, with regard to regulatory standards and baseline conditions, and following appropriate mitigation, the aggregate residual effect is slight, negative, and long-term. A smaller number of noise sensitive locations will experience a moderate, negative and long-term residual effect. Four locations would experience significant, negative, long-term residual effect.

Potential effects on human health are considered likely because there is a plausible source-pathway-receptor relationship:

- The source is noise and vibration generated by additional rail movements.
- The pathway is pressure waves through the air.
- Receptors are residents and long-term occupiers of nearby properties and community buildings.

Furthermore, the potential effect is probable as no highly unusual conditions are required for the source-pathway-receptor linkage.

The population groups relevant to this assessment are:

- The ‘site-specific’ geographic population close to the railways line in Zones A to D;
- The sub-population vulnerable due to:
    - Young age vulnerability (children and young people);
    - Old age vulnerability (older people);
    - Poor health vulnerability (people with existing poor physical or mental health);
    - Low-income vulnerability (people living in deprivation, including those on low incomes may have fewer resources to adapt, e.g. seek respite or install insulation furthermore, those who are economically inactive may spend more time in affected dwellings);
    - Access and geographical vulnerability (people for whom close proximity to the railway line increases sensitivity);

The assessment covers these populations within two groups. The general population of each section study area and the vulnerable sub-population for this area. The latter is a comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

The key health outcomes relevant to this determinant of health are cardiovascular health and mental health conditions (e.g. stress, anxiety or depression). Sleep disturbance is particularly associated

with night-time train movements, though the day-time rest of some vulnerable groups (such as the very young, elderly, or shift workers) could potentially be affected. Cognitive performance in children, particularly at school is also a potential outcome. The scientific literature indicates that there is an association between cardio-metabolic health outcomes and long-term transport noise exposures.

23.6.2.3.1 Assessment of Impacts

The sensitivity of the general population is low. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in Section 23.3.5.3. The general population comprise those members of the community in *good* physical and mental health and with resources that enable a *high* capacity to adapt to change. Additionally, most people live, work or study at a distance from the affected parts of the rail network where changes in transport noise are unlikely to be a source of concern.

The sensitivity of the vulnerable group population is high. This reflects that the sub-population includes a high representation of *dependants*, both children, elderly and those receiving care due to poor health. This sub-population may experience existing *widening* inequalities due to living in areas with increasing transport noise and *moderate* deprivation, with *limited* capacity to adapt to changes. Vulnerability particularly relates to those living close to the affected sections of track, including those spending more time in affected dwellings, e.g. due to low economic activity, shift work or *poor* health. People who are *concerned* or have high degrees of *uncertainty* about rail noise and vibration may be more sensitive to changes.

As reported in Chapter 14 Noise & Vibration, there are some negative impacts from the new track alignments, rail fleet electrification and additional rail movements. A small population of people would experience greater rail noise levels. More broadly, the proposed Project increases rail capacity, which drives the wider trend of more people experiencing rail noise than in the 'do-minimum' scenario. This latter exposure is at the lower noise levels, but nonetheless remains a public health consideration.

The magnitude of change due to the proposed Project is low. This reflects that with the noise barriers and other mitigation described in Chapter 14 a *small minority* of people along the railway line route are expected to experience a *small* scale increase in noise levels due to closer track alignments and more frequent trains. Changes would be *long-term*, with a *minor* influence on morbidity risk and quality of life.

As noted in Chapter 14 there are a very few (four locations) where noise barriers are not feasible, and these locations may experience significant adverse effects. These locations include buildings that appear to be relatively modern, with the majority of windows orientated away from the tracks. In line with a conservative assessment, in this context, it is considered that the effect to most residents would be mitigated to some extent. The scale of change at the four locations may be *medium to high*, with *long-term* and *frequent* exposures to rail noise. Such effects to a *very few* people may have a *moderate* effect on quality of life and morbidity outcomes. Such individual level effects are noted, but would not cause a material change in health outcomes at a population level.

Operational noise impacts of the proposed development are considered to result in a minor adverse (not significant) effect on population health. This reflects a *very limited* effect on the health baseline for the site-specific populations driven by rail noise increases. The conclusion has regard to scientific literature indicating a *clear association* between long-term exposure to transport noise and health

outcomes. The changes may have a *marginal* effect in widening inequalities, with the burden of elevated rail noise focused on the population already living along the railway line route.

23.6.2.4 Socio-economic Status

This section has been informed by Chapter 7 Population. This section considers the health implications of increased employment and economic impacts during operation.

The potential health effect is considered likely because there is a plausible source-pathway-receptor relationship:

- Source: direct and indirect job creation and economic activity;
- Pathway: level of income and employment linked to spend on health supporting resources; and
- Receptor: people of working age (and their dependants).

Furthermore, the potential effect is probable as no highly unusual conditions are required for the source-pathway-receptor linkage.

The population groups relevant to this assessment are:

- The 'local' population of Dublin City, South Dublin and Kildare;
- The 'regional' population of Leinster;
- The sub-population vulnerable due to:
    - Young age vulnerability (young adults as employees or apprentices, and children and young people as dependants);
    - Old age vulnerability (older people as dependants);
    - Low income vulnerability (people living in deprivation, including those on low incomes for who good quality employment may be particularly beneficial); and
    - Poor health vulnerability (people with existing poor physical or mental health, including as dependants).

The assessment covers these populations within two groups. The general population for the geographic area, notably local residents, and the vulnerable group population for the area. The latter is a sub-population comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

23.6.2.4.1 Key Findings

Chapter 7 Population concludes that during operation there would be positive, direct and indirect, moderate, long-term impacts on the overall economic activity of the region.

Chapter 7 also finds positive, indirect, slight to moderate, long-term effect on the tourism sector and recreational resources within Dublin and the wider region as a result of the improved reliability of the public transport train service.

23.6.2.4.2 Assessment of Impacts

The sensitivity of the general population is low. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in Section 23.3.5.3. The score reflects that most people would already be within stable employment that would be unaffected by the proposed Project (or being a dependant of such a person).

The sensitivity of the vulnerable sub-population is high. The health of vulnerable groups is particularly sensitive to employment. Vulnerability in this case relates to people and their dependants who are on low incomes or who are unemployed. Young people, including leaving education or early in their careers may have the most to gain from an increase in good quality job opportunities. Future young or older people may also come to rely on those employed.

For both the general population and for the vulnerable group sub-population, the magnitude of change due to the project is low. The scale of new employment is considered to be small in the local and regional economy context. The roles are predominantly expected to be filled by existing residents (rather than an influx of new residents taking up these roles). The effects are expected to be greatest at the local level, but also extend to the regional level. New good quality long-term roles (in terms of remuneration, working hours, working conditions and job security) are considered particularly likely to contribute to long-term population health benefits. Benefits are likely to relate to minor changes in quality of life and morbidity for a small minority of the local and regional population (including through indirect benefits to dependants).

The significance of the population health effect is minor positive (not significant). The professional judgment is that there would be a slight beneficial change in the health baseline for the local and regional population. This conclusion reflects that the scientific literature establishes a clear relationship between good quality employment and factors that promote health or are protective against poor health, particularly mental health. The scale and nature of employment is not expected to widen existing health inequalities.

23.6.2.5 Electro-Magnetic Fields

This section has been informed by Chapter 22 Electromagnetic Compatibility and Stray Current.

This section considers the potential health effect due to electro-magnetic fields (EMF) exposure. EMF effects diminish rapidly with distance, often requiring only a few metres, or less, to reach background levels. Consideration is given to both actual risk and people's understanding of risks (risk perception). The latter relates to the potential for community concern about their proximity the proposed Project's electrical infrastructure affecting their mental health, even where relevant public EMF exposure guideline limits are met.

All electrical systems, including natural processes and living organisms generate EMF. The main electrical infrastructure relevant to the health assessment are the proposed Project's Overhead Line Equipment (OHLE) and the six new substations. Other sources produced by the proposed Project are noted but are not considered to have the potential for actual population health risks or community concern.

The overall conclusions of the Chapter 22 modelling study were: The protection distance for public exposure from energised conductors for quasi-DC (<1Hz) and 50Hz magnetic fields is a few centimetres under worst-case operating conditions of the railway. This protection distance is

respected for publicly accessible areas on stations and for areas outside the railway boundary. Monitoring is proposed to confirm acceptable standards are met through the design.

The potential health effect has a plausible source-pathway-receptor relationship:

- The source is electrical equipment introduced by the proposed Project, notably the OHLE and substations;
- The pathway is actual field strength affecting biological processes, or concern about the former affecting mental health; and
- Receptors are residents in the local community, particularly those living in close proximity to new electrical infrastructure.

Although this theoretical pathway exists, the potential for actual risks to population health for the proposed Project is not probable, i.e. unlikely. This is because Chapter 22 describes the adoption of regulatory standards as part of the design and operation of the proposed Project, which would break the source-pathway-receptor linkage.

On the basis that a public health effect is unlikely, there could not be a likely significant effect for population health and therefore this issue of actual EMF risk is not assessed further. Chapter 22 provides the details of the standards that would be met to ensure health protection.

Understanding of risk can differ from actual risk, so it is relevant to consider how any effect on population mental health from concern about EMF may be avoided.

The population groups relevant to this assessment are:

- The ‘site-specific’ geographic population in Zones A to D living adjacent to the electrified line or close to new substations;
- The sub-population vulnerable due to:
    - poor health, specifically people already experiencing high levels of stress or anxiety who may have strong views about the project and EMF as a risk factor;
    - low income vulnerability (people living in deprivation, including those on low incomes); and
    - access and geographical factors, specifically people living close to the new EMF sources.

The assessment covers these populations within two groups. The general population for the geographic area, and the vulnerable group population for the area. The latter is a sub-population comprised of the vulnerabilities listed above. The differentiation of these two groups, allows a discussion of any potentially significant health inequalities and the targeting of any mitigation.

23.6.2.5.1 Assessment of Impacts

The sensitivity of the general population is low. Common factors that differentiate the sensitivity of the general population and the vulnerable group population have been taken into account and are listed in Section 23.3.5.3. Most people in the site-specific geographic population are likely to live, work or travel at a separation distance from the proposed Project’s electrical infrastructure where they would

not be concerned about the potential for EMF risks. This group also includes that proportion of the population who are ambivalent or not concerned about EMF as a risk factor.

The sensitivity of the vulnerable sub-population is high. This reflects that the sub-population includes people who may be uncertain or concerned about EMF and this may exacerbate existing mental health conditions or be a source of stress and anxiety in itself. This may particularly be the case for people with near views and/or who live in close proximity to the OHLE or substations. Low incomes or existing deprivation may contribute to a limit sense of control and reduced capacity to obtain further information.

For both the local population and for the vulnerable group sub-population, the magnitude of change due to the project is low. The level of actual exposure is negligible, however the scale of change that may contribute to community concern about EMF is medium, continuous and long-term. The severity of the health outcome relates predominantly to a minor change in mental health related morbidity for a very few people within the population. Such individual level effects are unlikely to have implications for health service capacity. For many people there is likely to be a rapid reversal of effects should their concerns be responded to and resolved to their satisfaction.

The significance of the population health effect is minor adverse (not significant). The professional judgment is that there could be a slight adverse change in the health baseline for the local population if concerns are widespread. This conclusion reflects scientific understanding of the impact of uncertainty or concern about environmental risks on mental health. It also reflects that the actual risks would be well within regulatory standards for EMF and that most members of the public would expect this to be the case. The context that electrified rail lines and substations are relatively common features of transport networks would also be expected to inform population risk perception.

23.7 Mitigation Measures

23.7.1 Construction Phase

Communication with the local community, with Dublin City Council, South Dublin City Council, Kildare County Council and other relevant stakeholders will be undertaken at an appropriate level and frequency throughout construction. A Community Engagement Manager and Community Liaison Officer will be appointed prior to construction. A Community Liaison Plan will be prepared prior to construction and will be updated regularly.

23.7.1.1 Transport

The following further mitigation is proposed:

- Early notice to affected general practice surgeries, hospitals and emergency services of the diversions and bridge closures. Including ongoing updates to support their travel advice to service users and their own vehicle route planning.
- Sarsfield Road Bridge closure is for 5-7 days. This is considered a length of time where it would be feasible and appropriate, given the Chapter 6 findings on safety, to provide a safety steward to direct pedestrians, cyclists and mobility impaired.
- The Khyber Pass Footbridge closure should be accompanied by early and ongoing diversion advice that encourages cycling. This may include information boards that show the route in

cycling travel times and measures to support a safe and accessible cycle route, e.g. dropped kerbs and where feasible separation form road traffic.

- There is a public health opportunity to more broadly encourage active travel given that, not only do the road diversions have significant car journey time implications, but the proposed Project is also providing temporary pedestrian, cyclist and mobility impaired crossings in many instances. The duration of most bridge works would be sufficiently long to support lasting behavioural change that increased physical activity levels and supported mental health. The intervention would primarily relate to early and ongoing information at both the crossing points and at other community locations, e.g. educational facilities. The information boards could provide: the relative journey time differences for different transport modes; the benefits of active travel to health and the environment; public transport links, supporting multi-modal transport for longer journeys; and links to wider local authority, voluntary sector or public health schemes that support walking and cycling uptake. This would support general population health as well as reducing travel time delays for essential journeys, such as healthcare-related journeys.

23.7.1.2 Air Quality

No further mitigation is proposed beyond that already set out in Chapter 12.

23.7.1.3 Noise

No further mitigation is proposed beyond that already set out in Chapter 14. Mitigation that avoids a risk to both individual and population health (such as temporary rehousing of eligible residents) is supported.

23.7.1.4 Socio-Economic Status

The following measures would enhance the benefits and would be expected to narrow existing health inequality:

- As far as reasonably practicable (e.g. subject to standards and security checks) provide preferential access to construction apprenticeships and training schemes for young people in the local (Dublin City, South Dublin and Kildare) area who are Not in Education, Employment, or Training (NEET). Young people who are NEET are at a critical intervention point for public health. Targeted support at this stage can have a substantial effect on the health of this group and their future dependants. This is a low-cost measure with a high societal return.
- Engage and support Dublin City, South Dublin and Kildare, where practicable, to provide local adult learning linked to construction related job opportunities relevant to disadvantaged adults facing skills barriers to construction opportunities.

23.7.2 Operational Phase

23.7.2.1 Transport

No further mitigation is proposed beyond that already set out in Chapter 6.

23.7.2.2 Air Quality

No further mitigation is proposed.

23.7.2.3 Noise

No further mitigation is proposed beyond that already set out in Chapter 14.

23.7.2.4 Socio-Economic Status

The following measures would enhance the benefits and would be expected to narrow existing health inequality:

- As far as reasonably practicable (e.g. subject to standards and security checks) provide an ongoing scheme of preferential access to operational rail training schemes for young people in the local (Dublin City, South Dublin and Kildare) area who are Not in Education, Employment, or Training (NEET).

Engage and support Dublin City, South Dublin and Kildare, where practicable, to provide local adult learning linked to operation related job opportunities relevant to disadvantaged adults facing skills barriers to construction opportunities.

23.7.2.5 EMF

The following mitigation is proposed:

- The sharing with site-specific communities within Zones A to D of non-technical summary information about EMF regulatory standards, the actual negligible EMF risks of the proposed Project and the results of monitoring proposed in Chapter 22. This information sharing to reduce uncertainty and support a shared understanding could be via a website and/or posted leaflets.

23.8 Monitoring

23.8.1 Transport

23.8.1.1 Construction Phase

No monitoring by the project is proposed. The mitigation provided in the form of information sharing with healthcare providers would support their own monitoring and further action if appropriate. Communication would be maintained with these services.

23.8.1.2 Operational Phase

No monitoring is proposed.

23.8.2 Air Quality

No monitoring is proposed.

23.8.3 Noise

No monitoring is proposed.

23.8.4 Socio-Economic Status

Monitoring of uptake of the NEET and adult learning interventions by the project can identify if there are barriers, and address these. Monitoring can also identify the successes and this information can be shared.

23.8.5 EMF

No health-related monitoring of EMF is proposed.

23.9 Residual Effects

23.9.1 Construction Phase

23.9.1.1 Transport

With the mitigation measures outlined in Section 23.7.1.1 secured, the residual health assessment significance of the effect on population health due to changes in transport would be minor adverse (not significant). The project is considered to appropriately mitigate effects on population health.

23.9.1.2 Air Quality

The significance of the population health effect is minor adverse (not significant).

23.9.1.3 Noise

The residual health assessment significance for population health is minor adverse (not significant).

23.9.1.4 Socio-Economic Status

The residual significance of the construction stage on health-related aspects of socio-economic status would be moderate positive (significant). This score reflects active enhancement of the proposed Project's employment opportunities, with these opportunities targeted to vulnerable groups.

23.9.2 Operational Phase

23.9.2.1 Transport

The significance of the population health effect for this determinant of health is moderate positive (significant).

23.9.2.2 Air Quality

The significance of the population health effect is minor beneficial (not significant).

23.9.2.3 Noise

The residual health assessment significance for population health is minor adverse (not significant).

23.9.2.4 Socio-Economic Status

The residual significance of the operational stage on health-related aspects of socio-economic status would be moderate positive (significant). This score reflects active enhancement of the proposed Project's employment opportunities, with these opportunities targeted to vulnerable groups.

23.9.2.5 EMF

The residual significance of the effect on mental health from public uncertainty or concern about EMF risks would be negligible (not significant).

23.10 Cumulative Effects

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

23.11 References

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