
Chapter 6

Population and Human Health

Chapter 6

Population and Human Health

6.1 Introduction

This chapter addresses the potential population and human health impacts relating to the construction and operational phases of the Flood Defences West project referred to hereafter as “the proposed development”. Actual and perceived impacts of the proposed development on the population and human health may arise from various aspects of the proposed development. These impacts are dealt with throughout this Environmental Impact Assessment Report (EIAR). In particular, interactions may occur with effects described in a number of chapters and require specialists input as provided in Table 6.1.

Table 6.1 Population and Human Health Interactions and Specialist Contributions

Relevant Aspects	Chapter & Specialists Contributor
Traffic	Chapter 5: Traffic Analysis: Roughan & O'Donovan
Contaminated Land	Chapter 8: Soils and Geology: Roughan & O'Donovan
Noise and Vibration	Chapter 12: Noise and Vibration: AWN
Air Quality and Climate	Chapter 13: Air Quality and Climate: AWN
Water Quality and Flooding	Chapter 10: Hydrology: Roughan & O'Donovan
Material Assets and Land	Chapter 16 Material Assets and Land: Roughan & O'Donovan
Cumulative Impacts	Chapter 17: Interactions and Cumulative Impacts
Major Accidents and Emergencies	Chapter 18: Major Accidents and Disasters Outline Environmental Operating Plan (Appendix 4.1): Roughan & O'Donovan

This chapter sets out the methodology used for the population assessment and human health assessment (Section 6.2), then describes the receiving environment (Section 6.3) and sets out the potential impacts of the proposed development on population and human health aspects (Section 6.4). The mitigation measures are set out that are (Section 6.5) recommended to be incorporated into the design of the proposed development. A conclusion and a summary of the assessment are provided in Section 6.7. A list of reference material used to compile this chapter is contained in Section 6.8.

6.2 Methodology

This population and human health impact assessment has been undertaken in accordance with Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, as amended in turn by Directive 2014/52/EU and transposed into Irish Law through Regulations S.I. No. 296 of 2018. The methodology devised is based on established best practice with cognisance given to all relevant guidelines and legislation listed in section 6.2.1.

6.2.1 Relevant Guidelines

The following guidelines have influenced the preparation of this chapter:

- Draft Guidelines on information to be contained in the Environmental Impact Assessment Report, (EPA, 2017);
- Draft Advice Notes for preparing environmental impact statements (EPA, 2015);
- Guidelines on the information to be contained in Environmental Impact Statements (EPA, 2002);
- Advice notes on current practice (in the preparation of Environmental Impact Statements) (EPA, 2003);
- Guidelines on the treatment of Tourism in an Environmental Impact Assessment (Fáilte Ireland, 2011);
- Additionality Guide (Homes and Communities Agency (UK), 2014);
- Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report (European Commission, 2017);
- Health Impact Assessment Resource and Tool Compilation (US EPA, 2016);
- Health Impact Assessment (Institute of Public Health Ireland, 2009)
- Framework for Human Health Risk Assessment to Inform Decision Making (United States Environmental Protection Agency (USEPA), (2016))

6.2.2 Study Area

There is no national guidance available on an appropriate study area to focus the assessment of population and human health. The study area has been defined with reference to the potential for impact from the proposed development using professional judgement and based on availability of relevant information.

The primary study area is defined by the Electoral Divisions (EDs) that are wholly and/or partially contained within 500m of the proposed development. It is recognised that the development of flood defences measures could affect activities across a wider area, particularly in terms of land use considerations. For this reason, a study area of 1km is also included. The EDs wholly and / or partially contained within the 500m study area and the 1km 'context' study area are listed in Table 6.2 and presented in Plate 6.1.

Table 6.2 Electoral Divisions (EDs) Wholly and / or Partially Contained within the Study Area

Electoral Divisions (EDs)	Location (north or south of the River Suir)
Primary Study Area (500m)	
Aglish	North
Ferrybank	North
Kilculliheen	North
Custom House B	South
Centre A	South
The Glen	South
Bilberry	South
Military Road	South
Cleaboy	South

Electoral Divisions (EDs)	Location (north or south of the River Suir)
Primary Study Area (500m)	
Gracedieu	South
Wider Study Area (1km)	
Dunkitt	North
Shortcourse	South
Ballybricken	South
Custom House A	South
Centre B	South
Mount Sion	South
Morrison's Avenue East	South
Morrison's Avenue West	South
Morrison's Road	South
Newport's Square	South
Park	South
Slievekeale	South

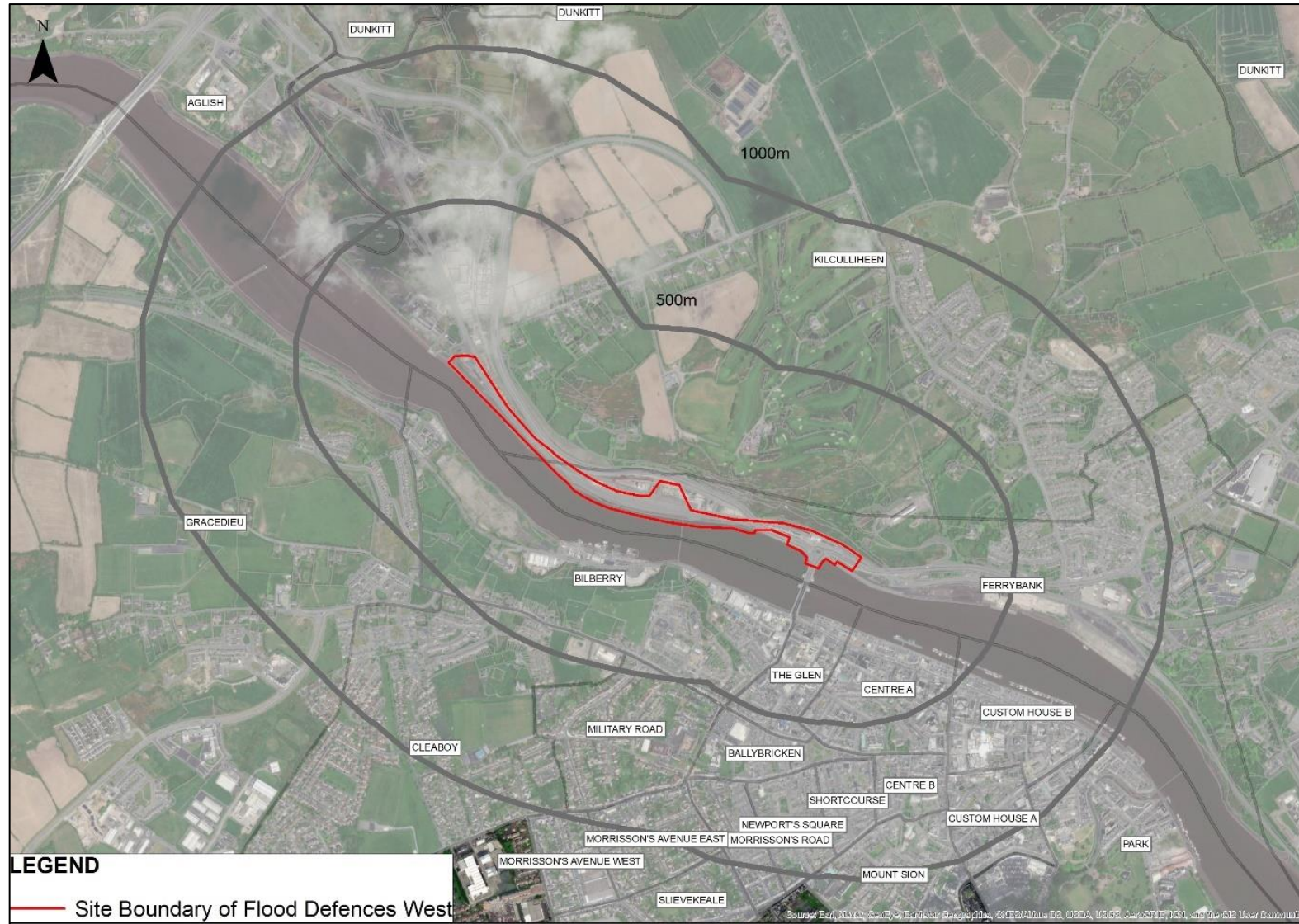


Plate 6.1 Study Area for Population and Human Health Assessment

The human health study area is related to the potential impacts of any emissions as a result of the proposed development. Generally, the closer to the works, the greater the potential for impacts. The most significant environmental impacts are likely to be confined within 50-100m of the proposed development. Some impacts such as noise, air quality and traffic may have a wider study area, and these are defined and considered as part of the respective specialist chapters as part of this EIAR that inform this assessment. Where population or human health information is not specifically available for the defined EDs within the 500m, information relating to the Waterford City and/ or environs is relied upon. The study area also includes the marine environment - the River Suir, in terms of potential for economic impact on boating, and tourism from the proposed development.

6.2.3 Data Collection Methods

The data collection methods include a mixture of primary and secondary data collection and analysis. Initially a desk-based assessment determined the existing receiving environment (in terms of population and human health), including the existing population, future population projections, existing and future economic activity in the area, employment, community infrastructure, tourism, and recreation amenities. Mapping and aerial photography were also used to inform and validate the baseline description.

6.2.4 Data Sources

Data sources consulted include:

- Population, demographic and health data from Census 2011 and 2016 by the Central Statistics Office (CSO);
- Pobal and Institute of Public Health (IPH);
- Health Service Executive (HSE); and
- Other relevant environmental data considered during the various environmental assessments, particularly traffic, noise, air and climate, water, land and soil as listed in Table 6.1.

A range of policy documents that may affect existing and future populations were also reviewed including:

- Project Ireland 2040 – National Planning Framework 2040 and National Development Plan 2018-2027;
- Southern Regional Spatial and Economic Strategy (2020);
- South East Region Employment Action Plan 2011;
- South East Economic Development Strategy (SEEDS) 2013-2023;
- Kilkenny City and Environs Development Plan 2014-2020;
- Kilkenny City and County Development Plan 2021- 2027;
- Waterford City Development Plan 2013- 2019 (as extended) (incorporates the Housing Strategy);
- Draft Waterford City and County Development Plan 2022 – 2028;
- Waterford County Development Plan 2011-2017 (as extended);
- North Quays Strategic Development Zone Planning Scheme (adopted February 2018);
- Ferrybank- Belview Local Area Plan 2017 – 2023;
- One Waterford: Local Economic & Community Plan 2015-2020;

- Report of the Waterford Re-Organisation Implementation Group and Economic Strategy for Waterford City and County, One Waterford – Delivering Jobs, Efficiency and Growth (2013);
- Waterford Children & Young People's Services Committee Children & Young People's Plan 2015-2018;
- Waterford City & County Council Corporate Plan 2014-2019;
- Waterford City Retail Strategy (2012);
- Strategic Plan 2014 – 2017 Waterford – Active People, Active Place;
- Waterford City Centre Urban Renewal Scheme (2015);
- Waterford Planning, Land Use and Transportation (PLUTS) Study (2004);
- Transforming Waterford Integrated Transport Proposals; and
- Literature review – bridges, sustainable transport bridges.

6.2.5 Difficulties Encountered

No particular difficulties were encountered in preparing the population assessment. In terms of the human health assessment, there are uncertainties in relation to assessing impacts on individuals or communities due to the lack of available health data and the difficulty in predicting effects, which could be based on a variety of assumptions.

6.2.6 Population Impact Assessment Categories

6.2.6.1 Overview

The purpose of the population assessment is to identify the likely significant impacts as they might affect users of the proposed development and the local community. It usually follows that impacts of a population and human health nature are a function of:

- The location and character of the local environment;
- The sensitivity of the local population and its capacity to absorb change;
- The nature of the environmental effect;
- The scale or extent of the effect in terms of area or population affected;
- The duration and frequency of an effect; and,
- The probability of an impact's occurrence and possibility of effectively reducing the effects (mitigation).

The description of the quality, significance, extent (magnitude), probability and duration of effects outlined within this assessment are based on the definitions set out within Section 3.7 Impact Assessment of the 'Guidelines on information to be contained in Environmental Impact Assessment Reports' (EPA, Draft 2017), and outlined in Table 6.3.

Impacts result from direct, indirect, secondary and cumulative effects on existing environmental conditions. Effects can be *positive, neutral or negative*. Significance of an effect depends on, among other considerations, the nature of the environmental effect, the timing and duration of an effect and the probability of the occurrence of an effect. The significance of an effect is described as *imperceptible, slight, moderate, Significant, Very Significant or Profound*. The impacts may be short-term, medium-term or long-term. The duration of an effect may be *momentary, brief, temporary, short-term, medium-term, long-term, permanent or reversible* in accordance with the timescales detailed in Table 6.3. The frequency of that effect can also influence significance i.e. if the effect will occur once, rarely, occasionally, frequently, constantly

– or hourly, daily, weekly, monthly, annually. For example, disruption to a road for a few hours could be described as having an *imperceptible, negative, brief* impact versus the complete closure of a road for a number of months which could be described as a *very significant, negative, temporary* impact.

Table 6.3 Criteria used to describe population effects (adapted from the EPA, 2017)

Quality of Effects:	
Positive	A change which improves the quality of the environment.
Neutral	No effects, or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
Negative	A change which reduces the quality of the environment.
Describing Significance of effect:	
Imperceptible	An effect capable of measurement but without significant consequences on population.
Not significant	An effect which causes noticeable (<i>Note 1</i>) changes in the character of the population environment without affecting its sensitivities.
Slight effects	A small effect which causes noticeable changes in the population and character of the environment without affecting its sensitivities.
Moderate effects	An effect that alters the character of the population environment in a manner that is consistent with existing and emerging baseline trends.
Significant effects	An effect which, by its character, magnitude, duration or intensity significantly alters a sensitive aspect of the population environment.
Very significant Effects	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the population environment.
Profound effects	An effect which obliterates sensitive characteristics.
Describing the Extent and Context of Effects:	
Extent	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.
Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
Describing the Probability of the Effects:	
Likely effects	The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.
Unlikely effects	The effects that can reasonably be expected not to occur because of the planned project if all mitigation measure are properly implemented.
Describing the Duration and Frequency of Effects:	
Momentary effects	Effects lasting from seconds to minutes
Brief effects	Effects last less than a day
Temporary effects	Effects lasting less than a year
Short-term effects	Effects lasting one to seven years

Medium-term effects	Effects lasting seven to fifteen years
Long-term effects	Effects lasting fifteen to sixty years.
Permanent effects	Effects lasting over sixty years
Reversible effects	Effects that can be undone, for example through remediation or restoration.
Frequency of effects	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hour, daily, weekly, monthly, annually).
<i>Note 1:</i>	<i>for the purposes of planning consent procedures</i>

In accordance with the draft EPA Guidelines (2017), the relevant components of this chapter will examine the attributes and characteristics associated with:

- Land use and social considerations, including effects on general amenity, journey characteristics, severance, amenity uses of the site or of other areas in the vicinity;
- Economic activity including employment and tourism; and
- Human health, considered with reference to and interactions with other environmental receptors contained in corresponding chapters such as air, noise, traffic, flooding, as appropriate.

The above-listed topics are discussed in terms of their relevance to the assessment in the following sections.

6.2.6.2 Land Use Change

Land use changes can affect populations in different ways. Planning policy plays an important role in guiding and facilitating approximate changes in land use which can influence settlement as well as transportation patterns. Planning policy ensures these changes are managed sensitively and are appropriate to the unique, existing and emerging social, economic and environmental conditions. The primary consideration relating to land use change is to assess whether the proposed development conforms with land use policy and to identify if the proposed development is likely to change the intensity of patterns, types of activities and land uses. Therefore, a review of planning policy was carried out as part of this assessment as well as an assessment of the existing and emerging baseline and its capacity to absorb predicted changes.

6.2.6.3 Journey Characteristics

Journey length refers to the distance associated with a journey, whilst duration is the time taken to make the journey. Average walking speed for pedestrians is taken to be 5 km/h. Average cycling speed is assumed at 20 km/h. Impacts on journey amenity and community severance are described below. There are obvious interactions between each of these categories and with economic impacts and therefore the assessment is combined with positive impacts resulting from a decrease in journey length/ time and negative impacts resulting from an increase in journey length/time. In addition, new transport facilities can improve accessibility or connectivity through the combined effect of reduced journey time and reduced severance.

6.2.6.4 Journey Amenity and General Amenity

The assessment of journey amenity relies on the significance categories given in Table 6.3 and is supported by cross-reference where necessary with the relevant Chapters. The level of traffic on a road, the proximity and separation of footpaths and cycle-paths,

the nature of any crossings/junctions to be negotiated, the legibility of a journey (including signage), visual intrusion (including sightlines) and safety for equestrians, are amongst the factors relevant to the assessment of amenity, as are the number and types of people affected. The principal concern is with pedestrians and cyclists, but journey amenity impacts also apply to drivers; for example, due to safety and anxiety associated with the crossings of major roads. There are interactions, too, with the assessment of journey characteristics and community severance.

6.2.6.5 Severance

The definition of severance is not precise. Severance is an impact of transport infrastructure development such as roads or bridges. Its effect is to discourage community interaction and it occurs where access to community facilities or between neighbourhoods is impeded by a lengthening of journey time or by the physical barrier. For example, construction of a road can result in a physical barrier but can also create further severance affecting communities due to high traffic volumes or perimeter fencing.

Sensitive groups are identified specifically where they comprise a higher proportion of pedestrian journeys or where specific amenities are associated with these groups. Sensitive groups can include young and older population cohorts, the mobility impaired and people at risk of social isolation. Relevant facilities include schools, surgeries, hospitals, churches, post offices and shops.

Table 6.4 provides a guide to criteria used in the assessment of severance. Where the assessment varies from these definitions due to the context in which the impact occurs, the reasons for the assessment are discussed in the text. There may also be potential for interactions with journey amenity.

Table 6.4 Criteria Used in the Assessment of Severance

Impact Level	Significance Criteria
Imperceptible	No noticeable consequences for journey patterns
Not significant	Some minor effects on connectivity but present journey patterns are maintained.
Slight	Slight effects on connectivity but journey patterns are maintained with some hinderance to movement.
Moderate	Moderate effects on connectivity. Some moderate hinderance to movement is likely to be experienced by some populations but journey patterns maintained.
Significant	Significant effects on connectivity i.e. changes could dissuade/ promote populations from making particular journeys or result in requirement for alternative route to origin and destination.
Very Significant	Very significant effects on connectivity i.e. dramatic changes could dissuade/ promote populations from making particular journeys or result in requirement for alternative route to/from origin and destination.
Profound	Profound changes to connectivity. Populations are likely to be required to completely alter journey patterns.

6.2.6.6 Economic Impacts

Economic and employment impacts occur at both the regional and local scale and can be either positive or negative. Economic impacts are assessed at a community level however development may affect identifiable local business. In this case, impacts on

individual companies are discussed where relevant. Other economic impacts could affect the wider community, for example where a number of businesses are affected, tourism, or where the retail or business environment of a City/town is impacted.

6.2.7 Human Health Impact Assessment Categories

This section describes the methodology relating to the assessment of human health effects. Health, as defined by the World Health Organization (WHO), is *"a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."* The United States Environmental Protection Agency (USEPA) Human Health Risk Assessment is a useful framework for considering potential human health impacts. It includes four basic steps to inform decision making detailed in the Table 6.5 below.

Table 6.5 Framework for considering potential human health risk/impacts. (informed by USEPA)

Step 1 – Hazard Identification	Examines whether a stressor has the potential to cause harm to humans and/or ecological systems, and if so, under what circumstances. For example, in the case of transport infrastructure project one might consider an emission such as noise or air pollutants and examine its potential for harm.
Step 2 – Dose Response Assessment	Examines the numerical relationship (emission standards) between exposure and likely human health response/effects. For example, typically when the dose/ emission increases the response/health effect increases. Some individuals may have a different dose response/ health effect than others e.g. vulnerable groups such as the old, very young or sick.
Step 3 – Exposure Assessment	Examines what is known about the frequency, timing, and levels of contact with a stressor (e.g. emission). For example, estimating human exposure to an emission/agent in the environment or estimating future exposure of an agent that has not yet been released/ present in the environment.
Step 4 – Risk Characterisation	Examines how well the data support conclusions about the nature and extent of the risk from exposure to environmental stressors. A risk characterisation conveys the risk assessor’s judgment as to the nature and presence or absence of risks, along with information about how the risk was assessed, and where assumptions and uncertainties still exist. (This includes cross-referencing with the other environmental chapters of this EIAR).
<i>Note: Informed by USEPA</i>	

6.2.7.1 Significance of Health Effects

The assessment of significance relates to the identification and assessment of potential human health effects on the community. It does not assess effects on an individual basis. It is recognised that some individuals may have a different response to effects than others. Examples might include vulnerable groups, such as the elderly, very young or the sick.

The EPA Revised Draft Guidelines on the information to be contained in Environmental Impact Statement (August 2017) states, *"The evaluation of effects on these pathways is carried out by reference to accepted standards (usually international) of safety in dose, exposure or risk. These standards are in turn based upon medical and scientific investigation of the direct effects on health of the individual substance, effect or risk. This practice of reliance upon limits, doses and thresholds for environmental pathways,*

such as air, water or soil, provides robust and reliable health protectors [protection criteria] for analysis relating to the environment.”

The significance criteria to assess human health effects is defined in Table 6.6 (as per EPA revised Guidelines). The quality of impact (*positive, negative or neutral*), the probability, duration and timing of effects that are used to qualify the type of human health impact are defined in Table 6.6.

Table 6.6 Criteria Used in the Assessment of Human Health Impacts (adapted from the EPA)

Impact Level	Significance Criteria
Imperceptible	An effect capable of measurement but without significant human health consequences.
Not significant	An effect which causes noticeable changes in the character of the environment without affecting the community human health sensitivities.
Slight	A slight/ small effect which causes noticeable changes in the reported symptoms of the population without affecting the community human health sensitivities (morbidity or mortality).
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging community's human health baseline trends.
Significant	An effect which, by its character, magnitude, duration or intensity significantly alters a sensitive aspect of the environment affecting human health (morbidity or mortality).
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment affecting the community's human health (morbidity or mortality).
Profound	An effect which changes a sensitive characteristic of the environment that profoundly affects the human health status of the community.

6.2.7.2 Health Based Standards

Health based standards are set by bodies such as World Health Organisation (WHO) and the European Union (EU). The standards are environmental health thresholds set for a range of environmental parameters to ensure no adverse health effects on the most vulnerable in society. For example, air quality and noise levels are set at levels to protect the vulnerable, not the robust (see Chapter 12 Noise and Vibration and Chapter 13 Air Quality and Climate for the relevant standards). These standards are set to ensure scientific analysis (i.e., modelling) is undertaken on the baseline environment which includes an analysis of the likely changes in the receiving/baseline environment as a result of the proposed development to predict potential human health effects. This results in a level of certainty in relation to the potential effects (positive or negative) before a project is developed. This scientific analysis provides decision makers with a clear methodology outlining what information was used, data gaps and any assumptions that were made in order to provide a comprehensive assessment of impacts on human health.

Regardless of the methodology, psychological effects or well-being effects are difficult to measure as these effects are more subjective in nature. It must also be recognised that there are uncertainties in relation to assessing impacts on individuals due to availability of health data about individuals and the difficulty in predicting effects on individuals, which could be based on a variety of assumptions. Subsequently, the

existing receiving environment and relevant health-based standards assessment are relied upon to arrive at conclusions relating to likely human health effects.

6.2.7.3 Identification of Vulnerable Groups

The population baseline characteristics or the community profile is required to inform the assessment of the proposed development on human health and this informs the identification of potential vulnerable groups in the environment. Children and adolescents constitute a vulnerable group as they lack the experience and judgement displayed by adults. Studies also show that they may be more sensitive than adults to noise and air pollution and other environmental impacts.

Older people also constitute a vulnerable group, but this can vary depending on a number of factors including level of income, education, deprivation and individual preferences or genetics. However, an assumption can be made that older populations move slower than their younger counterparts, particularly when moving around in traffic and public places. Older persons are also more vulnerable to health conditions occurring than their younger counterparts. Ease of access to medical and community facilities become very important in maintaining health and quality of life outcomes for all cohorts. Vulnerable groups in general have greater sensitivity to air pollution and potential effects on the respiratory system and cardiovascular system. There are many reasons for this including the possible presence of other medical conditions such as respiratory or cardiovascular disease. Some subtle changes in the environment have the potential to have an adverse effect that would not be experienced by a younger more resilient person. Other vulnerable groups also include the mobility impaired or psychologically ill.

6.2.7.4 Hazard Identification

Human health impacts related to transport infrastructure can arise as a result of a variety of factors and interactions across environmental receptors e.g. traffic accidents or safety issues, air and noise pollution, impacts on water quality, flooding, etc. which have the potential to cause a threat to the health of populations and the wider environment. Therefore, all aspects of the environment influence human health to some degree or another.

A literature review was performed and identified recognised health effects of road and bridge construction and operations on human health. Transport can affect health outcomes both directly and indirectly. For example, directly through air pollution or traffic accidents and indirectly, as a result of supporting an increase in car-based transport which in turn increases the fossil fuelled vehicles on roads, thereby increasing carbon emissions into the atmosphere and contributing to climate change.

Although somewhat outdated, the information contained in the Institute of Public Health (IPH) published *Health Impacts of Transport* (2005) is still relevant today where it analysed the pathways from transport to health, as presented in Plate 6.2. The main impacts can be summarised as: road traffic injuries, air pollution, noise pollution, effects on physical activity, effects on community (social networks, social capital on health) and social inclusion (effect on access and social inclusion).

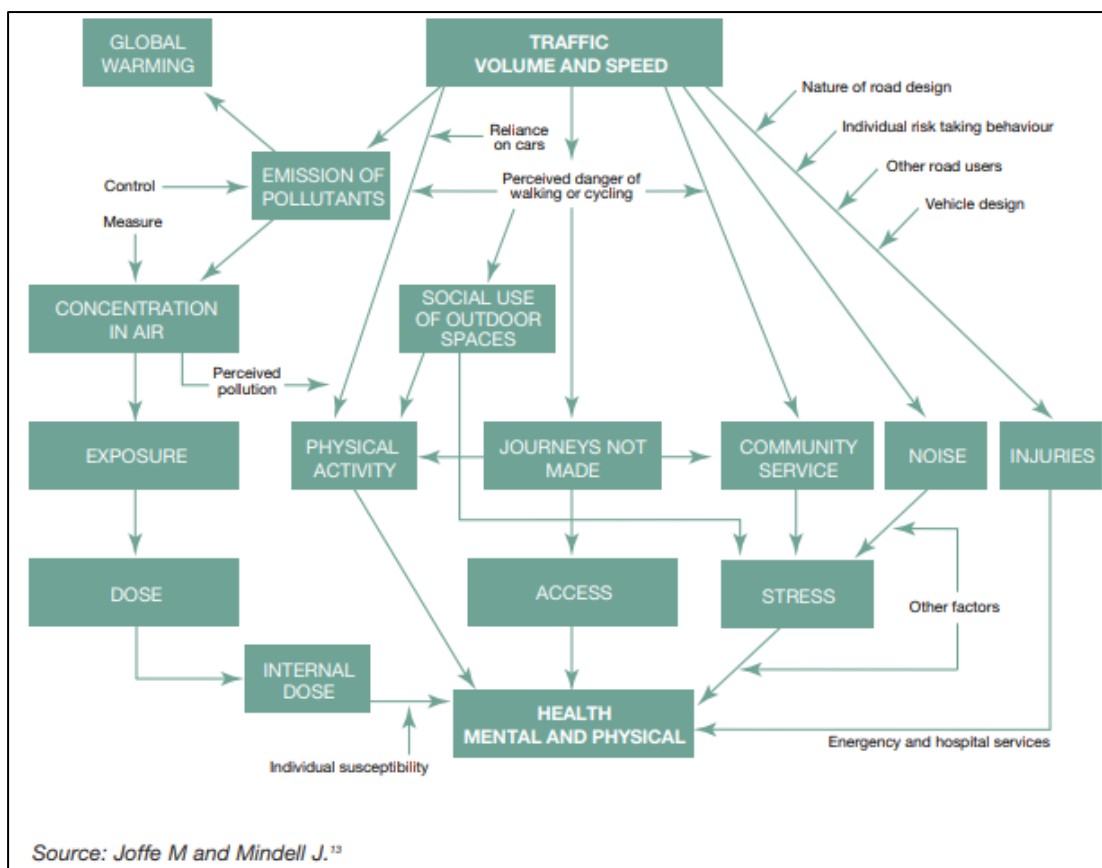


Plate 6.2 Pathways from transport policy to health outcomes (IPH, 2005)

Hazards to human health that can be classified under four headings: physical, psychosocial, chemical and biological hazards and are summarised in Table 6.7.

Table 6.7 Four Main Hazards to Human Health

Physical Hazards	Psychosocial Hazards	Chemical Hazards	Biological Hazards
<p>The main physical hazards identified are:</p> <ul style="list-style-type: none"> Noise (including nuisance/disturbance, noise induced hearing impairment, interference with speech communication, sleep disturbance, hypertension and cardiovascular disease), Vibration (including nuisance) Air quality (including construction dust, carbon monoxide, fine particles, etc.), Water quality (including effects due to contaminated land); Soils (contamination of land); Traffic – including collisions, injuries or worst-case fatalities); 	<p>The main hazards identified include:</p> <ul style="list-style-type: none"> Nuisance Anti-social behaviour 	<p>The main hazards identified include:</p> <ul style="list-style-type: none"> Heavy metals, Contaminants. 	<p>The main biological hazards identified are:</p> <ul style="list-style-type: none"> Surface water and ground water (including water contamination) Aspergillus (A fungi with potential for human health impacts) Rodent-borne diseases e.g. Leptospirosis

Physical Hazards	Psychosocial Hazards	Chemical Hazards	Biological Hazards
<ul style="list-style-type: none"> Other physical hazards e.g. radon 			

6.2.7.5 Impact of Emissions to Air

Air quality is generally classified as good in Ireland. However, traffic is a key pressure on air quality and is the main cause of air quality problems in our larger towns and cities (EPA, 2016). Vehicles emit a range of air pollutants including nitrogen oxides (NOx), particulate matter (PM₁₀ and PM_{2.5}), black carbon and volatile organic compounds (VOCs) particularly present in urban areas and areas with high congestion levels. There are significant human health impacts from particulate matter (PM) and nitrogen oxides (NOx) emissions, which include cardiovascular disease, lung disease and heart attacks (EPA, 2015).

National standards for ambient air pollutants in Ireland have generally ensued from Council Directives enacted in the EU. In order to reduce the risk to health from poor air quality, National and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or “Air Quality Standards” are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set (see Chapter 13, Table 13.1 and Appendix 13.1 Ambient Air Quality Standards 2011 and Dust Deposition Limits of this EIAR). Institute of Air Quality Management (IAQM) guidelines (IAQM 2014) for assessing the impact of dust emissions from construction and demolition activities based on the scale and nature of the works and the sensitivity of the area to dust impacts are the basis for the human health assessment.

6.2.7.6 Impact of Noise and Vibration Emissions

Noise is measured using the standard decibel scale (dBA). The “A” represents a weighting that mimics human hearing. It is important to note that because the decibel is a logarithmic scale i.e. non-linear scale, therefore the figure can be somewhat confusing. An increase in 3dB means a doubling of the sound intensity in energy terms. However, the human ear does not normally perceive this degree of increase in volume. Normally, a 10dB increase in noise levels equates to a subjective doubling in audible sound.

According to the WHO, noise is the second greatest environmental cause of health problems, after air quality. Excessive noise can seriously harm human health, affect mental health and people’s daily activities including in sensitive receptors such as residential properties, schools, workplace and during amenity or leisure time. EPA, 2016 states that “noise can disturb sleep, cause cardiovascular and psychophysiological effects, reduce performance and provoke annoyance responses and changes in social behaviour”.

EPA, 2016 also states that “a study commissioned by the European Commission on the health implications of road, railway and aircraft noise in the European Union (RIVM, 2014) found that exposure to noise in Europe contributes to:

- about 910,000 additional prevalent cases of hypertension;
- 43,000 hospital admissions per year;
- at least 10,000 premature deaths per year related to coronary heart disease and stroke.” (EPA, 2016)

The assessment and management of noise from the infrastructural transport sources (roads, rail, and airports) are governed by the Environmental Noise Directive and associated 2006 Environmental Noise Regulations (S.I. 140 of 2006).

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. In lieu of statutory guidance, an assessment of significance has been undertaken as per British Standard BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Noise.

The approach adopted here calls for the designation of a noise sensitive location into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded at this location, indicates a significant noise impact is associated with the construction activities.

BS 5228-1:2009+A1:2014 sets out guidance on permissible noise levels relative to the existing noise environment. Table 12.1 of Chapter 12 sets out the values which, when exceeded, signify a significant effect at the façades of residential receptors (replicated in Table 6.8).

Table 6.8 Example Threshold of Potential Significant Effect at Dwellings

Assessment category and threshold value period	Threshold value, in decibels (dB) ($L_{Aeq, T}$)		
	Category A ^A	Category B ^B	Category C ^C
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
Evenings and weekends ^D	55	60	65
Night-time (23:00 to 07:00hrs)	45	50	55

^A Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.

^B Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.

^C Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.

^D 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

For the appropriate assessment period (i.e. daytime in this instance) the ambient noise level is determined through a logarithmic averaging of the measurements for each location and then rounded to the nearest 5dB. If the construction noise exceeds the appropriate category value, then a significant effect is deemed to occur.

Table 6.9 presents the DMRB (2011) likely impacts associated with change in traffic noise level. The corresponding significance of impact presented in the 'EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR), Draft, August 2017 is presented alongside this for consistency in wording and terminology for the assessment of impact significance.

Table 6.9 Likely Impact Associated with Change in Traffic Noise Level

Change in Sound Level DMRB, 2011 (dB L _{A10})	Subjective Reaction DMRB, 2011	Impact Guidelines for Noise Impact Assessment Significance (Institute of Acoustics)	Impact Guidelines on the Information to be contained in EIAR (EPA)
0	No change	None	Imperceptible
0.1 – 2.9	Barely perceptible	Minor	Not Significant
3.0 – 4.9	Noticeable	Moderate	Slight, Moderate
5.0 – 9.9	Up to a doubling or halving of loudness	Substantial	Significant
10.0 or more	More than a doubling or halving of loudness	Major	Very Significant, Profound

The criteria above reflect the key benchmarks that relate to human perception of sound. A change of 3 dB(A) is generally considered to be the smallest change in environmental noise that is perceptible to the human ear. A 10dB(A) change in noise represents a doubling or halving of the noise level. The difference between the minimum perceptible change and the doubling or halving of the noise level is split to provide greater definition to the assessment of changes in noise level.

What determines its significance is the amount of the exceedance. The other factor that needs to be considered is the baseline. If the change from the current baseline is 3dB or less, even if the absolute levels are above 55dB the change is likely to be imperceptible.

It is assumed that average noise levels in a building with windows open will be at least an estimated 15dB less than outside. Average sound inside a building with the windows closed can be greater than 35dB, depending on the building fabric. Accordingly, the attenuation can vary depending on the size of windows, building type and other factors. The potential health impacts due to noise include:

- Noise-Induced Hearing Impairment
- Interference with speech communication
- Disturbance at schools
- Sleep disturbance
- Hypertension and cardiovascular disease

In terms of the health effects of environmental noise there is some limited evidence of effects on blood pressure, cardiovascular risk, school performance and in relation to sleep disturbance. Any effects demonstrated are more likely at higher noise levels. Many effects are only demonstrated with ambient noise in excess of 70 dB. Whilst noise levels are often quoted with respect to potential effects on health and they are used in the significance assessment, it should be noted that the differences in significance between the different levels are relative rather than absolute.

6.2.7.7 Impact of Emissions to Hydrology and Hydrogeology

Emissions standards and pathways that affect human health relating to hydrology and hydrogeology include water quality and flood risk. From a human health perspective these pathways are discussed below.

Water quality

Construction and operational (fuel spillages, etc) activities pose a risk to watercourses, particularly contaminated surface water runoff from construction activities entering the watercourse. Impacts to sources of drinking water are also sensitive and should be considered as part human health issue in this context.

Flood Risk

Hydraulic structures such as flood defences, bridges, culverts, channel diversions and outfalls can, if not appropriately designed, impact negatively on upstream water levels causing potential increased flood risk.

6.2.7.8 Impacts of Emissions to Soil

Consideration of likely emissions to and from a project relating to contamination of soil or the potential to uncover contaminated land based on previous land uses (e.g. landfill, industrial, manufacturing uses) have the potential to affect human health. During construction activities there is potential to unearth or uncover previously buried materials or contaminants and depending on the nature of the contamination may have the potential to effect human health if not appropriately addressed.

Radon is a naturally occurring radioactive gas that originates from the decay of uranium in rocks and soils. It is colourless, odourless and tasteless and can only be measured using special equipment. Radon rises up through the ground to disperse in the air and only becomes a health hazard when it is trapped in buildings.

6.2.7.9 Psychosocial Impacts

Consideration of likely negative psychosocial hazards relating to the new developments include; nuisance, anti-social behaviour and suicide. On the contrary, there could also be positive psychosocial impacts on the community due to improved connectivity particularly for pedestrians and cyclists and as a result of regeneration associated with landuse changes and increased economic prosperity. Due to the subjectivity relating to psychosocial effects it is not possible to use a standard based approach in this assessment.

Demolition and property acquisition can also have impact on both the occupants themselves but also at community level due to impact on community ties and amenity of residents, local economy, etc.

6.3 Description of Receiving Environment

6.3.1 Introduction

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City, refer to Figures 1.1 in Volume 3 of this EIAR. The development extends for approximately 1km to the west and 100m to the east of the Waterford (Plunkett) Station, following the alignment of the existing quay wall and the Iarnród Éireann (IÉ) railway corridor located to the north of the proposed development.

The proposed flood defence measures are for the protection of critical infrastructure including the existing Plunkett Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout. The proposed development will also form a continuation of the flood protection measures, Flood Defences East proposed along

the North Quays Strategic Development Zone (SDZ) as part of the Transport Hub Part 8 planning approval, eliminating the risk of flooding to the Transport Hub.

A design flood level of +4.0m OD (metres above Ordnance Datum Malin) is proposed for this development. The design flood level has been based on a flood with an annual exceedance probability of 0.5% and allowances for climate change and isostatic tilt as noted below.

The design (top-of-wall) level for the proposed flood protection measures is +4.30m OD (metres above Ordnance Datum Malin). The following allowances are integrated into the proposed height of the flood defence walls:

- 0.5% annual exceedance probability combined tidal-fluvial event (+3.45 m OD);
- An additional 0.55m to allow for climate change and isostatic tilt; and,
- 0.30m freeboard to the wall, including local wave wake effects.

The proposed flood protections measures will consist of:

- Construction of overground flood defences in the form of c.170 of glass flood barriers for the Rice Bridge Roundabout and the three roundabout arms (R680 Rice Bridge, R448 Terminus Street and R711 Dock Road) and c.15m of demountable flood barriers on the R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.
- Remedial Works to c.75m of existing quay wall by raising its height by 0.6m to 1.2m to conform with the design top-of-wall level of +4.30m OD.
- Construction of c.365m underground impermeable trench within the car parking areas in front of the Plunkett Station;
- Construction of c.730m of new sheet pile flood defence wall consisting of:
 - c.540m of sheet pile wall within the foreshore, 1m from the front face of the existing quay wall.
 - c.190m of sheet pile wall will be installed on Iarnród Éireann land, 1 m behind the existing quay wall. Construction of a c.30m underground isolation structure composed of underground sheet piles and of temporary overground flood barriers (e.g. water filled inflatable flood barriers) should these be required to be implemented during a flood event.
- Drainage works consisting of:
 - Remedial works to the existing drainage outfalls to the River Suir by extending them to reach an outlet within the new sheet pile wall and/or retrofitted to pass through the new sheet pile wall, and installation of non-return valves.
 - Construction of new trackside drainage and groundwater drains to include 2 no. pumping stations and 3 no. surface water outfalls to the River Suir.

Context

The proposed development is located on the periphery of Waterford City along the northern bank of the River Suir. The proposed development will defend lands which are primarily utilised for industrial and commercial uses from flooding, in extreme flood events. This includes the rail line servicing Waterford City and the Port of Waterford. Passenger rail services currently terminate at Plunkett Station which serves the city. An integrated multi-modal transport hub is also planned to be developed along the Dock Road which received planning approval as part of a Part 8 Planning Application. The proposed development will ensure that rail infrastructure is protected, promoting

resilience in extreme events. The rail line is bounded to the north by Plunkett Station, Irish Rail / industrial yards and the R448 regional road. The proposed development is consistent with the planning policy of the Waterford City Development Plan 2013-2019 regarding promoting sustainable transport use.

Character

Waterford City has a rich, historical and maritime past. Waterford City has a strong historical urban centre, rich in architectural heritage and supports a range of commercial and mixed-use developments serving the City and south east region population. The River Suir still influences the character of the city with national and international boats berthed on the six pontoons that line the south quays year-round. Meagher's Quay on the south of the River Suir is the location of extensive carparking area servicing the everyday carparking needs of people working and/ or visiting the City. The main road access to the city centre is via the R680 over Rice Bridge and along the south quays.

The site of the proposed Flood Defences West project is located to the northwest of the city centre on the northern edge of the River Suir, to the west of Rice Bridge. It is located approximately 0.7-1.5km northwest / west of Waterford city centre (Broad St / Barrow St). The site extends for approximately 1.0km and is oriented generally east - west. The land uses are industrial, focused on the Irish rail infrastructure. The development site is narrow as it follows the existing quay wall south of the IÉ train tracks, widening out at the eastern side, south of Plunkett Station to almost 100m, where it encompasses the existing railway station and the Rice Bridge roundabout. Most of the land use within the footprint of the site is infrastructure. There are no trees or significant landscape vegetation within the site.

Significance

Waterford City is the key city in the south east region and the National Planning Framework (NPF) focuses on supporting its continued growth and development. The NPF supports ambitious growth targets to enable Waterford City along with Cork, Limerick and Galway to grow by at least 50% to 2040 and to enhance their significant potential to become cities of scale. The rail line that terminates at Plunkett Station links Waterford City to the national rail network. The rail line and Plunkett Station are currently vulnerable to flooding in extreme events.

Sensitivity

There are no schools, childcare facilities/ crèches, sports grounds, libraries and community centres located within 500m of the proposed development lands.

Sensitive receptors present in the immediate study area (within 500m) on the south of the city include: Waterford Marina Hotels (Granville Hotel, Dooley's Hotel), Waterford Bus Station and bus stops, banking services and shops. A range of retail and commercial units, tourism facilities and services operate along the south quays and in the wider city centre area.

Sensitive receptors present on the north of the city (within 500m) include a number of residential areas associated with the Ferrybank residential areas, Plunkett Station and a range of neighbourhood facilities including shops. The Waterford Golf Club is located on elevated lands to the north of the R448 across from the road from the proposed development.

Other examples of sensitive community facilities in the wider 1km study area include: a range of schools, medical, religious and cultural and institutions, leisure centres, gyms, GAA, rugby and soccer clubs. Waterford City has rich tourism and amenity offer including historical sites in the city, nature walks and tours along the River Suir and surrounding landscape. The city has many supporting services including hotels, hostels, café, restaurants, etc. Due to the urban location and mixed-use city centre nature of the area, populations in these areas are considered to be more adaptable and less sensitive to change than their rural counterparts.

The River Suir serves an important function from an amenity, recreation and well-being perspective for city dwellers and visitors alike. It is currently used as a river walk on the south quays of the city and is deemed to be a sensitive natural and ecological resource. It is sensitive from an amenity, landscape and visual perspective and from a cultural heritage perspective as the South quays are designated as an Architectural Conservation Area (ACA). Public access to the River Suir is restricted for the general public from lands within the proposed development as they are privately controlled and utilised by Iarnród Éireann.

There has been a consistent decline in unemployment rates in the South East region which is a good indicator of increasing economic activity. Although, Waterford City unemployment rates are improving but are still high (18.8% when compared with the State 12.9%) Census 2016. In terms of demographics, Waterford City has a very young and ageing population, and both of these cohorts are considered to be vulnerable from a health perspective. The HP Pobal deprivation scores (Table 6.) indicate that the majority of the study area is either 'marginally below average' affluence or 'disadvantaged'.

A more detailed description of the baseline environment including sensitivities is presented under the following sections to include:

- Land use and Social considerations: including population, deprivation levels, age profile, amenity and community infrastructure;
- Economic Activity including tourism; and
- Human health aspects.

6.3.2 Land Use and Social Considerations

The proposed development site is characterised by its industrial land uses immediately to the north, and the River Suir directly to the south. The Iarnród Éireann (IÉ) lands to the north consist of Plunkett Station, railway and associated yards. The railway constitutes strategic infrastructure connecting Waterford City to the rest of Ireland. The lands are wholly owned by IÉ with public access limited to the existing Plunkett Station (see Chapter 16 Material Assets and Land for further information regarding land ownership). The River Suir is a navigation channel and is a source of ecological, recreation, amenity and economic value. Furthermore, the site of proposed development is located directly to the west of the North Quays Strategic Development Zone (SDZ).

6.3.2.1 NQ SDZ Planning Scheme (2018)

The NQ SDZ Planning Scheme was adopted by elected members in February 2018. The Waterford North Quays SDZ Planning Scheme 2018 aims to promote the expansion of the City Centre to the north of the River Suir in a manner that enhances and supports balanced and sustainable growth in Waterford City and encourages its vitality and viability and to create a sustainable urban environment, which respects it's

natural, historic and cultural heritage, whilst providing sustainable solutions that address and manage the risk of flooding and climate change.

The Vision for the area is to provide for the development of the sustainable, mixed use, modern compact extension to the city centre and a regeneration catalyst for the city that includes a multi modal transport hub. Plate 6.3 illustrates the location of the transport hub and access strategy provisions required to support the SDZ.

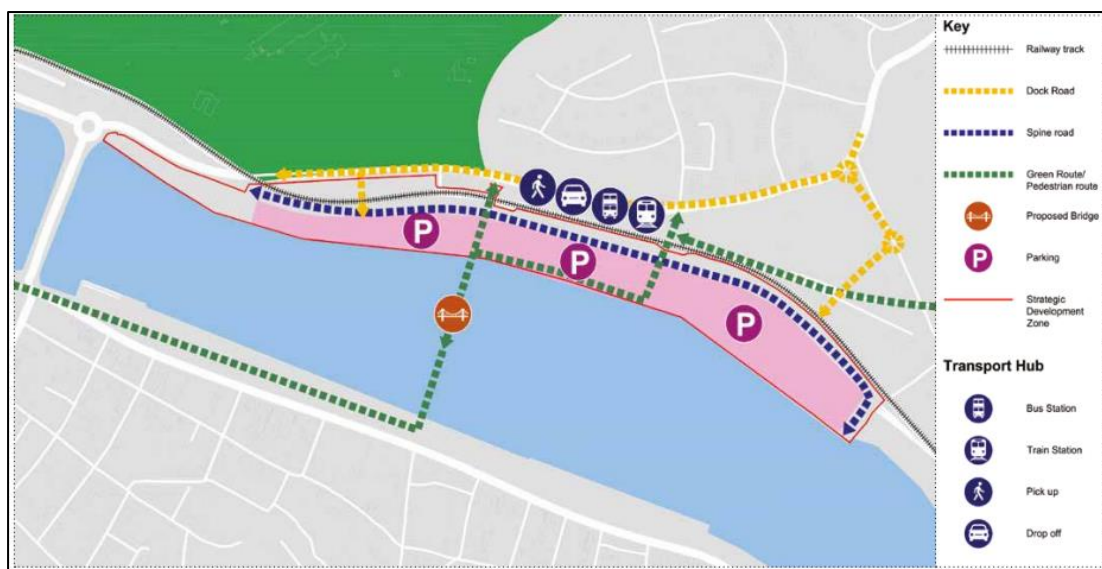


Plate 6.3 Transport Hub and Access Strategy (Source NQ SDZ Planning Scheme)

The improved location of the train station in the Transport Hub development will enhance access to the site for those using active modes or public transport. This will positively impact travel to and from Waterford, providing a better connection to a wider catchment of people outside of Waterford City and providing better connectivity for tourists arriving by train to the city. This would complement Irish Rail's long-term strategic plan for Waterford, to provide an hourly service to Dublin in addition to a peak hour commuter service to Carlow & Kilkenny.

Planning approval for the SDZ Transport Hub was granted in September 2019 as part of a Part 8 planning application. Flood defence measures, Flood Defences East have been proposed as part of this planning application that will protect the SDZ lands, including the area to the east of the Rice Bridge roundabout. The proposed Flood Defences West will connect with the Flood Defences East and will provide flood protection for the entire north quays area of Waterford City. The proposed development will protect the existing rail infrastructure and will facilitate the development of future rail services as part of the SDZ Transport Hub.

6.3.3 Population

Census 2016 reports that there was a total population of 48,216 persons in City Waterford. Waterford City and Suburbs had a population of 53,504. The population of Waterford City and suburbs increased by 3.85% between 2011 and 2016 which is largely in line with the population growth of the State.

The proposed development is located in the two Electoral Divisions (EDs) (Ferrybank and Kilculliheen). In 2016 census, the total combined population residing within these EDs was 6,104 persons. Due to the nature of the existing land uses there are no properties within 100m of the proposed development, however there are a number of

residential properties along the Dock Road that are located within close proximity. The Ferrybank ED reported a 53-person decline (-5.3%) between 2011 and 2016 with a total of 858 persons residing there in 2016. In contrast, Kilculliheen increased by 9% to a total of 5,246 persons over the same period. Together, both EDs comprise the Waterford City suburbs north of the River Suir. Refer to Plate 6.1 Study Area for Population and Human Health Assessment.

There have been consistent increases in the population of Waterford City in the study area except in the Ferrybank area which has experienced consistent population decline as detailed in Table 6.9. The population in County Waterford is higher than in the City – a trend similar to other Counties across Ireland however the County has been experiencing a decline in population since the last census period which could be attributed to the economic decline and subsequent migration patterns to urban areas across Ireland or abroad.

Table 6.9 Population Change in the Study area by Electoral Division, City and County (Census, 2016, 2011)

Study Area (500m) Electoral District	Population 2011	Population 2016	% change 2011-2016
Aglish	871	883	1.4
Ferrybank	911	858	-5.8
Kilculliheen	4811	5246	9.0
Custom House B	213	269	26.3
Centre A	679	791	16.5
The Glen	566	742	31.1
Bilberry	718	802	11.7
Military Road	821	763	-7.1
Cleaboy	2576	2556	-1
Gracedieu	1234	1662	34.7
EDs within 1km Study Area	Population 2011	Population 2016	% change 2011-2016
Dunkitt	1058	1015	-4
Shortcourse	274	301	9.9
Ballybricken	130	145	11.5
Custom House A	287	353	23.0
Centre B	233	236	1.3
Mount Sion	747	849	13.7
Morrison's Avenue East	560	510	-8.9
Morrison's Avenue West	295	300	1.6
Morrison's Road	508	490	-3.5
Newport's Square	556	543	-2.3
Park	1382	1520	10.0
Slievekeale	592	593	0.2
Waterford City	46,732	48,216	3.17

Study Area (500m) Electoral District	Population 2011	Population 2016	% change 2011-2016
Waterford County	69,444	67,960	-2.14

6.3.3.1 Age profile and dependency ratio

Waterford City has a young population profile relative to the national average as can be seen from the age profile graph in Plate 6.4. The majority of the population in Waterford is between the 20 to 39 years age group cohorts. The largest cohort is 35-39 reflecting the last 'baby boom' of the early 1980s. The age profiles illustrate the large increase in fertility (birth) rates and increase in the number of older (over 65+) population reflective of the national trend whereby people are living longer.

Age dependency ratio is the population ratio of those typically not in the labour force (0-14 and 65+) and those typically in the labour force (15-64). It indicates the pressure on the productive population to support services for younger and older age cohorts of the population. The age profile indicates that there is a high older dependency ratio across the study area with 16% of the population 65 years of age or over. The average age dependency ratio for the study area is very high at 31.30. This figure indicates that there is currently pressure on the population and a higher potential for pressure to occur on productive population to support the younger and older age cohorts now and into the future. This will also have pressure on landuse and services to support the changing needs of the population over time such as medical care, social, education and community services.

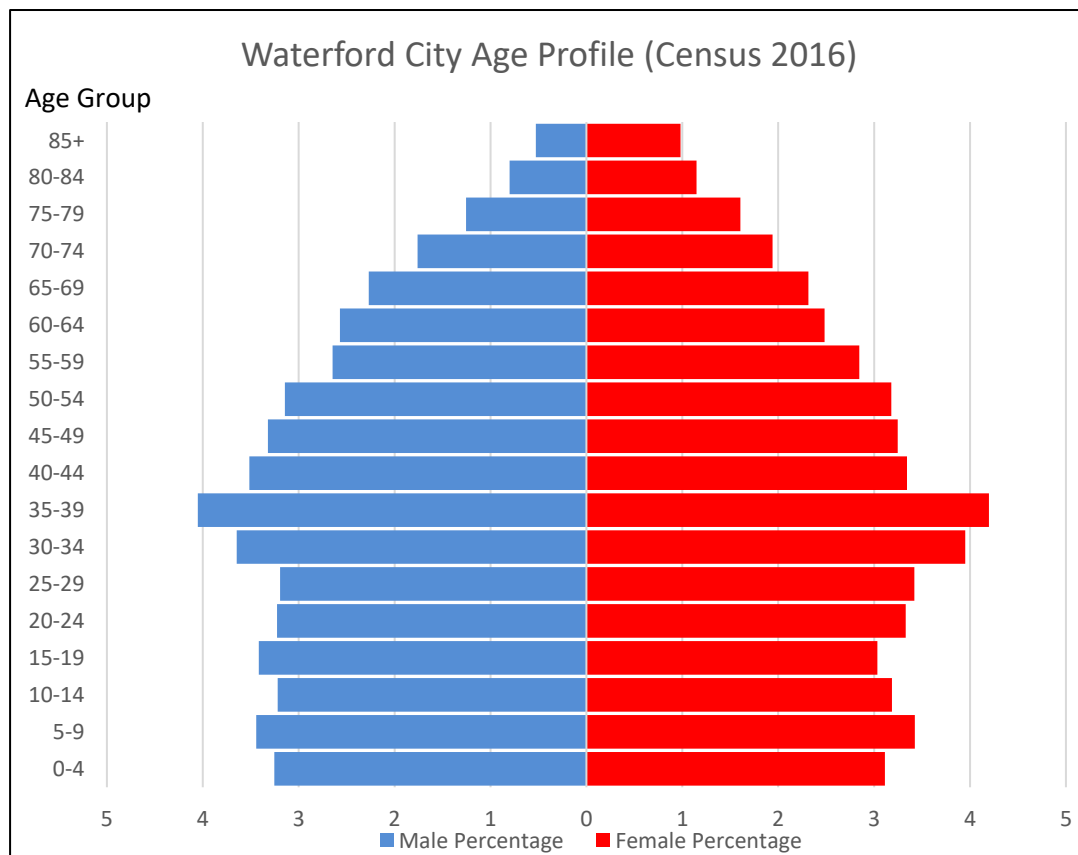


Plate 6.4 Waterford City Age Profile

6.3.3.2 Households and household formation

In 2016, there were 18,958 households in Waterford City with 8,066 within the study area. Waterford City largely comprises 1 or 2 person households with the next biggest category being 4 and 3 person households respectively. There is approximately 20% of the population in the study area in local authority rented accommodation.

6.3.3.3 Education

Education levels have greatly improved across Ireland, particularly over the last two decades. In 2016, 42% of people in the State had a third level education compared with 13.6% in 1991. Waterford City census 2016 report 12,801 persons attained a secondary education, 7,944 attained a third level education (bachelor's degree or over) and 4,073 had a primary education. An additional 6,570 persons attained a technical, vocational or advanced higher certificate/ apprenticeship. 607 people had no formal education.

6.3.3.4 Travel to work, school or college

Census 2016 results for primary means of travel to work, school or college for Waterford City and Suburbs is set down in Table 6.10. Census figures show the majority of population travels either by 'car driver' or 'car passenger' with a combined total of 21,214 people. The second largest mode of transport is by foot with a total of 6,000 people walking. Travel by train is not a popular mode of travel in Waterford City, with only 75 persons utilising it as their primary means of travelling to work, school or college.

Table 6.10 Population aged 5 years and over by means of travel to work, school or college Waterford City and Suburbs (Census 2016)

Means of Travel	Work	School or College	Total
Car driver	12,557	670	13,227
Car passenger	1,549	6,438	7,987
On foot	2,632	3,368	6,000
Not stated	1,155	669	1,824
Bus, minibus or coach	501	866	1,367
Van	823	17	840
Work mainly at or from home	522	6	528
Bicycle	399	121	520
Motorcycle or scooter	78	12	90
Train, DART or LUAS	53	22	75
Other (incl. lorry)	43	2	45
Total	20,312	12,191	32,503

Census 2016 also reports on the travel time and indicates that the majority (13,715) of people within Waterford City and Suburbs travel under 15 minutes to work, school or college. This Census also reports that most people leave home between the hours of 08.01-08.30am (8,136) and 8.31-9.00am (7,984) as presented in Table 6.11. These times would correspond with the increase in traffic conditions/ congestions patterns witnessed during site visits along the south quays during these periods. More details on traffic movements in the area can be found in Chapter 5 Traffic Analysis of this EIAR.

Table 6.11 Population aged 5 years and over by time leaving home to travel to work, school or college Waterford City and Suburbs (Census 2016)

Time Leaving Home (am)	Persons
Before 06:30	1,927
06:30-07:00	1,601
07:01-07:30	1,855
07:31-08:00	3,916
08:01-08:30	8,136
08:31-09:00	7,984
09:01-09:30	1,866
After 09:30	2,643
Not stated	2,047
Total	31,975

6.3.3.5 Community Infrastructure

Community infrastructure is far reaching and can include a range of physical, social and economic infrastructure. Community infrastructure includes places where people can relax and enjoy public spaces such as parks or the various seating areas located along the south quays. There are a wide range of community and social services available in Waterford City and its environs. These include education and religious facilities including, primary, secondary and third level, places of worship, community centres. Community facilities include parks, sports grounds and other sports and youth centres/ clubs that are located across the study area. All of these community facilities are considered to be significant and sensitive receptors within the study area.

No community facilities were identified within 500m of the study area (with the exception of Plunkett Station. Community facilities within Waterford City and the wider urban area include: Garda stations, post offices, libraries, the City Hall and the newly refurbished courthouse. There are also a number of public spaces throughout the city / the study area including William Vincent Wallace Plaza located on the south quays, the Peoples Park, Ballybricken Green and Red Square. The recently refurbished Apple Market is a key public space which is also located in the study area.

Education facilities

Educational facilities are a significant local and regional resource and are considered sensitive receptors. Waterford City has a range of education facilities from early education (crèches) to third level. Waterford Institute of Technology (WIT) is a significant education facility in the city and region. WIT is located approximately 2.5km south west of the study area and has approximately 10,000 students. No educational facilities are present within the study area (500m). However, a large number are located in the wider study area and are listed below:

North of the River Suir:

- Abbey Community College and Ferrybank Secondary School; and
- St. Mary's Boy School.

South of the River Suir:

- St. Stephen's De La Salle Primary School;
- St. Joseph's Special School;
- Mount Sion CBS Secondary School;
- Mount Sion Primary School;
- Calvary School of Ministry;
- Our Lady of Mercy Secondary School;
- Our Lady of Mercy Senior National School;
- Presentation Primary and Secondary School;
- St. Declan's National School;
- Christchurch National School;
- Waterpark, De La Salle College;
- Newtown School;
- St. John of God, Newtown Junior School;
- Christchurch National School; and
- Waterford College of Further Education

Similarly, there are no childcare facilities present within the study area (500m). However, a large number are located in the wider study area and are listed below: Bumble Bees Creche & Playgroup, FerryFun childcare and Afterschool centre, Jeanes Montessori school, Mercy Preschool Ltd., Mount Sion play/preschool, Nurture and Grow, Play Together, St Brigid's Children's Centre, St Declan's pre-school, St Joseph's Childcare Centre, St Stephens Preschool, The Children's House Montessori School, Waterford Montessori school, Waterford Women's Centre Childcare Service. Ferrybank Library is located to the north of the city and Waterford City and County library is located on Lady Lane in the south of the city centre.

Transport infrastructure**Road Infrastructure**

The road transport network within the study area consists of the R680 Regional Road which carries traffic across the River Suir via Rice Bridge to and from Waterford South Quays. The Rice Bridge roundabout located on the north quays provides a connection to the regional road network between the city and the wider area. To the east of the roundabout, the R711 Dock Road serves the Ferrybank/Belview area before joining the N29. The R448 Terminus Street is a dual carriageway and comes towards the Rice Bridge roundabout from the west and carries traffic to and from the city via its connection to the N25. The R448 dual carriageway is located to the north of the study area.

Waterford City is connected to major surrounding regions, towns and cities through bus and train services and there is a high concentration of commuting traffic to, from and through Waterford City.

Rail Infrastructure

The study area of the proposed development contains the Waterford Railway corridor serviced by Plunkett Station, Waterford railway station. Presently, Plunkett Station serves as a significant interchange point for Intercity services from Dublin Heuston and from Limerick Junction which provides onward connections to Cork, Limerick and

Galway. Before the Covid-19 pandemic, seven train services operated each way between Waterford and Dublin from Monday to Saturday inclusive, while only four services were provided each way on Sundays. Only two train services operated each way daily between Waterford and Limerick Junction on Mondays to Saturdays inclusive.

Until 18th September 2010, there was one daily service provided each way between Waterford and Rosslare to the east along the North Quays and via Belview, however due to low passenger numbers and competition with the road network, the rail corridor was suspended (NTA, 2010). The rail service was replaced by bus services to provide connection to Waterford City from Rosslare. This railway corridor east of Plunkett Station is currently out of service and maintained by Iarnród Éireann.

The operation of the rail infrastructure in Waterford City has been impacted by recurring flood events. Over the past 15 years, flooding at, and in the vicinity of Plunkett Station has been reported in news articles and observed by the Iarnród Éireann (IÉ) Inspection Staff – the latest being in October of 2020 (see Chapter 2 Need for Proposed Development of this EIAR). It has been found that large sections of the existing quay walls which separate the rail infrastructure from the River Suir are of inadequate height and are below the design flood level of 4mOD, rendering it ineffective at protecting IÉ lands and associated rail infrastructure against flooding. The flood waters frequently enter into Iarnród Éireann (IÉ) property and affect the railway infrastructure.

Marine based community infrastructure

The River Suir serves an amenity function as well as a transport corridor. It is also the location for a number of marine based community services including Waterford City River Rescue and Waterford Marine Search and Rescue (WMSAR) both of which operate east of the proposed development. Both organisations operate on a voluntary basis and are non-profit organisations and provide 24 hour a day, 365 days per year search and rescue services on the River Suir.

Waterford City River Suir Rescue base is at the Millennium Plaza (approximately 850m downstream of the proposed development) and is a member of the Community Rescue Boats of Ireland (CRBI) and affiliated to the Irish Coast Guard.

WMSAR is based further downstream (approximately 1.5km east from the proposed development) and is also a part of the CRBI and conducts suicide prevention night patrols along Waterford City's quaysides, participates in search and rescue, maintains and monitors ring-buoys among other activities. They are also an official Irish Sailing Association (ISA) training centre.

6.3.4 Economic Activity

The South East region generates 8% of the national Gross Domestic Product (GDP), estimated to be €19.9 billion¹. There has been an overall decline in unemployment rates over the past number of years in the South East region which is a good indicator of economic activity. The following sections include a review of employment and key industries, unemployment rates and a review of commercial, retail and tourism activity in the area.

¹ Waterford Institute of Technology. 2017. *South East Economic Monitor*

6.3.4.1 Employment

The labour force consists of those who are able to work i.e., those aged 15 and over and out of full-time education. There was 91,631 persons at work in Waterford City and County in 2016 (census 2016), representing an increase of 2,416 persons recorded as working since the 2011 census. Table 6.12 provides a breakdown of the population employed in Waterford City and Suburbs at work by socio-economic group. The majority of the City's workforce (22%) are engaged in work under 'gainfully occupied and unknown', followed closely by 'non-manual' and then 'semi-skilled manual'.

Table 6.12 Persons in private households by socio-economic group Waterford City and Suburbs (census 2016)

Socio-economic group of reference person	Households	Persons
Z All others gainfully occupied and unknown	4,855	10,719
D Non-manual	4,174	10,629
F Semi-skilled	2,282	6,086
A Employers and managers	2,142	5,867
E Manual skilled	2,188	5,503
C Lower professional	2,041	5,197
B Higher professional	1,133	3,071
G Unskilled	1,247	2,908
H Own account workers	673	1,892
I Farmers	55	141
J Agricultural workers	23	56
Total	20,813	52,069

Persons at work by industry and sex in Waterford City and suburbs is presented in Table 6.13 from census 2016. These figures indicate that the majority of the workforce in the City and suburbs are engaged in professional services industry (5,476), the second largest industry is commerce and trade sector (4,510), with 'other' industry engaging 4,126 persons, followed by manufacturing industry (3,614) with a larger portion of this group involving males (2,592). Only 738 persons are employed in the building and construction industry which would be likely to increase with the proposed development and also the wider regeneration presented as a result of the NQ SDZ Planning Scheme.

Table 6.13 Persons at work by industry and sex Waterford City & suburbs (census 2016)

Industry	Male	Female	Total
Professional services	1,714	3,762	5,476
Commerce and trade	2,236	2,274	4,510
Other	2,046	2,080	4,126
Manufacturing industries	2,592	1,022	3,614
Transport and communications	946	300	1,246
Public administration	413	360	773

Industry	Male	Female	Total
Building and construction	688	50	738
Agriculture, forestry and fishing	105	26	131
Total	10,740	9,874	20,614

6.3.4.2 Unemployment

Census 2016 reports the average rate of unemployment in the State was 12.9%. Waterford City including its suburbs had the highest unemployment rate at 18.8% during this period.

6.3.4.3 Transport Infrastructure

There is extensive at-grade car parking extending from Merchants Quay east to Clyde Wharf that is operated by Q-Park. Other car parks in the city include: IPairc city square (on High street), Bolton Street car park, IPairc Apple Market carpark, waterside car park, IPairc Railway Square car park and Thomas Hill car park.

Outside of the study area, significant economic and transport activity includes: Waterford Airport (approximately 8.5km south) and the Port of Waterford located at Belview Port and associated Industrial area that are sources of major economic activity, transport and trade. The road network is also important transport and economic infrastructure and includes many local, regional and national roads including, M9 to Dublin and N25 Cork to Rosslare Europort via Waterford and N24 national primary route serving Limerick to Waterford through Tipperary all located approximately 3km north west of the site.

6.3.4.4 Marine Based Economic Activities

There is significant marine based transport and economic activity on the River Suir. The marina to the east of the proposed development (Pontoon D) is owned and operated by Port of Waterford Company, currently leased to a private operator. The economic activities associated with the Port is located downstream at Belview Port.

Waterford City Marina is located on the south side of the River Suir and extends for approximately 650m east along the south quays. River Suir Cruises offer cruises of the River for tourism and amenity purposes and operate from Pontoon C (referred hereafter as the existing floating jetty). There are also occasional cruise ship and fishing vessels that berth in the area.

Fastnet Shipping Ltd. and South East Tugs, two commercial companies, operate on the south bank of the River Suir directly across the river from the proposed development and regularly use the River Suir channel.

The area is included in an International Ship and Port Facility Security Code (ISPS) which permits any ship to berth in this area. The International Maritime Organization (IMO) states that the ISPS code is a comprehensive set of measures to enhance the security of ships and port facilities, developed in response to the perceived threats to ships and port facilities in the wake of the 9/11.

6.3.4.5 Retail Activity

Waterford City has significant commercial and retail activity. There are several retail shopping locations, primarily in the south of the city and within the study area to include: Georges Shopping Centre and City Square Shopping Centre. The retail streets of Barronstrand Street, Broad Street and New Street are also important city centre retail and commercial areas along with Michael Street and Merchant's Quay.

Economic activity on the south quays include a number of hotels, restaurants, leisure facilities, retail, financial services including banking and accounting and other professional services.

The Economic Strategy for Waterford City and County stated that in 2013 “*Waterford has an estimated catchment of 250,000 people [and] estimates indicate that aggregate retail sales in the City currently amount to €287 million (convenience) and €393 million (comparison²) per annum.*”³ The current comparison retail offer is weak when compared with Waterford’s main competitors. Both comparison scenarios considered in the Retail Strategy estimated the level of trade draw and retention of comparison expenditure within the city area will increase within the timeframe of the Strategy in line with improvements to the retail offer. It is likely that the proposed development will facilitate improved access to the NQ SDZ which is earmarked for significant retail development and as such will facilitate the growth in Waterford’s retail offer and economic activity.

The Waterford City Retail Strategy Update (2018d) household survey found that “*approximately 92% of comparison goods expenditure in Waterford City is retained by the City Centre area and attracts a further 90% of comparison expenditure from the 0-30 minute drivetime isochrone and 52% from the 30-45 minute isochrone. The survey identifies an inflow of 8% of comparison expenditure from the 45-60-minute drivetime*”.

6.3.4.6 Tourism Amenities

Tourism is a significant contributor to the region and local economy. In 2018, over 1,028,000 overseas visitors came to the South East region (Carlow, Kilkenny, Tipperary (South), Waterford, Wexford) generating €261 million in revenue⁴. Fáilte Ireland Key Tourism Facts 2018 report that the South East was the third most popular location for domestic trips in Ireland with over 1,683,000 domestic visitors travelling to the region generating €304 million revenue. Waterford City is located in ‘Ireland’s Ancient East’ a marketing initiative developed by Fáilte Ireland which includes improved transport signage across Ireland to increase visitor numbers to Ireland’s living culture and ancient heritage across Ireland.

A review of tourism related locations, community amenities and recreation facilities within the study area indicates that Waterford City has rich tourism and amenity offer including historical sites located in the heart of the city, nature walks and tours along the River Suir and surrounding area. The city has many support services including hotels, hostels, café, restaurants, tourist office, Theatre Royal, Edmund Rice centre, Garter Lane Theatre, etc. that would be considered to be significant and sensitive receptors. The Clock Tower is a significant and sensitive landmark feature along the historic south quays streetscape, located in the vicinity of the proposed south quays public plaza.

There is an amenity walkway along the existing flood defence wall on the south quays with a number of access points (gangways) to the various pontoons associated with Waterford City Marina.

² Comparison goods include clothing/footwear, medial/ pharmaceutical, newsagents/ bookshops and bulky goods/ electrical equipment to include furniture, household appliances, tools/ equipment for household or gardens, small-scale hardware and, recreation and leisure products.

³Economic Strategy for Waterford City and County (2013) DKM Economic Consultants, Colliers Int. & Brady Shipman Martin

⁴Key Tourism Facts 2018, September 2019, Fáilte Ireland

The Waterford City to Dungarvan greenway has resulted in an increase in the number of visitors to Waterford City and the surrounding areas since its official opening in March 2017. Waterford City Council reported that in 2017 a total of 247,545 people used the greenway, of which 105,639 of this were on foot while 141,906 travelled by bike. The Waterford Greenway Bilberry car park is located on the south quays, approx. 1.4km west of Rice Bridge.

In the wider study area, on the south quays, other sites of interest include: The Waterford Viking Triangle which is part of the 'cultural quarter' in the City and includes Reginald's Tower (containing the Viking museum), Waterford Treasures Medieval Museum, King of the Vikings virtual reality experience and Bishop's Palace. Waterford Crystal is located on The Mall close to where guided tours are available. The Granary is also a site of interest on Merchant's Quay.

6.3.4.7 Marine related tourism activities

The River Suir is a significant tourism attraction, source of recreation and general amenity source for the city, mariners and its many tourists. Direct access to the River Suir from the city is via the Waterford Marina, which comprises six pontoons. All six pontoons have pedestrian gangways access points to the south quays. These accesses are located from east to west: Georges Quays and off Canada Street/Canada Square, Adelphi Quay and Customs House Parade (beside William Vincent Wallace Plaza). Meagher's Quay (adjacent to the Clock Tower) and Merchants Quay. There is also some private mooring located off Adelphi Quay. Georges Quay is also the location of Waterford City Marina building.

The Waterford City Marina is fully serviced, open year-round with approximately 100 berths available. Mariners can avail of daily, weekly or seasonal rates. Access to the marina is by means of a mobile phone operated Global System for Mobile (GSM) communication system.

River Suir Cruises operate from this jetty and offer tours along the River Suir year-round.

Previous consultation with the marina operators undertaken for the River Suir Sustainable Transport Bridge EIAR which was completed in 2018, indicates that the marina is generally at capacity during peak summer months and on average 70% occupied at all other times of the year. The users of the marina comprise a significant proportion of local berth holders and visitors from Europe many of whom are from the United Kingdom including Milford Haven east of Waterford City in South Wales. Visiting boats generally stay up to 2 or 3 nights in the marina and have economic benefits to the wider City.

6.3.5 Health Profile

The majority of Waterford City reported that their health was either very good (56%) or good (29%) representing a total of 45,562 people (Census, 2016). 1.7% stated that their health was bad and 0.4% stated it was very bad (190 people). Census 2016 also reports that there were 8,333 people or 18% of the population with a disability in Waterford City. The number of carers was 2,114 persons. Types of disabilities can vary to include: physical disabilities, vision impairment, deaf or hard of hearing, mental health conditions and intellectual disability, etc.

The average lone parent ratio for the study area was 40.0 in 2016 (Pobal, 2016). The Lenus health profile for Waterford City published in 2015 (HSE, 2016) was also

consulted and reports that Waterford City had the 3rd highest percentage of lone parent households of 13.5% in the State compared to the national rate of 10.9%.

Cancer incidence rates in Waterford City and County are average or below average for all cancers, except for male malignant melanomas and male lung cancer which has the highest rate nationally (City & County data 2015). Waterford City and County has average or below average death rates for all causes, except deaths due to cancers which are above the national average.

6.3.5.1 Levels of deprivation

The Haase and Pratschke (HP) deprivation index looks at geographical areas in order to measure the relative affluence or disadvantage of a particular geographical area. These are compiled from various census under 10 key indicators including: the proportion of skilled professionals, education levels, employment levels, and single-parent households found in an area. This data is particularly useful in assessing predicted health outcomes.

Overall the south east region is the second most disadvantaged region of Ireland and Waterford City is the second most disadvantaged area within the region. Analysis of census statistics together with Pobal data indicate that Waterford City South is the third most disadvantaged local electoral areas in the State with a deprivation score of -9.4 after Cork City West (-12) followed by Glenties (-10.6)⁵.

The HP Pobal deprivation scores (Table 6.14) indicate that the majority of the study area is either 'marginally below average' affluence or 'disadvantaged'. Morisson's Road ED located within the south quays of the study area has a HP deprivation score of -20.32, 'very disadvantaged'. In contrast, the Park ED ranked the least deprived of all the areas in the study area but still scored 'marginally below average'. The combined HP Index deprivation score of the study area (500m) is -6.01.

Table 6.14 HP Pobal Deprivation Scores in the Study Area

ED's within 500m Study Area	Deprivation Score 2016	Deprivation Description
Aglish	-3.16	marginally below average
Ferrybank	-10.98	disadvantaged
Kilculliheen	-0.17	marginally below average
Custom House B	-5.20	marginally below average
Centre A	-2.49	marginally below average
The Glen	-4.61	marginally below average
Bilberry	-9.86	marginally below average
Military Road	-13.83	disadvantaged
Cleaboy	-3.73	marginally below average
Gracedieu	-3.26	marginally below average
EDs within 1km Study Area		
Dunkitt	-0.87	marginally below average
Shortcourse	-14.32	disadvantaged

⁵Trust Hasse & Jonathan Pratschke (2017) The 2016 Pobal HP Deprivation Index For Small Areas

ED's within 500m Study Area	Deprivation Score 2016	Deprivation Description
Ballybricken	-9.71	marginally below average
Custom House A	-4.98	marginally below average
Centre B	-10.28	disadvantaged
Mount Sion	-8.39	marginally below average
Morrison's Avenue East	-10.22	disadvantaged
Morrison's Avenue West	-18.08	disadvantaged
Morrison's Road	-20.32	very disadvantaged
Newport's Square	-18.57	disadvantaged
Park	0.33	marginally above average
Slievekeale	-12.23	disadvantaged
Waterford City	-9.2	marginally below average
Waterford County	-4.6	marginally below average
Source: Census 2016 and Pobal		

Historically, a number of the EDs within the study area have been targeted for investment and revitalisation through the Waterford RAPID programme which was recast in 2017 to become the Community Enhancement Programme (CEP). Other programmes such as the Social Inclusion and Community Activation Programme (SICAP) aims to reduce poverty and promote social inclusion and equality. SICAP in the study area is overseen and managed by the Local Community Development Companies operating in the area namely, Waterford Area Partnership and County Kilkenny Leader.

6.3.5.2 Collisions Statistics

The Road Safety Authority reports on collisions across Ireland. Plate 6.5 illustrates road collision from 2005 to 2016 across all modes of transport (pedestrian, bicycle, motorcycle, car, goods vehicles, bus and other). This information shows that there has been a high level of collisions occurring across the study area particularly along the south quays and on Rice Bridge.

Seven fatal collisions have occurred in the study area, see Chapter 5 Traffic Analysis for details.

Several other serious pedestrian collisions occurred along the south quays and dock road have occurred in addition to numerous minor collisions involving pedestrians, bicycle, goods vehicles, motorcycle, and cars occurring along the south quays and in a number of places across the study area. These collisions indicate there are safety issues along the roads in the vicinity of the study area.

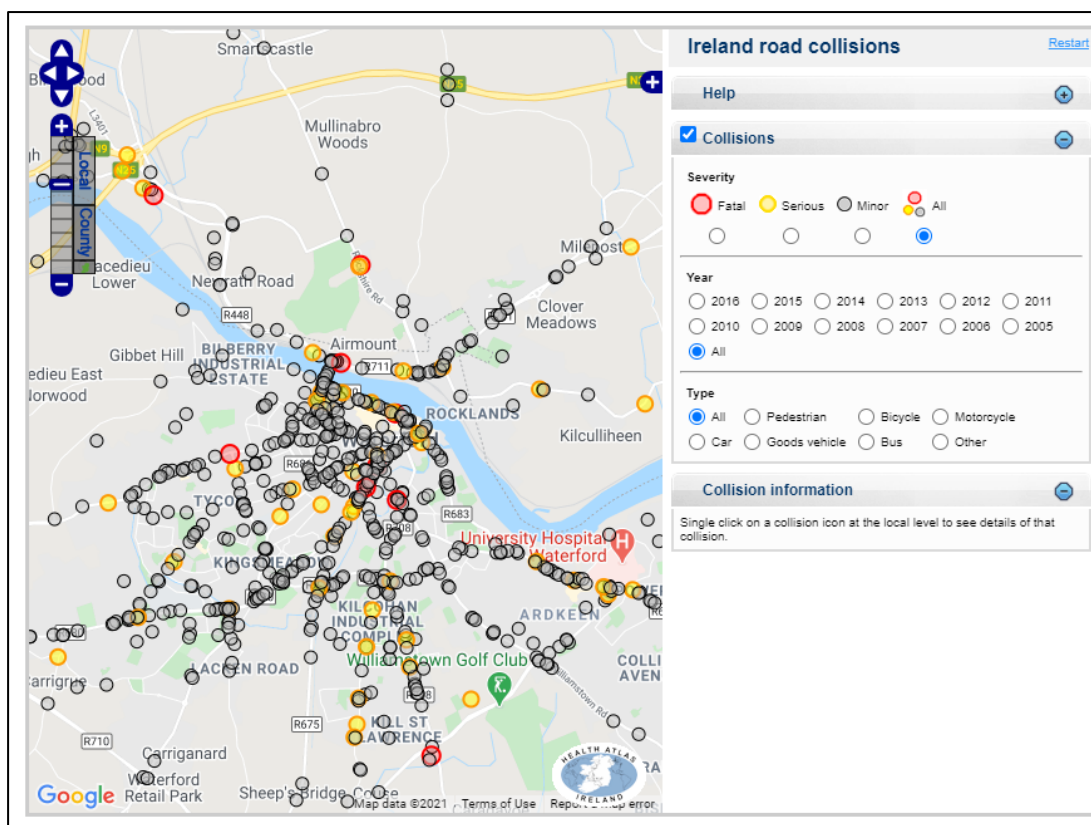


Plate 6.5 Study Area Road Collisions Source: Road Safety Authority

6.3.5.3 Major Accident / Seveso Sites

Human health and the environment are at risk of serious injury due to major industrial accidents which involve dangerous substances. All planning applications within 700m of Seveso sites require referral to the Health & Safety Authority (HSA) for technical advice in order to reduce the risk and limit the consequences of major industrial accidents. The Trans-Stock Warehousing and Cold Storage Limited is designated as an Upper Tier establishment under the Major Accident Seveso III (Directive 2012/18/EU). The site is located approximately 1.5km from the proposed development in Christendom, Ferrybank, see Chapter 18 Major Accidents and Disasters for more details.

6.3.5.4 Noise Environment

A baseline environmental noise survey was conducted in the vicinity of the proposed development in order to quantify the existing noise environment in the vicinity of the noise-sensitive locations that may be affected by the proposed development. The Noise and Vibration Chapter 12 details the results of this assessment. The potential for vibration at neighbouring sensitive locations during construction is typically limited to excavation works, piling activities, breaking operations and lorry movements on uneven road surfaces. The results of the noise survey from Chapter 12 indicate that the baseline noise levels at all locations assessed are dominated by existing traffic flows along the roads within Waterford City and train movements.

6.3.5.5 Air Quality Environment

Air quality in Ireland and in the area of the proposed development is considered to be good. Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality "Air Quality in Ireland 2019 (EPA 2020), details the range and scope of monitoring undertaken throughout Ireland. Long-term monitoring data has been used to determine

background concentrations for the key pollutants in the region of the proposed development. The background concentration accounts for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.) Chapter 13 details the results from this monitoring.

6.3.5.6 Radon

Radon is a naturally occurring radioactive gas that originates from the decay of uranium in rocks and soils. It is colourless, odourless and tasteless and can only be measured using special equipment. The proposed development is located in a high radon area. 'High Radon Area' is one in which more than 10% of homes are predicted to have radon levels in excess of the reference level of 200 Bq/m³. Radon rises up through the ground to disperse in the air and only becomes a health hazard when it is trapped in buildings.

6.4 Predicted Impacts on Population and Human Health

In accordance with the EPA Guidelines and the above methodology, the following sections provide an overview of the predicted impacts on:

- Land use and social considerations, including effects on general amenity, journey characteristics, journey amenity and severance.
- Economic activity including tourism e.g. employment and population including associated land use.
- Human health, considered with reference to and interactions with other environmental receptors contained in corresponding chapters such as air, noise, traffic, as appropriate.

Likely or predicted significant impacts are split based on construction and operational phases under the headings above.

6.4.1 Construction Phase

6.4.1.1 Land Use and Social Considerations

Land use

Construction compounds will be located wholly within the IÉ landownership boundary. The lands are currently used as Irish Rail Yards with adjacent scrubland. General land use changes from Irish rail yards to construction sites/ compound is likely to have a *negative, imperceptible - slight, temporary* impact on landuse characteristics of the area throughout the construction period.

The construction of an impermeable trench within the car parking areas of Plunkett Station will temporarily restrict the number of parking spaces at the station, having a *negative, slight and temporary* impact on this land use.

Journey Characteristics, journey amenity and severance

Construction traffic will consist of vehicles transporting sheet piles, material required for construction and the movement of construction vehicles to and from the site, including cranes and other general construction traffic. Construction activities may impact on journey times during specific periods as part of construction works for both roads and navigational channel users. The main access route to the main construction compound is the R448 Regional Road which has a direct connection to the N25 National Road. A local road off the R448, near Newrath roundabout, goes directly to the proposed main construction compound location. An ancillary construction compound at Sally Park depot can be reached directly from the R448.

Chapter 5 Traffic Analysis determined that at the peak of the construction stage, the proposed development will result in an 0.1% increase in total traffic movements and an increase of 1.2% in HGV movements over the course of a working day on the R448 Terminus Street. Temporary traffic management arrangements are to be implemented to facilitate ongoing access for road users throughout the works. The potential impacts are likely to have *negative, temporary, not significant* impacts on the existing road network.

Construction of the overground flood defences at Rice Bridge roundabout will necessitate implementing traffic management to ensure the continuity of travel. Additionally, small sections of the pedestrian footpaths on the roundabout may be temporarily closed while the glass flood barriers are being installed, requiring minor diversions. The proposed works at Rice Bridge are estimated to be undertaken over 6 - 8 weeks. The potential impacts on users are likely to be *negative, imperceptible to slight and temporary* due to localised diversions of road traffic and pedestrian footpaths.

Access will be maintained to Plunkett Station and properties throughout the construction phase therefore no severance is predicted. Pedestrians will experience *imperceptible, neutral, temporary* severance.

The construction of an impermeable trench will require the closure of the western car park of Plunkett station for approx. 2 weeks, and for 10 weekends at the eastern car park reducing the number of car parking spaces at the station. However, the construction works will be carried out in a phased approach, whereby the eastern section of the car park will be open while the works to the western section are carried out and vice versa, ensuring that the car park remains open to the public throughout the construction phase. It is likely that there will be *negative, slight and temporary* impacts on journey characteristics.

The proposed development will not have any impacts on the rail commuter services as night-time works will be carried out when rail possessions are necessary.

Access will be maintained on the navigational channel throughout the construction phase. All boat users including search and rescue organisations vessels will continue to have access as required, therefore *no significant* impact on marine journey times is likely.

The riverside sheet-pile wall installation works will be carried out from a maximum of 2 barges positioned within the River Suir in the vicinity of the northern bank, and as such, the proposed riverside works are not likely to obstruct the navigational passage of commercial and recreational vessels during the construction phase. However, piling construction activities at the site may cause annoyance or nuisance to maritime recreational users of the River Suir over the duration of the construction phase. As such, the construction phase has the potential for *negative, slight to moderate, temporary* impacts on maritime recreational users.

Community Facilities

There is potential for community uses such as school traffic using the R448 & R680 Regional Roads to be impacted in the vicinity of the construction site however, these impacts are not likely to be significant or change the use of community facilities. The works contractor, when appointed, will be required to finalise the Construction Environmental Management Plan (CEMP) submitted with this application (see Appendix 4.1 A) and the traffic management procedures (as outlined in the CEMP)

that maximises the safety of the workforce and the public, and minimises construction traffic generation and disruption, while maintaining access to properties at all times. The CEMP will be developed in consultation with Waterford City & County Council. The potential impacts are likely to be *negative, imperceptible to slight* and *temporary*.

6.4.1.2 Economic Activity

It is envisaged that that the proposed development is a sufficient distance away from the Waterford City Core economic area that impacts to amenity and journey characteristics will be limited during the construction phase. Impacts / disruptions resulting from temporary noise, and visual disruption may impact sensitive sites such as hotels and other commercial properties in the vicinity and are likely to have a *negative, slight to moderate temporary* impact on economic operators.

The construction stage will result in direct employment of construction workers for the 30 to 35 -week construction programme. Additional indirect employment and economic activity is likely due to provision of goods and services during construction stages. The proposed development during the construction phase is likely to have a positive, slight, and *temporary* impact on employment.

Marine based economic impacts

The River Suir will remain navigable to all marine based traffic throughout the construction stage. However, it is likely that there will be *negative, slight, and momentary* impacts to marine based operators during the construction stage primarily as a result of the presence of construction barges and transportation of materials on the River Suir. The contractor will be required to communicate the Traffic Management procedures (as outlined in the CEMP) to the Harbour Master and the Port of Waterford Company to minimise disruption to economic and social activities.

Marine Tourism Impacts

The majority of construction activities will be carried out within and in vicinity of the River Suir, and may be *indirect, negative, slight, and temporary* impacts on marine tourism. The proposed works may affect the attractiveness and amenity value of the River Suir and may impact on tourist numbers visiting both the south quays and boats berthing from overseas at Waterford City Marina.

6.4.1.3 Human Health

As already stated, environmental health standards are set to protect the vulnerable and not the robust, who are generally more resilient to changes in their environment. In accordance with the methodology outlined in Section 6.2.7, a summary of likely significant human health impacts/ hazards relating to the proposed development have been identified to include:

- Impacts of collisions/risks of accidents;
- Impacts of Emissions to Air;
- Impacts of Noise Emissions;
- Impact of Emissions to Hydrology and Hydrogeology;
- Psychosocial hazards; and
- Effects on physical activity.

Chemical and biological hazards will remain a possibility in certain limited circumstances during the construction and operation phases from potential traffic, spillages or accidents. Mitigation measures have been put in place throughout the various chapters of this document which aim to avoid, prevent and mitigate for any

spillages / accidents during construction stage. These will be managed at detailed design and in accordance with best practice construction methods relating to good housekeeping and implementation of environmental, health and safety standards throughout the lifetime of the project as required by EU Directives, statutory legal requirements and national construction and employment law as appropriate and for this reason are not considered further as part of this environmental assessment.

Prior to any demolition, excavation or construction, the Construction Environmental Management Plan (CEMP) appended to this application (see Appendix 4.1A) will be finalised by the successful contractor. The CEMP will set out the Contractor's overall management and administration of the construction project. The CEMP will be finalised by the Contractor during the pre-construction phase to ensure commitments included in the statutory approvals are adhered to, and that it integrates the requirements of the outline CEMP, Environmental Operating Plan (EOP) and the Construction and Demolition Waste Management Plan (CDWMP).

6.4.1.4 Impacts of Collisions/ Risk of accidents

Construction activities may increase the risk of collisions due to an increase in the number of movements of HGVs entering and exiting the construction compounds on haulage routes, and during the construction of the overground flood defences at Rice bridge roundabout. Vulnerable persons in the population (the very young, elderly or disabled) are likely to be more at risk in this respect. The successful contractor will be required to prepare a CEMP and an Incident Operating Plan (IRP) in advance of the commencement of works, in order to ensure the safety of site personnel and members of the public and minimise construction phase-related traffic delays and disruptions. The proposed development is not likely to significantly increase the risk of accidents and collisions.

Construction workers will be exposed to a risk of potential accidents occurring while working at or near water. The Environmental Operating Plan (EOP) will be required to address these risks and detail measures to address health and safety risks as appropriate. Overall, *not significant, negative, temporary* impacts during the construction phase are predicted.

6.4.1.5 Impacts of Emissions to Air

The primary sources of air impacts that may affect air quality from the proposed development occur in the construction phase of the proposed development relating to dust generation and emissions from plant and vehicles. This can cause local impacts through air quality and dust nuisance at the nearest sensitive receptors. The assessment in Chapter 13 Air Quality and Climate relating to the sensitivity of the area to human health impact is low according to IAQM guidance (IAQM 2014). In the absence of mitigation there is the potential for *imperceptible, negative, short-term* impacts to human health as a result of the proposed development. Nonetheless, standard mitigation measures are to be incorporated as outlined in Chapter 13.

6.4.1.6 Impact of Noise and Vibration Emissions

The results of the noise survey completed as part of this EIAR as detailed in Chapter 12 Noise and Vibration indicate that the baseline noise levels at all locations assessed are dominated by existing traffic flows along the roads within Waterford City and train movements directly adjacent to the proposed development. The risk hazards include a variety of items of plant which will be in use for the purposes of site clearance, demolition and construction.

Noise levels for all other day time construction activities at all other receptors are predicted to be lower than the designated construction noise thresholds. All day-time activities have the potential to cause a *negative, slight to moderate* impact at all receptors.

The construction of an underground isolation structure and a c.50m section of the landside sheet pile wall will be undertaken over a four-week period during night-time possession works. It is expected that these works may cause a *negative, significant and temporary* impact at receptor R3 (residential properties), see Chapter 12 Noise and Vibration of this EIAR for further details.

Whilst the entire programme of works is expected to last approx. 7 months, individual activities such as piling will likely last for a smaller percentage of the entire programme (approximately 4 weeks of night-time piling is required) and as such, these exceedances will not be occurring continuously throughout the construction phase. The piling works are expected to take place at a range of distances from the sensitive receptors.

The Contractor undertaking the construction of the works will be required to take specific noise abatement measures and comply with the host of mitigation measures and noise monitoring programme set out in the Chapter 12.

Chapter 12 also assessed the vibratory piling works that will be carried out for the proposed flood defence wall. The closest receptors to the sheet piling works are the commercial properties at Sally Park yard, at approximately 20m distance from the works. It can be seen that vibration magnitudes at 20m distance are below those associated with cosmetic damage to buildings. These works will take place in a controlled manner and during daytime hours. The vibration assessment found that the works will not emit vibrations that may cause building damage and therefore are not likely to impact on human health. Given the distances between works and receptor locations it is expected that vibration impacts will be *negative, temporary and imperceptible to slight* impacts are likely.

6.4.1.7 Impact of Emissions to Hydrology and Hydrogeology

Water quality

There are no surface water abstraction points for potable water within the study area (or downstream on the River Suir) and therefore it is not considered to be a significant human health issue in this context. However, mitigation measures are proposed as part of this EIAR in Chapter 7 Biodiversity and Chapter 10 Hydrology in order to mitigate any likely contaminants entering the water table and the River Suir which may potentially affect human health during the construction phases. Therefore, no further mitigation is deemed to be required as part of this assessment.

Flood Risk

There is potential for flood events to occur during the construction phase. The construction works will increase the number of people near a known source of flooding, thus increasing the potential for flood risk related impacts on human health. However, with the inclusion of mitigation measures outlined in the CEMP and IRP during the construction phase, these is an expected *negative, temporary, imperceptible to slight* impact.

Hydrogeology

Sheet piles will be the primary method for achieving flood defences. Chapter 9 Hydrogeology of this EIAR found that there is likely to be an *imperceptible* impact on hydrogeology during construction phase.

6.4.1.8 Impacts of Emissions to Soil

Chapter 8 Soils and Geology of this EIAR was consulted regarding potential for contaminated land. The results indicate that there are no known existing contaminated soils and all borehole samples were classified as non-hazardous. During the construction stage, mitigations measures to reduce any adverse impacts to soils and surface water quality are described in Chapter 8 Soils and Geology and in Chapter 9 Hydrogeology.

6.4.1.9 Psychosocial Impacts on Human Health

Consideration of likely psychosocial hazards relating to the proposed development include nuisance, annoyance, and anti-social behaviour. During the construction phase, the proposed development has the potential to create nuisance particularly due to emissions from noise, air and dust that can impact on psychological health (described above). The construction activities are limited to specific locations and daytime periods for use of certain plant and machinery in order to reduce impacts to sensitive receptors. There is potential for an increase in noise levels during construction to cause nuisance and annoyance. Based on the results of Chapter 12 Noise and Vibration, during construction, daytime activities are expected to cause a *negative, slight to moderate temporary* effects and not significant impact at all receptors. During the night possession works for the underground isolation structure it is expected that a *negative, temporary, significant* impact will occur at R3 over the four-week period, Monday to Friday. Whilst individual annoyance as a result of temporary increase in noise levels cannot be discounted, annoyance is not a health effect. Therefore, impacts on Human Health are predicted to be *negative, temporary, and not significant*.

6.4.1.10 Other Physical Effects

The construction stage is not likely to result in changes / impact significantly to physical activity during the construction stage.

6.4.2 Operational Phase

6.4.2.1 Land use and Social Considerations

Land use

The proposed flood defences will encroach into the River Suir estuary ~1-2m for approximately 540m. Therefore, a minor amount of reclaimed land will be created in between the new defences and the existing wall. The reclaimed land will be managed by Irish Rail and the treatment and appearance of the area will be in keeping with railway and associated lands.

Development Plans for both Waterford and Kilkenny promote sustainable growth in the northern bank of Waterford City. The northern suburb of Ferrybank is within the administrative area of KCC and is also included in the Waterford Metropolitan Area Strategic Plan (MASP) area. The Kilkenny City and County Development Plan 2021 - 2027 is supportive of the Waterford MASP as outlined in the Regional Spatial and Economic Strategy (RSES) for the Southern Region, which identifies policy objectives supporting sustainable mobility and improved regional connectivity to / and from Waterford, including rail connectivity.

The proposed Flood Defences West will form a continuation of the flood defences east which received planning approval as part of the SDZ Transportation Hub and will cumulatively protect the existing and future land use within the Waterford City North Quays area against existing and future flood risk. As such, the proposed development will assist the Kilkenny City and County Development Plan 2021 - 2027 to realise its sustainable development objectives by enabling sustainable growth of the areas on the northern side of the River Suir, such as Ferrybank. The proposed development is likely to have *positive, slight to moderate* impacts on land use within the north quays area of Waterford City.

Journey Characteristics, Amenity and Severance

The nature of the proposed development means that during the operational phase there will be a positive impact to road traffic. The overground flood defences at Rice Bridge roundabout will protect the road infrastructure and adjacent roads in extreme flood events. The predicted impact is *positive, moderate to significant and long-term*.

The introduction of the proposed development will increase resilience of the existing rail services. Previous flood events have resulted in disruptions to rail services to Plunkett Station. It is envisaged that, although rail services would be halted in extreme flood events, the defence against flooding for the railway corridor would lead to less maintenance and repair work post flood event, thus increasing service provision and reliability and can potentially result in increased uptake of rail as a mode of travel. The expected impact is *positive, significant, and long-term*.

During operation, the proposed flood defences will have no impact on marine navigation.

Community Facilities

Unobstructed access will be maintained to the navigable reach of the River Suir for search and rescue vessels (Waterford City River Suir Rescue and WMSAR) in order to patrol the river. The proposed development will not obstruct the navigation channel and therefore, will not impact on search and rescue services.

The proposed development will increase reliability of existing transport 'community' infrastructure such as the train services and subsequently increase access to education, religious, recreational and employment opportunities. The likely impact on community facilities is *positive, slight to moderate and long-term*.

6.4.2.2 Economic Impact

The proposed development will protect the strategic rail infrastructure connecting Waterford City to the rest of the country. Previous recurring flood events have resulted in significant monetary costs for the repair of sensitive rail network components. A minor increase in maintenance expenses is anticipated but this is negligible compared to long term savings afforded by the scheme. The predicted impact is *positive, significant, and long term*.

During operation, the proposed flood defences will have negligible impact on marine based economic activities. The navigational channel will remain navigable after construction, and no other economic impacts are predicted.

6.4.2.3 Human Health

Flooding can result in deaths, injuries and mental health illnesses during the flood event itself, during the recovery process, or from subsequent effects brought about by

damage to major infrastructure such as health facilities, infrastructure, ecosystems, food and water supplies (WHO, 2017).

Although the lands proposed to be defended are mainly industrial, there is the potential risk to workers and users of the rail service. The proposed flood defences will reduce flood risk and thus benefit human health, resulting in a *positive, moderate to significant long-term* impact.

6.4.2.4 Impacts of Collisions/ Risk of accidents

It is not envisaged that there will be any impacts to Collisions/ Risk of accidents during the operational phase. The likely impact is *neutral, imperceptible, and permanent* to Collisions/ Risk of accidents.

6.4.2.5 Impacts of Emissions to Air Quality and Climate

Due to the nature of the proposed development, there will be no emissions to atmosphere during the operational phase. Therefore, there is no potential for impacts to air quality or climate as a result of the proposed development. The operational phase is considered *neutral* in terms of air quality and climate.

6.4.2.6 Impacts of Noise Emissions

As there are no predicted noise and vibration impacts during the operational stage, the likely impact is therefore *neutral*.

6.4.2.7 Impact of Emissions to Hydrology and Hydrogeology

Water quality

There are no surface water abstraction points for potable water within the study area (or downstream on the River Suir) and therefore it is not considered to be a significant human health issue in this context. The minor amendments to the existing drainage networks will likely have a *positive slight to moderate, long-term* impact as discussed in Chapter 10 Hydrology. Therefore, no further mitigation is deemed to be required as part of this assessment.

Flood Risk

The proposed development will defend lands, rail and road infrastructure on the north quays in extreme events from flooding. Through the design of the proposed development, the likely impact is seen as *positive, significant and long term*.

6.4.2.8 Psychosocial Impacts on Human Health

Consideration of the negative psychosocial hazards relating to the proposed development include potential for nuisance, anti-social behaviour. The proposed development is located on the periphery of Waterford City on lands that will not be open to the public. As a result of the isolated nature of the site which is in the private ownership of CIÉ (operated by IÉ) and the nature of the development during the operation phase, it is unlikely that the proposed development would result in negative psychosocial effects.

6.4.2.9 Other Physical Effects

Effects on physical activity

The proposed development site will not be open to the public and as such it is not likely to result in changes / impact significantly to physical activity during the operational stage.

6.5 Mitigation & Monitoring Measures

The design process, site visits and consultation undertaken to date has allowed for the inclusion of a number of mitigation measures for Population and Human Health as part of the design of the Flood Defences West development.

6.5.1 Construction Stage Mitigation Measures:

Develop and implement all mitigation measures detailed in Chapter 4 (Description of the Proposed Development); this is to include development of Construction Environmental Management Plan (CEMP) and associated traffic management proposals to address all modes of transport and will be required to be agreed with WCCC prior to construction stage.

- The CEMP will be required to maximise the safety of the workforce and the public and minimise traffic delays, disruption and maintain access to properties.
- The CEMP will also address temporary disruption to traffic signals, footpath access and the management of pedestrian crossing points.
- The contractor shall provide an appropriate information campaign for the duration of the construction works.
- The CEMP should minimise disruption to economic, marine users and residential amenities to be agreed by WCCC prior to construction and ensure access is maintained along the R448 & R680 for vehicles, pedestrians, cyclists, and economic operators at all times and ensure marine navigation is maintained.

Include appropriate measures relating to working near water as part of EOP.

The contractor will be required to develop and implement Stakeholder Management and Communication Plan and will be required to be agreed with WCCC prior to construction stage.

- All stakeholders will be required to be agreed with WCCC prior to construction commencing.
- Details of the general construction process/phasing will be communicated to the relevant stakeholders prior to implementation to ensure local residents and businesses are fully informed on the nature and duration of construction works.

Noise and Vibration mitigation will be provided for during construction of the development. Measures to mitigate noise and vibration impacts on sensitive receptors are detailed within Chapter 12 Noise and Vibration. The contractor will work within stringent construction limits and guidelines to protect residential and commercial amenities including the application of binding noise limits, hours of operation, along with implementation of appropriate noise and vibration control measures.

In order to minimise dust emissions during construction, a series of mitigation measures have been prepared as part of Chapter 13 Air Quality and Climate. Provided the dust minimisation measures are adhered to, the air quality impacts during the construction phase will not be significant. No further mitigation measures are required.

Emissions from the construction activities such as dust and risk of accidents were found to be potential short-term, negative impacts. It was found that noise emissions from construction activities, plant and machinery on site is likely to have a significant noise impact within the immediate area during distinct construction phases (i.e. piling activities) of the development.

Nightworks will also have a significant impact during the short duration they are required. All construction stage impacts will be temporary in nature and reduced and managed by CEMP and associated EOP and CDWMP and the range of mitigation measures of this EIAR.

All construction works will be temporary in nature and will be carried out in line with best practice thereby minimising the likely significant impacts to the community and human health impacts. The contractor will work within stringent construction limits and guidelines to protect surrounding populations and amenities.

6.5.2 Operational Stage Mitigation Measures

No operational mitigation measures are proposed as part of the proposed development.

6.6 Residual Impacts

The construction phase is likely to have *imperceptible to slight, negative* temporary residual impacts to the traffic, air and land uses including economic and tourism facilities in the immediate vicinity of the construction activities including those in the marine environment. The noise and vibration assessment determined that during night possession works for the construction of the underground isolation structure and c.50m of the landside sheet pile wall, it is expected that a *negative, temporary, significant* impact will occur at R3 over the four-week period, Monday to Friday.

The assessment has found that the construction phase is likely to have negligible impact on journey characteristics and general amenity. However, it is also likely to result in positive impacts on the local economy due to employment and local expenditure by construction workers, purchases of local materials and services.

During the operation phase, the proposed development will result in a *significant, positive, long-term* impacts due to the development defending lands north of the River Suir with benefits to the economy and human health.

The operation of the development will provide many significant positive impacts to the city which include the following;

- Protecting the existing rail and road infrastructure such as Plunkett Station and the Rice Bridge roundabout from existing and future flood risk.
- Upgrading the existing drainage network within the extents of the proposed development by increasing its capacity to account for extreme weather events induced by climate change.
- Eliminating costs associated with flood damage on built assets, particularly the rail infrastructure at, and to the west of Plunkett Station and the road infrastructure, specifically Rice Bridge roundabout.

The assessment found that the proposed development is likely to result in positive long-term change to human health by reducing flood risk. The development will also benefit the adoption of sustainable transport for the population's journey characteristics, journey amenity and general amenity due to the improvement in transportation infrastructure resilience.

6.7 References

Atkins (2004) *Waterford Planning, Land Use and Transportation Study (PLUTS) 2004-2020*

Central Statistics Office. 2017. Census 2016. [ONLINE] Available at: <https://www.cso.ie/en/>. [Accessed 18 July 2018].

CSO. (2017). *Ireland - Facts and Figures 2017*, Central Statistics Office, Ireland.

Department of the Environment, Community and Local Government. (2002) *National Spatial Strategy 2002-2020*.

CSO *Suicides classified by county of residence of deceased, 2008-2014* [Online] Available at <https://www.cso.ie/en/releasesandpublications/ep/p-vsar/vsar2014/deaths2014/> [Accessed 01/08/2018]

Department of Transport (2013) *The Design Manual for Urban Roads and Streets*.

Department of Transport Tourism and Sport & Department of Environment, Community and Local Government (2013) *Design Manual for Urban Roads and Streets*

Design Manual for Roads and Bridges (1993) Volume 11 Section 3, Part 8, Department of Transport, United Kingdom

DKM Economic Consultants, Colliers Int. & Brady Shipman Martin (2013) *Economic Strategy for Waterford City and County*.

Dublin and Mid East Regional Authorities. 2010. *Regional Planning Guidelines for The Greater Dublin Area 2010-2022*.

Environmental Protection Agency. 2002. *Guidelines on the Information to be contained in Environmental Impact Statements*.

Environmental Protection Agency. 2003. *Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)*.

Environmental Protection Agency. 2015. *Updated Advice Notes on Current Practice (in the preparation of Environmental Impact Statements (Draft) September 2015*.

Environmental Protection Agency. 2017 *Guidelines on the information to be contained in Environmental Impact Assessment Reports, Draft August*

Environmental Protection Agency (2016) *State of the Environment Report 2016, Ireland's Environment 2016 - An Assessment*, Environmental Protection Agency, [Accessed 16/02/2018]
<http://www.epa.ie/irelandsenvironment/stateoftheenvironmentreport/>

Fáilte Ireland guidelines on the treatment of Tourism in an Environmental Impact Assessment (2011).

Fáilte Ireland (2018) *Tourism Facts 2017 Preliminary (2018)* [ONLINE] Available at: http://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Resea

[rch_Insights/5_International_Tourism_Trends/Failte-Ireland-s-Tourism-Facts-2017-preliminary.pdf?ext=.pdf](#) [Accessed 01/08/2018]

Government of Ireland. (2018). *Project Ireland 2040 National Planning Framework*. [ONLINE] Available at: <http://npf.ie/>. [Accessed 20 July 2018].

Health Service Executive. (2015). *Health profile Lenus The Irish Health Repository*

Homes and Communities Agency. (2014) *Additionality Guide*

Institute of Public Health. (2005). *Health Impacts of Transport: A Review* Available at: https://www.publichealth.ie/files/file/IPH_Transport_text_44pp.pdf [Accessed 01/08/2018]

Institute of Public Health (2009). *Health Impact Assessment Guidance* [ONLINE] Available at https://www.publichealth.ie/sites/default/files/documents/files/IPH%20HIA_0.pdf [Accessed 01/08/2018]

Kilkenny County Council. (2021). *Kilkenny City and County Development Plan 2021 - 2027*

Pobal 2016 <https://maps.pobal.ie/> [Accessed 18 July 2018]

RSA. (2018). *Provisional Review of Fatal Collisions January to December 31st, 2017*. [ONLINE] Available at: http://www.rsa.ie/Documents/Fatal%20Collision%20Stats/Provisional_Reviews_of_Fatal_Collisions/RSA%20Provisional%20Review%20of%20Fatalities%2031%20December%202017.pdf. [Accessed 20 July 2018].

Southern Regional Assembly. (2017) *Regional Spatial and Economic Strategy Issues Paper*

Transport Infrastructure Ireland/ National Roads Authority (2008) *Environmental Impact Assessment of national road schemes- A practical guide (Revision 1, November 2008)*

Toronto Public Health (2018) *Interventions to Prevent Suicide from Bridges: An evidence review and jurisdictional scan* [Online] Available at: <https://novascotia.cmha.ca/wp-content/uploads/2018/06/Interventions-to-Prevent-Suicides-from-Bridges.pdf> [Accessed 06/03/2018]

Trust Hasse & Jonathan Pratschke. (2017) *The 2016 Pobal HP Deprivation Index For Small Areas*.

United States Environmental Protection Agency. (2014). *Framework for Human Health Risk Assessment to inform Decision Making*. USEPA. [ONLINE] Available at: <https://www.epa.gov/sites/production/files/2014-12/documents/hhra-framework-final-2014.pdf> [Accessed 01/08/2018]

Waterford City Council and Loci, (2008). *Waterford North Quays - Urban Design Framework Plan 2008, Revision 2*.

Waterford City and County Council. (2012) *Waterford City Retail Strategy*

Waterford City Council (2013) *Waterford City Development Plan 2013 – 2019*

Waterford City and County Council. (2018a). *North Quays Planning Scheme*
Waterford City Council (2013a). *Waterford City and County Noise Action Plan 2013-2018*

Waterford City and County Council (2016) *One Waterford: Local Economic and Community Plan 2015-2020*

Waterford City and County Council (2018) *Waterford North Quays Planning Scheme*

Waterford City and County Council. (2018b). *North Quays Strategic Development Zone Traffic and Transportation Impact Assessment (TTIA)* prepared by Roughan and O'Donovan Consulting Engineers.

Waterford City and County Council. (2018c). *North Quays Strategic Development Strategic Environmental Assessment* prepared by Roughan and O'Donovan Consulting Engineers.

John Spain and Associates (2018d) *Waterford City Retail Strategy Update February 2018*

Waterford Institute of Technology. (2017) *South East Economic Monitor July 2017*

[World Health Organisation \(2017\). *Flooding: Managing Health Risks In the WHO European Region.* \[Online Accessed 07 April 2021\]](#)

