

# Arklow Wastewater Treatment Plant Project

Environmental Impact Assessment Report

**Volume 2: Main text (Book 2 of 3)**





# Contents

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## Book 1 of 3

	Page
<b>1 Introduction</b>	
1.1 Introduction	Ch 1 - 1
1.2 Overview of the Proposed Development	Ch 1 - 1
1.3 Overview of the Planning Process	Ch 1 - 2
1.4 Approach to the EIA	Ch 1 - 3
1.5 Consultation undertaken	Ch 1 - 9
1.6 Difficulties Encountered During the Assessment	Ch 1 - 17
1.7 References	Ch 1 - 18
<b>2 Background</b>	
2.1 Introduction	Ch 2 - 1
2.2 Irish Water	Ch 2 - 1
2.3 Need for the Proposed Development	Ch 2 - 1
2.4 Objectives of the Proposed Development	Ch 2 - 3
2.5 Planning History	Ch 2 - 3
2.6 Site and Surrounds	Ch 2 - 4
2.7 References	Ch 2 - 21
<b>3 Alternatives</b>	
3.1 Introduction	Ch 3 - 1
3.2 Do-nothing	Ch 3 - 1
3.3 WwTP Site and Sewer Route Selection	Ch 3 - 2
3.4 Treatment Processes	Ch 3 - 21
3.5 Options considered during Design Development	Ch 3 - 30
3.6 Integrated Scheme	Ch 3 - 51
3.7 Construction Methods	Ch 3 - 52
3.8 References	Ch 3 - 54
<b>4 The Proposed Development</b>	
4.1 Introduction	Ch 4 - 1
4.2 Procurement Strategy	Ch 4 - 1
4.3 Design of the Proposed Development	Ch 4 - 2
4.4 Community Gain	Ch 4 - 39
4.5 Separate Consents	Ch 4 - 40
4.6 Operation of the Proposed Development	Ch 4 - 42
4.7 Decommissioning	Ch 4 - 44
4.8 References	Ch 4 - 45

---

<b>5</b>	<b>Construction Strategy</b>	
5.1	Introduction	Ch 5 - 1
5.2	Approach	Ch 5 - 1
5.3	Indicative Duration and Phasing	Ch 5 - 2
5.4	Land Use Requirements	Ch 5 - 8
5.5	Enabling Works	Ch 5 - 10
5.6	Indicative Construction Methods for the Proposed Development	Ch 5 - 21
5.7	Traffic Management	Ch 5 - 58
5.8	Site Management	Ch 5 - 62
5.9	Environmental Management	Ch 5 - 66
5.10	References	Ch 5 - 67
<b>6</b>	<b>Planning and Policy</b>	
6.1	Introduction	Ch 6 - 1
6.2	National Planning Policy and Guidance	Ch 6 - 1
6.3	Regional Policy Guidance	Ch 6 - 6
6.4	Local Policy Guidance	Ch 6 - 7
6.5	References	Ch 6 - 12

## Book 2 of 3

<b>7</b>	<b>Traffic and Transportation</b>	
7.1	Introduction	Ch 7 - 1
7.2	Assessment Methodology	Ch 7 - 1
7.3	Baseline Conditions	Ch 7 - 5
7.4	Characteristics of the Proposed Development	Ch 7 - 10
7.5	Likely Significant Effects	Ch 7 - 35
7.6	Mitigation Measures and Monitoring	Ch 7 - 42
7.7	Residual Effects	Ch 7 - 44
7.8	References	Ch 7 - 44
<b>8</b>	<b>Air Quality and Climate</b>	
8.1	Introduction	Ch 8 - 1
8.2	Assessment Methodology	Ch 8 - 1
8.3	Baseline Conditions	Ch 8 - 10
8.4	Likely Significant Effects	Ch 8 - 11
8.5	Mitigation Measures and Monitoring	Ch 8 - 18
8.6	Residual Effects	Ch 8 - 19
8.7	References	Ch 8 - 19

---

<b>10</b>	<b>Noise and Vibration</b>	
10.1	Introduction	Ch 10 - 1
10.2	Assessment Methodology	Ch 10 - 1
10.3	Baseline Conditions	Ch 10 - 12
10.4	Likely Significant Effects	Ch 10 - 15
10.5	Mitigation Measures and Monitoring	Ch 10 - 41
10.6	Residual Effects	Ch 10 - 46
10.7	References	Ch 10 - 46
<b>11</b>	<b>Biodiversity</b>	
11.1	Introduction	Ch 11 - 1
11.2	Assessment Methodology	Ch 11 - 1
11.3	Baseline Conditions	Ch 11 - 13
11.4	Likely Significant Effects	Ch 11 - 57
11.5	Mitigation Measures and Monitoring	Ch 11 - 79
11.6	Residual Effects	Ch 11 - 88
11.7	References	Ch 11 - 90
<b>12</b>	<b>Archaeology, Architectural and Cultural Heritage</b>	
12.1	Introduction	Ch 12 - 1
12.2	Assessment Methodology	Ch 12 - 1
12.3	Baseline Conditions	Ch 12 - 8
12.4	Likely Significant Effects	Ch 12 - 33
12.5	Mitigation Measures and Monitoring	Ch 12 - 35
12.6	Residual Effects	Ch 12 - 36
12.7	References	Ch 12 - 37
<b>13</b>	<b>Landscape and Visual</b>	<b>1</b>
13.1	Introduction	Ch 13 - 1
13.2	Assessment Methodology	Ch 13 - 1
13.3	Baseline Conditions	Ch 13 - 4
13.4	Likely Significant Effects	Ch 13 - 22
13.5	Mitigation Measures and Monitoring	Ch 13 - 33
13.6	Residual Effects	Ch 13 - 35
13.7	References	Ch 13 - 40

## Book 3 of 3

<b>14</b>	<b>Land and Soils</b>	
14.1	Introduction	Ch 14 - 1
14.2	Assessment Methodology	Ch 14 - 1
14.3	Baseline Conditions	Ch 14 - 9

---

14.4	Likely Significant Effects	Ch 14 - 44
14.5	Mitigation Measures and Monitoring	Ch 14 - 66
14.6	Residual Effects	Ch 14 - 73
14.7	References	Ch 14 - 73
<b>15</b>	<b>Water</b>	
15.1	Introduction	Ch 15 - 1
15.2	Assessment Methodology	Ch 15 - 1
15.3	Baseline Conditions	Ch 15 - 17
15.4	Likely Significant Effects	Ch 15 - 31
15.5	Mitigation Measures and Monitoring	Ch 15 - 43
15.6	Residual Effects	Ch 15 - 47
15.7	References	Ch 15 - 49
<b>16</b>	<b>Resource and Waste Management</b>	
16.1	Introduction	Ch 16 - 1
16.2	Assessment Methodology	Ch 16 - 1
16.3	Baseline Conditions	Ch 16 - 5
16.4	Likely Significant Effects	Ch 16 - 8
16.5	Mitigation Measures and Monitoring	Ch 16 - 17
16.6	Residual Effects	Ch 16 - 19
16.7	References	Ch 16 - 20
<b>17</b>	<b>Population and Human Health</b>	
17.1	Introduction	Ch 17 - 1
17.2	Assessment Methodology	Ch 17 - 2
17.3	Baseline Conditions	Ch 17 - 12
17.4	Likely Significant Effects	Ch 17 - 26
17.5	Mitigation Measures and Monitoring	Ch 17 - 36
17.6	Residual Effects	Ch 17 - 39
17.7	References	Ch 17 - 40
<b>18</b>	<b>Material Assets</b>	
18.1	Introduction	Ch 18 - 1
18.2	Assessment Methodology	Ch 18 - 2
18.3	Baseline Conditions	Ch 18 - 3
18.4	Likely Significant Effects	Ch 18 - 6
18.5	Mitigation Measures and Monitoring	Ch 18 - 13
18.6	Residual Effects	Ch 18 - 15
18.7	References	Ch 18 - 15
<b>19</b>	<b>Major Accidents and Natural Disasters</b>	
19.1	Introduction	Ch 19 - 1
19.2	Assessment Methodology	Ch 19 - 1
19.3	Baseline Conditions	Ch 19 - 9

---

19.4	Likely Significant Effects	Ch 19 - 10
19.5	Mitigation Measures and Monitoring	Ch 19 - 21
19.6	Residual Effects	Ch 19 - 23
19.7	References	Ch 19 - 23
<b>20</b>	<b>Cumulative and Interactive Effects</b>	
20.1	Introduction	Ch 20 - 1
20.2	Assessment Methodology	Ch 20 - 1
20.3	Interactive Effects	Ch 20 - 5
20.4	Cumulative Effects	Ch 20 - 10
20.5	References	Ch 20 - 13
<b>21</b>	<b>Summary of Mitigation, Monitoring and Residual Effects</b>	
21.1	Introduction	Ch 21 - 1
21.2	Summary of Mitigation Measures	Ch 21 - 1
21.3	Summary of Monitoring Measures	Ch 21 - 30
21.4	Residual Significant Effects	Ch 21 - 35
21.5	References	Ch 21 - 43

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## Glossary and Abbreviations

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AA	Appropriate Assessment – An assessment of the potential adverse effects of a plan or project (in combination with other plans or projects) on the Natura 2000 network of European designated sites for biodiversity as defined by the Habitats Directive
AADT	Annual Average Daily Traffic – The total volume of vehicle traffic of a motorway or road for a year divided by 365 days.
ACM	Asbestos Containing Material
AHU	Air Handling Unit
The Alps	The vacant land (approximately 2.9ha) located to the west of River Walk at Upper Main Street, between Parade Ground to the south and Avoca River to the north. This area is as defined as the Alps Opportunity Site in the Arklow LAP.
AQS	Air Quality Standards
Aquatic ecology	The topic that deals with all aspects of ecology in the River Thames up to and including the flood defence walls. This includes fish, invertebrates, marine mammals and aquatic plants using the River Thames and its foreshore areas. Wintering birds which use the foreshore are not included in the aquatic ecology section (Refer to terrestrial ecology)
Archaeological Heritage	the term ‘archaeological heritage’ is applied to objects, monuments, buildings or landscapes of an (assumed) age typically older than AD 1700 (and recorded as archaeological sites within the Record of Monuments and Places)
Architectural Heritage	The term ‘architectural heritage’ is applied to structures, buildings, their contents and settings of an (assumed) age typically younger than AD 1700  For the purposed of this report the terms ‘architectural heritage’ and ‘built heritage’ have the same intended meaning and are used interchangeably.
Area of Archaeological Potential	An area with known potential for significant archaeological remains as identified in the Wicklow County Development Plan 2016 -2022
Arklow Bridge	The 19 arch bridge over the Avoca River in between Arklow town (to the south) and Ferrybank (to the north).
Arklow LAP	Arklow Local Area Plan 2018 - 2024
As	Arsenic
Assessment area	Study area considered in the environmental assessment for a given topic
Baseline	Refers to existing conditions as represented by latest available survey and other data

Benthic	A description for animals, plants and habitats associated with the river or seabed
BGL	Below Ground Level
Birds Directive	Council Directive 79/409/EEC as amended by Council Directive 2009/147/EC on the conservation of wild birds
BOD	Biological Oxygen Demand – The amount of dissolved oxygen needed by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period
BSI	British Standards Institution
Caisson	A foundation formed by constructing a shaft, often supported by precast concrete segments in rings, and then filled with concrete
CCTV	Closed-circuit television
Cd	Cadmium
CDWMP	Construction and Demolition Waste Management Plan
CEMP	Construction Environmental Management Plan
CIRIA	Construction Industry Research and Information Association
COD	Chemical Oxygen Demand – The amount of oxygen consumed by reactors in a measured solution (that can be used to quantify organics in water)
Cofferdam	A temporary watertight structure to enclose an area underwater that is pumped dry to allow construction work to be carried out
COMAH	Control of Major Accidents Hazards involving Dangerous Substances
CoRTN	Calculation of Road Traffic Noise
County Development Plan	Wicklow County Development Plan 2018 - 2024
CPO	Compulsory Purchase Order
Cultural Heritage	<p>‘Cultural Heritage’ where used generically, is an over-arching term applied to describe any combination of archaeological, architectural and cultural heritage features.</p> <p>The term ‘cultural heritage’, where used specifically, is applied to other (often less tangible) aspects of the landscape such as historical event, folklore memories and cultural associations. This designation can also accompany an archaeological or architectural designation or describe features that have a more recent origin, but retain cultural heritage significance.</p>
CSM	Conceptual Site Model
CSO	Central Statistics Office
Cu	Copper

Cumulative effect	Likely significant effects arising from a cumulation of effects associated with the proposed development and other projects in the local area of relevance
DaS	Dumping at Sea
DBO	Design Build and Operate – A form of contract where the contractor is responsible for the design and construction of a facility, and has a long term responsibility for operation
DCCAE	Department of Communications, Climate Action and Environment
DCHG	Department of Culture, Heritage and the Gaeltacht
Decibel (dB)	The ratio of sound pressures, which we can hear, is a ratio of 106 (one million: one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the ‘sound pressure level’ (Lp) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.
DIN	Dissolved inorganic nitrogen
DMRB	Design Manual for Roads and Bridges
DO	Dissolved oxygen
DoEHLG	Department of the Environment Heritage and Local Government
DSA	Detailed Site Assessment
DWF	Dry Weather Flow
ECJ	Court of Justice of the European Union
ED	Electoral Division
EIA	Environmental impact assessment
EIAR	Environmental Impact Assessment Report
The EIA Directive	Council Directive 2014/52/EU on the assessment of certain public and private projects on the environment
EIS	Environmental Impact Statement
ELV	Emission limit value
EPA	Environmental Protection Agency
ETS	Emissions Trading Scheme
EU	European Union
European designated site	The Natura 2000 site network, i.e. Special Areas of Conservation - (including candidate SACs) protected under the provisions of the Habitats Directive and Special Protection Area - (including proposed SPAs) protected under the provisions of the Birds Directive
FFT	Full flow to treatment
Fluvial	Relating to a river, i.e. fluvial flow is the flow of freshwater

Foreshore	The area of a shore that lies between the mean high water and mean low water mark
FOG	Fat, Oil and Grease (removal)
FSR	Flood Studies Report
GDA	Greater Dublin Area
GSDS	Greater Dublin Strategic Drainage Study
GE	General Electric
GHG	Greenhouse Gas
GI	Ground Investigations
GNI	Gas Networks Ireland
GSI	Geological Survey of Ireland
ha	Hectare
Habitat	An area or natural environment formed of physical factors such as soil and moisture that reside in a defined topographical area in which organisms (fauna and flora) normally live.
Habitats Directive	Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
HGV	Heavy goods vehicle
HIA	Health Impact Assessment
HSE	Health Services Executive
HVAC	Heating, Ventilation and Air Conditioning
IAQM	Institute of Air Quality Management
ICE	Institute of Civil Engineers
ICPSS	Irish Coastal Protection Strategy Study
IE	Industrial Emissions Licence
IE	Intestinal enterococci
IED	Industrial Emissions Directive
IEMA	Institute of Environmental Management
IGI	Institute of Geologists Ireland
Interactive Effects	Likely significant effects arising from the interaction of different environmental factors that give rise to multiple effects on a single receptor
Intertidal	The area of shore that is exposed to the air at low tide and underwater at the high tide
IPPC	Integrated Pollution and Prevention Control

IROPI	Imperative Reasons for Overriding Public Interest
ISO	International Standards Organisation
$L_{Aeq T}$	The equivalent continuous sound level. It is an average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T).
$L_{Ar T}$	The rated noise level, equal to the $L_{Aeq}$ during a specified time interval (T), plus specified adjustments for tonal character and/or impulsiveness of the sound.
Lg	Local sand and gravel aquifer
LI	Local Zones
Lidar	A remote sensing technology that measures distance by illuminating a target with a laser and analysing the reflected light
m	metres
mOD	metres Above Ordnance Datum
MAND	Major Accidents and Natural disasters
MBR	Membrane Bioreactors
MEICA	Mechanical, Electrical, Instrumentation, Controls and Automation
MHWS	Mean High Water Springs – The highest level that spring tides reach on the average over a period of time
Mitigation	This is defined as measures which avoid or reduce environmental effects which are not included in the design of the proposed development or otherwise included ‘up front’ in the scheme description (such as the CoCP)
MMO	Marine Management Observer
Mt	Million tonnes
NDP	National Development Plan
NHA	National Heritage Area – An area considered by the NPWS important for the habitats present or which holds species of plants and animals whose habitat needs protection
Ni	Nickel
NIAH	National Inventory of Architectural Heritage
NIS	Natura Impact Statement
NO <sub>2</sub>	Nitrogen Dioxide
NTS	Non-technical summary
NPWS	National Parks and Wildlife Service
NPF	National Planning Framework
NRA	National Roads Authority
NSAI	National Standards Authority of Ireland

NSS	National Soil Survey
NVMP	Noise and Vibration Management Plan
NWSMP	National Wastewater Sludge Management Plan
OCU	Odour Control Unit
OD	Ordnance Datum
OPW	Office of Public Works
OHSAS	Occupational Health and Safety Assessment Series
OHSS	Occupational Hygiene and Safety Series
OS	Ordnance Survey
PCBs	Polychlorinated biphenyls
PCU	Passenger car units – One car is considered as a single passenger car unit (1 PCU), a motorcycle is considered as half a car unit (0.5 PCU). Buses and trucks (due to their large size) is considered equivalent to 3 cars (3 PCUs).
PE	Population Equivalent
PFRA	Preliminary Flood Risk Assessment
PID	Photo-ionisation detector
Pier	A column supporting the superstructure of a bridge
Planning boundary	The boundary for planning purposes of the project in question, i.e. the red line boundary as shown in Figure 1.1
PM	Particulate Matter
pNHA	Proposed Natural Heritage Area – An area identified by the NPWS on a non-statutory basis as sites of significance for wildlife and habitats
PO4	Orthophosphate
PPV	Peak particle velocity
Proposed development	The proposed Wastewater Treatment Plant and associated infrastructure including the interceptor sewer network, marine outfalls, upgrade to the revetment, Alps combined sewer overflow and stormwater storage tank.
Proposed Arklow Flood Relief Scheme	It is understood that Wicklow County Council funded by The Office of Public Works intends to undertake engineering works along the Avoca River to mitigate the risk of flooding in the Arklow and Ferrybank area in County Wicklow.
PSA	Preliminary Site Assessment
PSES	Public Sector Energy Efficiency Strategy
PV	Photovoltaics
RBC	Rotating Biological Contractors
RBMP	River Basin Management Plan
RDAS	Refurbishment / Demolition Asbestos Survey

Receptor	Something that could be adversely affected by the proposed development, such as people, an ecological system, property, water body or social infrastructure.
Rip-rap	Rock pieces 10-30 cm diameter used for scour protection of in-river works
RMP	Records of Monuments and Places
RPS	Records of Protected Structures
RQD	Rock Quality Description
RSES	Regional Assembly Spatial and Economic Strategy
SAC	Special Areas of Conservation - (including candidate SACs) protected under the provisions of the Habitats Directive
SBR	Sequencing Batch Reactor
Scour	Erosion of the riverbed due to water flows
SEA	Strategic Environmental Assessment
SI	Site investigation
SID	Strategic Infrastructure Development – Classified as such under the Seventh Schedule of the Planning and Development Act 2000, as amended including by the Planning and Development (Strategic Infrastructure) Act 2006.
Site	The entire area within the planning boundary for the proposed development
SMR	Sites and Monuments Record
Spring tide	The exceptionally high and low tides that occur at the time of the new moon or full moon when the sun, moon and earth are approximately aligned
SPA	Special Protection Area - (including proposed SPAs) protected under the provisions of the Birds Directive
SWO	Stormwater overflow – Relief valves within the network that allow excess combined storm water to be released to the storm water network, or directly to receiving waters (including rivers, lakes, estuarine or coastal waters).
T	Tonnes
TA	Total ammonia
TBM	Tunnel Boring Machine
TD	Téachta Dála – A TD is a member of Dáil Éireann, the lower house of the Oireachtas. It is the equivalent of terms such as ‘Member of Parliament’ or ‘Member of Congress’ used in other countries.
TDS	Total Dissolved Solids
TII	Transport Infrastructure Ireland
TSS	Total Suspended Solids

UMASW	Underwater Multichannel Analysis of Surface Waters
UPS	Uninterruptable power supply
UWWT Directive	Urban Wastewater Treatment Directive - Council Directive 91/271/EEC concerning urban waste-water treatment
WFD	Water Framework Directive – Council Directive 2000/60/EC establishing a framework for Community action in the field of water policy
WHO	World Health Organisation
WWDA	Wastewater Discharge Authorisation – Application made to and authorisation received from the EPA to discharge to aquatic environment as defined under Regulation 5 of the Waste Water Discharge Regulations 2007 (i.e. for an agglomeration with a population equivalent of more than 10,000 in the case of the proposed development)
WwTP	The proposed wastewater treatment plant that would be located at the Old Wallboard site, Ferrybank
WwTP site	The Old Wallboard site at Ferrybank where the proposed development would be constructed
WZ	Water-front Zone – Arklow’s Waterfront’ comprises the port, marinas, harbour, quays, north and south beaches and adjoining lands. The ‘Waterfront Zone’ is made of two district areas north and south of the river that have seen different development pressures and levels of activity over the year, but both sharing the common characteristics of water frontage onto the river and/or the sea and the presence of industrial lands / buildings, a large proportion of which is currently underutilised and vacant.

## 7 Traffic and Transportation

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### 7.1 Introduction

This chapter describes the likely traffic and transportation impacts associated with the construction and operation of the proposed development. A detailed description of the proposed development in relation to traffic and transportation is provided in **Section 7.4**.

This transportation assessment has considered likely significant effects during both the construction and operation of the proposed development. However, it is envisaged that it is during the construction of the proposed development that the likely impact on the various transportation networks will be greatest.

This report will present the receiving transport environment including reporting on traffic counts carried out on the surrounding street network. The projected increase in traffic associated with the operation of the proposed development and its likely significant effects on the receiving transportation networks. The likely phasing and scheduling of the proposed construction works is presented and their likely significant effects on the receiving environment. Finally, any mitigation measures which will assist in reducing the significant effects of the proposed development on the surrounding transportation network is presented.

### 7.2 Assessment Methodology

The following section presents the assessment methodology used in this transportation assessment.

#### 7.2.1 Study Area

The study area considered as part of this transportation assessment is illustrated in Figure 7.1 and includes the following primary streets/ roads;

- North Quay;
- South Quay;
- Arklow Bridge;
- Harbour Road;
- Abbey Street;
- Main Street; and
- Ferrybank.



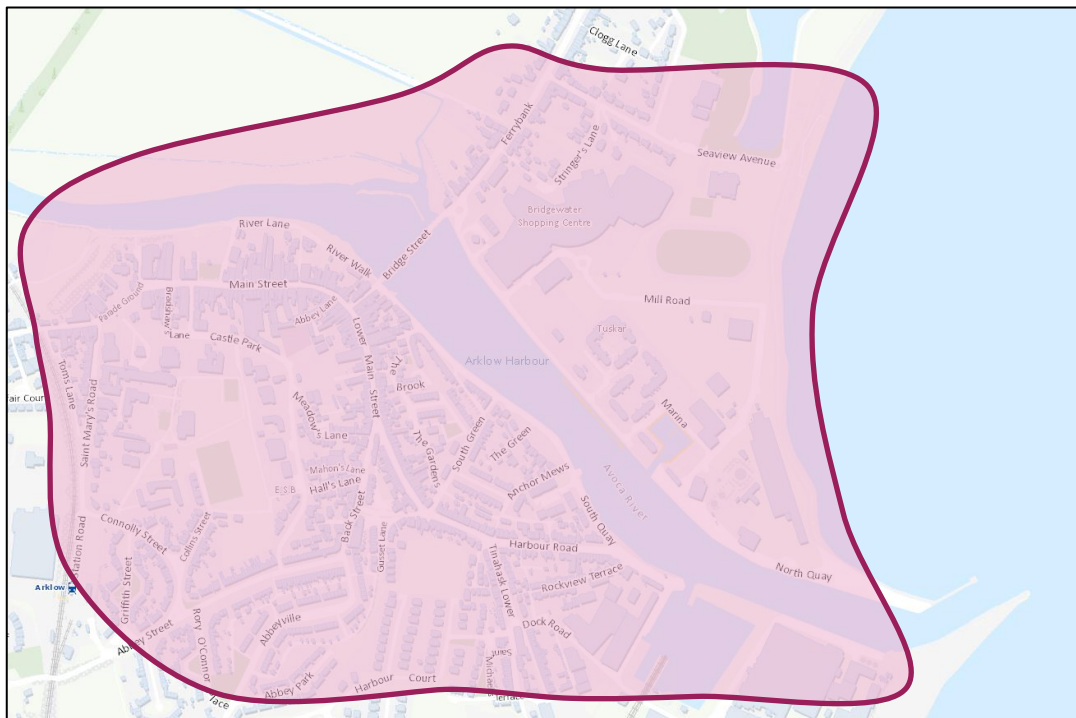


Figure 7.1: Study Area

The study area in Figure 7.1 is considered to be the primary zone of influence with respect to the management of traffic during the construction of the proposed development and is the area most likely to experience temporary changes in traffic flow during construction. As outlined in **Section 4.6 of Chapter 4**, the expected increase in traffic associated with the operation of the proposed development is expected to be very limited as the number of future employees is estimated at only 3-5 persons and regular deliveries/exports to the WwTP site will be minimal. This level of employment and the operational traffic associated with WwTP is expected to have little or no impact on the surrounding road network.

## 7.2.2 Traffic Count Data

Traffic counts were carried out in May 2017 and the traffic count locations are shown in Figure 7.2. The traffic counts were carried out to establish link flows only on an all day basis.

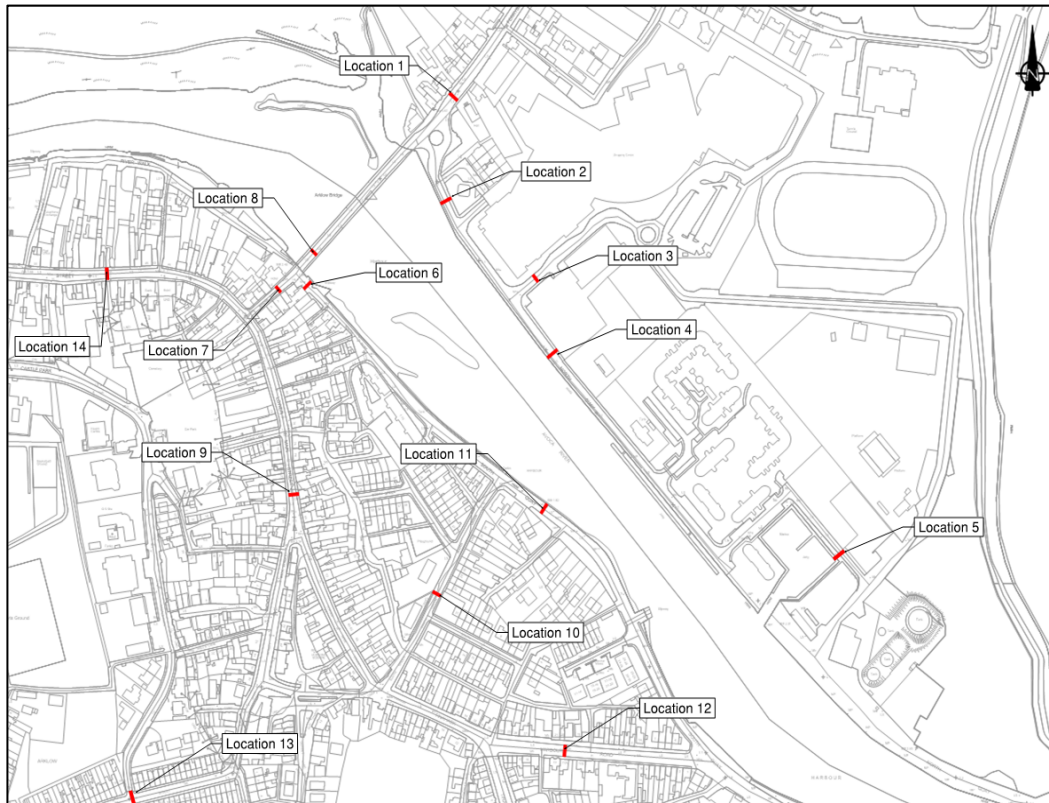


Figure 7.2: Traffic Count Locations

The first traffic survey was carried out from Thursday 4 May 2017 at 9:00 to Thursday 11 May 2017 at 14:00. Count information was obtained at the following locations.

- Location 1: R772-646 Ferrybank;
- Location 2: L6909-0 Bridgewater Road;
- Location 3: L6909-5 Off North Quay beside Aldi store;
- Location 4: L6909-10 North Quay; and
- Location 5: L6909-35 Marina.

The second traffic survey was carried out from Friday 12 May 2017 at 10:00 to Monday 22 May 2017 at 10:00. Count information was obtained at the following locations.

- Location 6: L6907 South Quay;
- Location 7: R775-656 Bridge Street;
- Location 8: R772-652 Arklow Bridge;
- Location 9: L2901-15 Lower Main Street; and
- Location 10: L6905-20 South Green.

The third traffic survey was carried out from Tuesday 23 May 2017 at 09:00 to Wednesday 31 May 2017 at 16:00. Count information was obtained at the following locations.

- Location 11: L6907-30 South Quay;
- Location 12: L6909-20 Harbour Road;
- Location 13: L2901-90 Abbey Street; and
- Location 14: R772-662 Main Street.

### 7.2.3 Future Year Traffic Growth Rates

Future traffic growth on the external road network is based on Transport Infrastructure Ireland's growth rates<sup>1</sup> for the Wexford Region. Based on Table 5.3.2. of the guidelines<sup>1</sup> (as presented in Figure 7.3) the recorded traffic flows have been increased by the central growth rates to establish Year 2020 base year traffic flows.

Year 2020 is expected to be the busiest year with respect to construction activity on the surrounding street/road network and thus has been used to present the likely significant effect of the construction of the proposed development. However, should the proposed development be delayed, there will be no change in the projected increase in traffic and resultant transport assessment as described herein.

**Table 5.3.2: Link-Based Growth Rates: Annual Growth Factors**

Region	Low Sensitivity Growth				Central Growth				High Sensitivity Growth			
	2013 - 2030		2030 - 2050		2013 - 2030		2030 - 2050		2013 - 2030		2030 - 2050	
	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV
1 <b>Dublin</b>	1.0089	1.0221	1.0004	1.0135	1.0134	1.0237	1.0038	1.0176	1.0149	1.0242	1.0054	1.0195
2 <b>Mid-East</b> Kildare Meath Wicklow	1.0109	1.0221	1.0018	1.0135	1.0140	1.0237	1.0048	1.0176	1.0154	1.0242	1.0054	1.0195
3 <b>Midland</b> Laois Longford Offaly Westmeath	1.0088	1.0221	0.9997	1.0135	1.0120	1.0237	1.0030	1.0176	1.0131	1.0242	1.0018	1.0195
4 <b>Border</b> Cavan Donegal Monaghan Leitrim Louth Sligo	1.0082	1.0221	0.9998	1.0135	1.0114	1.0237	1.0030	1.0176	1.0124	1.0242	1.0044	1.0195
5 <b>Mid-West</b> Limerick Clare North Tipperary	1.0066	1.0221	0.9962	1.0135	1.0099	1.0237	1.0000	1.0176	1.0110	1.0242	1.0018	1.0195
6 <b>West</b> Galway City/County Mayo Roscommon	1.0048	1.0221	0.9967	1.0135	1.0082	1.0237	1.0007	1.0176	1.0092	1.0242	1.0024	1.0195
7 <b>South-East</b> Carlow Kilkenny Wexford South Tipperary Waterford City/County	1.0076	1.0221	0.9996	1.0135	1.0106	1.0237	1.0022	1.0176	1.0118	1.0242	1.0038	1.0195
8 <b>South-West</b> Cork City/County Kerry	1.0070	1.0221	0.9983	1.0135	1.0102	1.0237	1.0012	1.0176	1.0112	1.0242	1.0031	1.0195

Figure 7.3: Future traffic growth (Source: Table 5.32 of the guidelines<sup>1</sup>)

<sup>1</sup> Transport Infrastructure Ireland (2016) Project Appraisal Guidelines for National Roads Unit 5.3 - Travel Demand Projections – October 2016.

## 7.2.4 Traffic Generation

The projected change in traffic flows associated with the construction and operation of the proposed development are based on the following information:

- The volume of construction traffic activity is based on, the scale of the individual construction phases, the level of deliveries on site, the removal of soil/ waste from the site in addition to staff and ancillary traffic movements (i.e. servicing, visitors, etc.); and
- The volume of operational traffic activity is based on the number of staff employed and the volume of servicing/maintenance (i.e. sludge removal, etc.) trips associated with the proposed development.

## 7.2.5 Traffic Distribution

The distribution of generated traffic both operational and construction will reflect the existing distribution of traffic recorded by the traffic counts carried out on the local road network. In addition, the distribution of construction traffic is based on the following:

- All construction deliveries to the WwTP and the sewer network north of the Avoca River will access and egress the works area from Junction 20 on the M11 Motorway.
- All construction deliveries to the sewer network south of the Arklow Bridge will access the works area from Junction 21 on the M11 Motorway and egress via Junction 20 on the M11 Motorway.

## 7.2.6 Time Periods Assessed

The time periods assessed as part of this transportation assessment include the 08:00-09:00 period (i.e. during the morning peak period), the 17:00 - 18:00 period (i.e. during the evening peak period) and on an all-day basis (i.e. 24 hour period).

In terms of future assessment years it is proposed to assess the proposed development for Year 2020 as this is the expected busiest period during the construction. The operational assessment will be based on Year 2022 flows.

## 7.2.7 Site Visit

A site visit was undertaken on 11 July 2018 to develop an appreciation of the movement of traffic and pedestrians within the study area.

## 7.2.8 Consultation

Wicklow County Council was consulted in early March 2018 during the development of the traffic management plans to facilitate the construction of the proposed development. In principle, they are in agreement with the proposed traffic management plans, subject to the finalisation and submission of these plans on appointment of a contractor.

A further meeting was held with Wicklow County Council in mid-June 2018 to discuss the proposed diversion of traffic from North Quay to Seafield Avenue during the course of the construction of the proposed development.

## 7.2.9 Impact Assessment Methodology

The significance of effects has been assessed based on the criteria presented in Table 7.1 and has been based on the projected change in prevailing travel conditions which has regard to the EPA draft guidance<sup>2</sup> and with reference to professional judgement of the author who has more than 20 years' experience in undertaking traffic and transportation assessments.

Table 7.1: Assessment Criteria

Significance of Effects	Topic Specific Criteria
Imperceptible	No perceived impact on prevailing travel conditions
Not Significant	A small change in traffic flows without causing a real change in travel conditions
Slight Effects	A change in traffic flow resulting in a minor change in travel conditions
Moderate Effects	A change in traffic flows resulting in a modest change in travel conditions
Significant Effects	A marked change in travel conditions resulting in long delays to traffic
Very Significant Effects	A significant change in travel conditions resulting in very long delays to traffic
Profound Effects	A major change in travel conditions resulting in the breakdown in traffic flow and significant delays to traffic

## 7.3 Baseline Conditions

### 7.3.1 Site Location

The WwTP site is located to the north east of Arklow and is approximately 1.5km from the centre of the town. The site is located adjacent to the shore and is bounded by North Quay on both its western and southern boundaries.

The location of the WwTP site is presented in Figure 7.4.

<sup>2</sup> Environmental Protection Agency (2017) Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft August 2017)

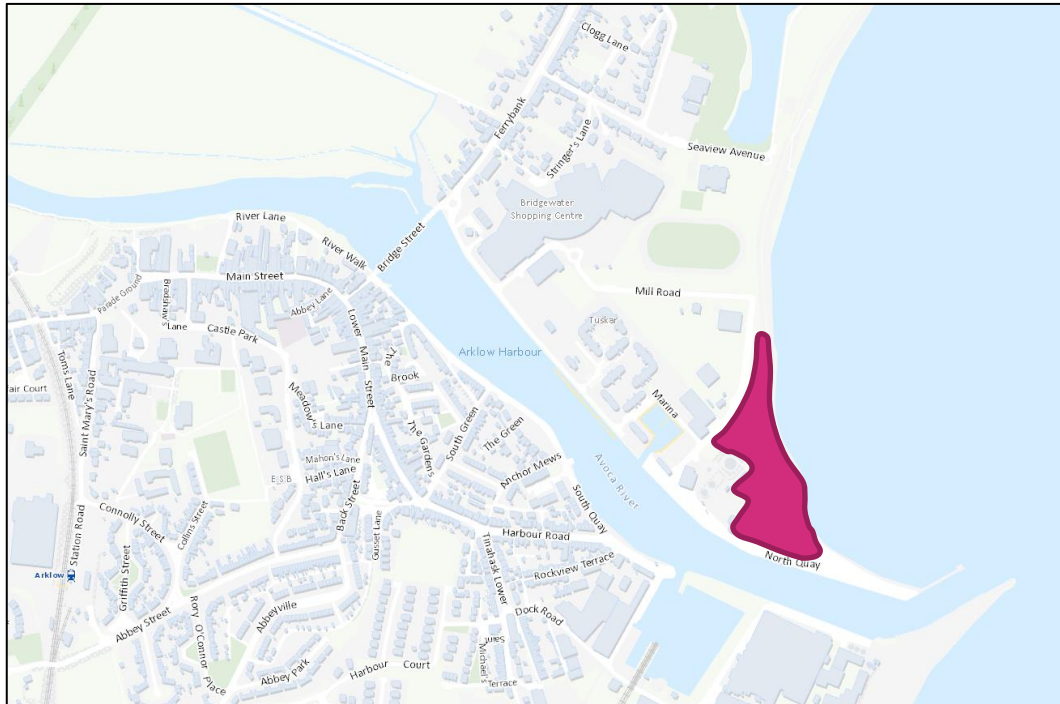


Figure 7.4: Location of proposed WwTP

## 7.3.2 Local Road Network

A brief description of the local road/street network in the vicinity of the proposed development is provided in **Sections 7.3.2.1 - 7.3.2.8**.

### 7.3.2.1 Ferrybank

Ferrybank is the primary route serving the northern side of Arklow and is the main road connecting Arklow to Junction 20 (Templeraíne) on the M11. Ferrybank is a two-way roadway and directly serves adjacent residential properties. The roadway has good pedestrian facilities with footpaths located on both sides of the roadway and there is a pedestrian crossing outside Abercorn Masonic Hall on the two-way Ferrybank Road.

### 7.3.2.2 North Quay

North Quay is the primary access route serving the proposed WwTP. The junction of Ferrybank and North Quay is controlled via a roundabout and is a relatively busy intersection as North Quay also provides access to the Bridgewater Shopping Centre. The roadway is a single carriageway road with a footpath provided along one side of the roadway only. North Quay generally serves a combination of industrial and commercial properties.

### 7.3.2.3 South Quay

South Quay is a two-way roadway primarily serving residential properties. The roadway is generally narrow in width and has only intermittent footpath provision.

The northern end of South Quay operates one-way northbound and there are no footpaths provided along this section of roadway. The junction of Bridge Street and South Quay is a give-way junction but traffic is not permitted to access South Quay from Bridge Street.

#### **7.3.2.4 Bridge Street**

Bridge Street connects Main Street with Arklow Bridge. The street is two-way and supports on-street commercial and retail premises, no parking is permitted along Bridge Street. Bridge Street has footpaths located on both sides of the roadway and also has a pedestrian crossing provided close to its junction with Main Street.

The junction of Bridge Street/ Lower Main Street is non-standard with traffic travelling from Main Street having to give-way to traffic travelling between Bridge Street and Lower Main Street. This junction is a relatively busy location for both vehicular and pedestrian traffic.

#### **7.3.2.5 Abbey Street**

Abbey Street serves the south west districts of Arklow and also provides access to Junction 21 on the M11 Motorway. The street is two-way and supports mainly residential properties. The street has footpaths on both sides of the roadway and also supports some on-street parking.

#### **7.3.2.6 South Green**

South Green connects South Quay with Lower Main Street. The street is residential in nature, is two way and supports on street parking.

#### **7.3.2.7 Harbour Road**

Harbour Road connects Abbey Street to the southern end of South Quay. The street is two-way, however the connection to Abbey Street requires the utilisation of a system of one-way streets encompassing Lower Main Street/ Back Street and Old Chapel Street. The roadway is generally wide in nature, supports on-street parking and has footpaths provided on both sides of the roadway.

#### **7.3.2.8 Main Street**

Main Street connects Wexford Road with Bridge Street, via Upper Main Street. The street is two-way and supports on street commercial and retail premises. The street has footpaths on both sides of the roadway and supports on-street parking along one side of the roadway.

As noted previously traffic on Main Street has to yield to traffic on the Bridge Street- Lower Main Street route as part of the existing management of traffic.

### 7.3.3 Public Transport Network

Arklow is served by a rail service with Arklow train station located approximately 10 minutes' walk from the junction of Main Street/ Bridge Street. In addition, Arklow is served by regional bus services connecting it with the surrounding towns and cities including:

- Intercity Route 2: Wexford to Dublin also serving Gorey, Enniscorthy and Wexford; and
- Regional Route 133: Dublin to Arklow serving Rathnew, Wicklow, Bray.

The location of the train station and the primary bus route in Arklow is presented in Figure 7.5.



Figure 7.5: Public Transport Network

### 7.3.4 Existing Traffic Patterns

In order to assess the potential impact of the proposed development on the local road network an examination of the existing traffic flows was necessary. Traffic counts were carried out during May 2017 at the following locations as illustrated in Figure 7.6.

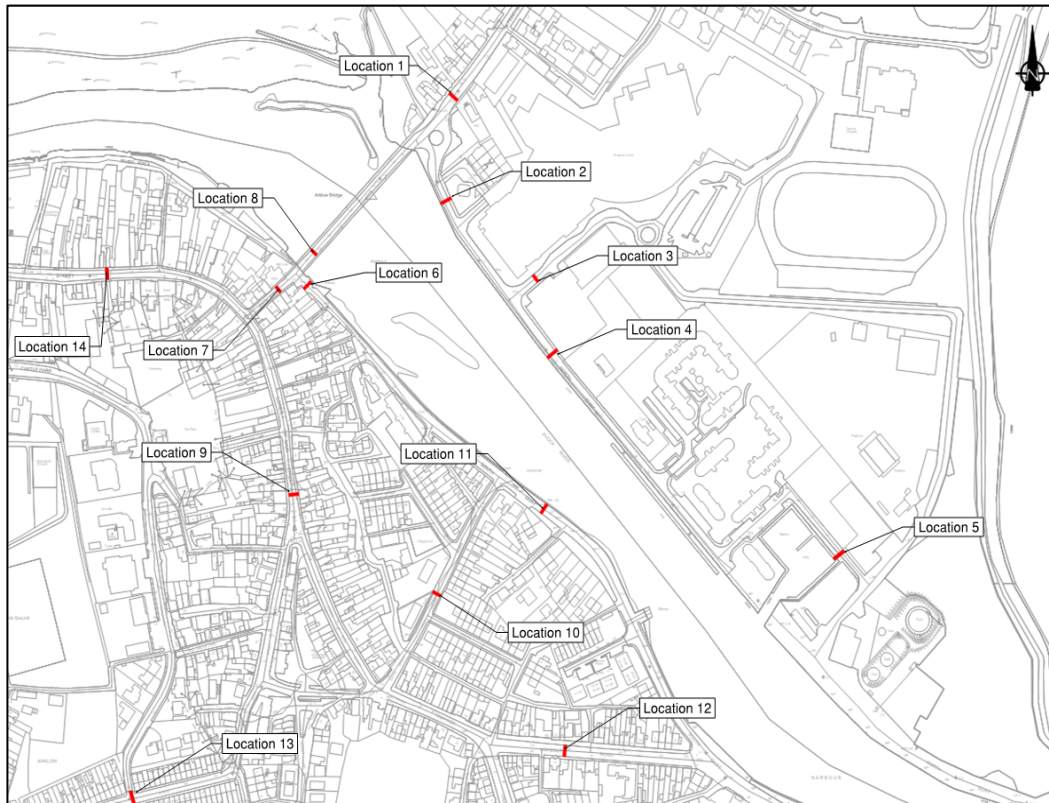


Figure 7.6: Traffic Count Locations

- **Location 1:** R772-646 Ferrybank;
- **Location 2:** L6909-0 Bridgewater Road;
- **Location 3:** L6909-5 Off North Quay beside Aldi store;
- **Location 4:** L6909-10 North Quay;
- **Location 5:** L6909-35 Marina;
- **Location 6:** L6907 South Quay;
- **Location 7:** R775-656 Bridge Street;
- **Location 8:** R772-652 Arklow Bridge;
- **Location 9:** L2901-15 Lower Main Street;
- **Location 10:** L6905-20 South Green;
- **Location 11:** L6907-30 South Quay;
- **Location 12:** L6909-20 Harbour Road;
- **Location 13:** L2901-90 Abbey Street; and
- **Location 14:** R772-662 Main Street.

Table 7.2 presents the morning peak (09:00-10:00), evening peak (17:00-18:00) and weekday daily traffic flows for the key streets in the vicinity of the proposed development.

Table 7.2: Existing Traffic Flow

Link	09:00 - 10:00	17:00 – 18:00	Daily
Ferrybank	1128 pcu	966 pcu	14726 pcu
North Quay	437 pcu	504 pcu	5779 pcu
South Quay – One Way Section	111 pcu	93 pcu	1369 pcu
South Quay – Two Way Section	66 pcu	70 pcu	1071 pcu
Arklow Bridge	1031 pcu	837 pcu	13498 pcu
Abbey Street	190 pcu	226 pcu	2540 pcu
South Green	204 pcu	122 pcu	2497 pcu
Harbour Road	48 pcu	55 pcu	693 pcu
Main Street	792 pcu	780 pcu	11677 pcu

Note: pcu = passenger car units

From the information in Table 7.2, it can be seen that the busiest routes include Ferrybank, Arklow Bridge and Main Street, with lower traffic flows using the remaining streets particularly on the south side of the Avoca River. The northern section of North Quay is relatively busy due to the presence of the Bridgewater Shopping Centre.

### 7.3.5 Committed Development

It is possible that the construction of the proposed development will be carried out at the same time as the proposed Arklow Flood Relief Scheme. The proposed Arklow Flood Relief Scheme includes works within the river itself, to the Arklow Bridge and works along both the North Quay and South Quay.

As noted previously the recorded baseline traffic flows have been increased by the suggested growth rates as presented by Transport Infrastructure Ireland<sup>1</sup> (Refer to Table 7.1). The inclusion of these growth rates reflects the potential increase in traffic on the surrounding road network from committed schemes in the general Arklow area.

## 7.4 Characteristics of the Proposed Development

### 7.4.1 Introduction

The following sections presents the proposed development and the likely changes to the existing transportation networks needed to accommodate the construction of the proposed development. In transportation terms, the construction of the proposed development can be divided into two primary phases, first the construction of the WwTP itself and the second the construction of the proposed interceptor sewer network and ancillary development to serve this new WwTP. The operation of the WwTP will be considered separately.

## 7.4.2 Wastewater Treatment Plant

The location of the WwTP is presented in Figure 7.7 along with the primary access route to the WwTP site, which will be via Mill Road. It is envisaged that this route will be used during both the operation and construction, however there may be some diversion of traffic along the North Quay during construction to facilitate the construction of the proposed interceptor sewer in this area. Further details of the proposed construction sequence associated with the sewers is presented in **Section 7.4.3**.

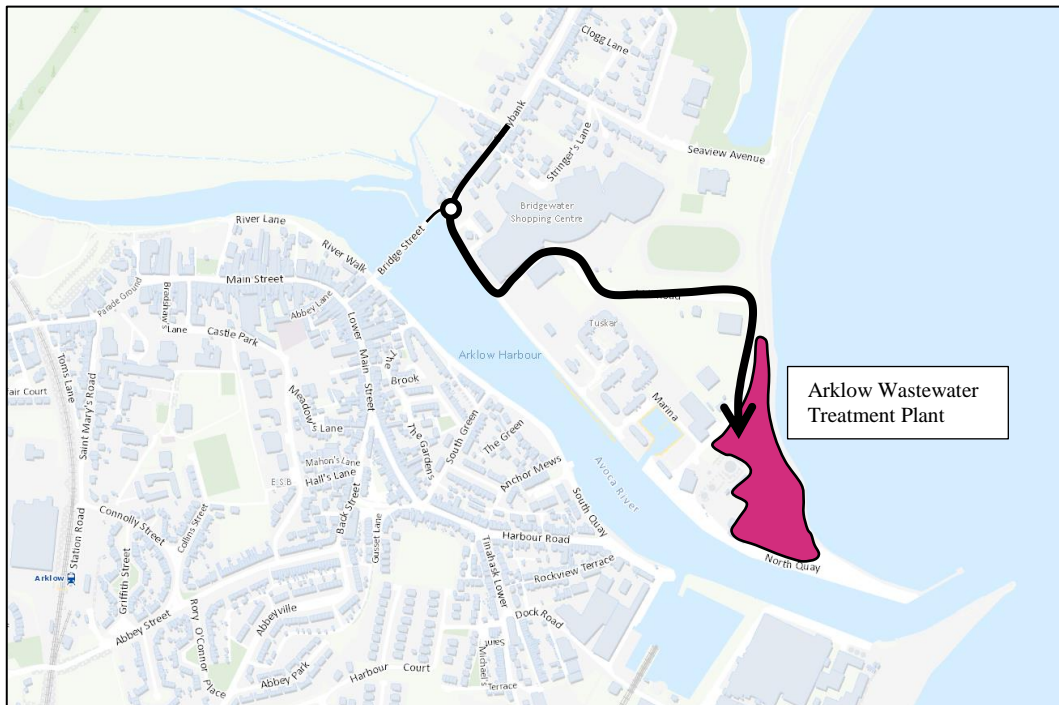


Figure 7.7: Primary Access Route – Arklow Wastewater Treatment Plant

### 7.4.2.1 Construction Phase

The construction of the WwTP at the Old Wallboard site at Ferrybank is expected to take approximately 42 months to complete and it is envisaged that the construction works will employ up to 120 persons during the peak construction period, which will last approximately 12 months.

There will only be limited parking provided at the WwTP site for site vehicles, management and occasional visitors with the remaining parking demand accommodated on either the surrounding road network or temporarily within an adjacent parking area secured by the contractor.

The WwTP will also include bicycle parking, changing rooms and showers to be provided for construction workers. Finally, an on-site canteen is proposed to minimise the movement of traffic between the site and the surrounding area during lunch and break times.

### 7.4.2.2 Traffic Generation

During the peak construction period, it is expected that the following volume of traffic will be generated by the proposed construction works based on the following key assumptions:

- 90% of construction staff traffic will arrive by car with a car occupancy of 1.2 persons.
- 50% of all construction staff traffic will arrive and leave during the traditional peak hour periods.
- The busiest construction period is likely to be during the revetment upgrade and the deep excavation required for the treatment plant. During this circa 3 month time period the estimated total volume of excavation and fill required is approximately 57,000m<sup>3</sup>.
- The delivery of fill and excavation material from the site will be via rigid trucks (9m<sup>3</sup>) and the calculation of truck movements is based on a 5 day operation with a 10 hour working day.
- The average delivery of fill and excavation material has been increased by 20% to represent some potential peaking in the arrival and departure of trucks to and from the site.
- All Heavy Goods Vehicles have been converted to passenger car units based on the following ratio: 1 HGV equals 2.3 passenger car units.

Table 7.3: Traffic Generation – Construction Phase

	Staff	Deliveries	Service
Daily	360 pcu	320 pcu	100 pcu
AM Peak	45 pcu	38 pcu	12 pcu
PM Peak	45 pcu	38 pcu	12 pcu

pcu = passenger car units.

### 7.4.2.3 Commissioning Works

As part of the commissioning of the WwTP some additional works will be required to the proposed interceptor sewer network to transfer flows from existing sewers to the proposed interceptor sewers. This will include the laying of short sections of spur pipelines from the new sewers and connecting these to the existing sewers. The sections of existing sewer to be abandoned will typically be pumped within concrete to form a plug at either end of the line.

The projected increase in traffic associated with the commissioning works will be less than that noted during the peak construction periods associated with the construction of the WwTP itself.

### 7.4.2.4 Operational Phase

On completion of the construction phase the WwTP is envisaged to employ 3-5 full time employees, some of whom would work in shifts as the facility would be operational 24 hours per day.

In terms of car parking a total of 20 spaces are proposed to cater both for the staff parking demand and potential visitor parking demands. In addition, there will be 4 bays for forklifts and 2 standby areas for trucks to collect and/ or deposit materials.

The WwTP will also generate service and maintenance trips with approximately 1 vehicle removing sludge expected on a daily basis.

### 7.4.3 Interceptor Sewer Network

It is envisaged that the construction of the proposed interceptor sewer network will be phased to both manage the overall construction programme and minimise effects on the receiving environment, particularly those associated with environmental conditions and local trader/resident requirements. For the purpose of this transportation assessment the following phased construction profile is presented in **Sections 7.4.3.1 - 7.4.3.13**, however it is noted that some modifications to this construction profile are possible reflecting the actual progress and potential impacts within the study area.

#### 7.4.3.1 Stage A: River Walk (West)

##### Overview

Stage A includes the construction of the proposed sewer network and Alps SWO and stormwater storage along the south side of the Avoca River to the west of River Walk. The works are primarily along the route of the existing river side walkway and the extent of Stage A works is noted in Figure 7.8.

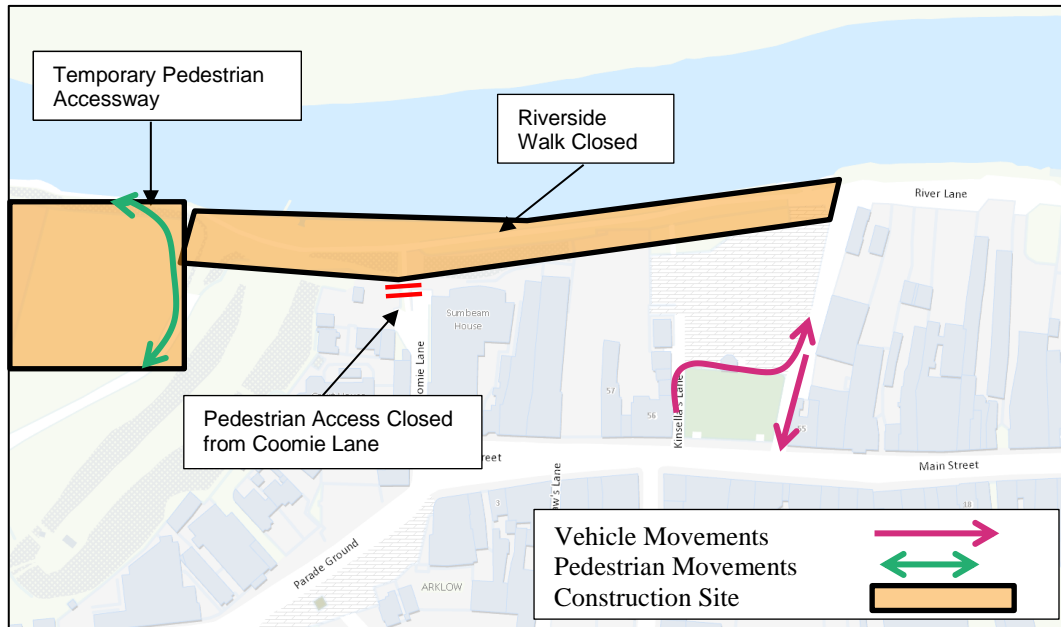


Figure 7.8: Proposed Sewer Network – Stage A

The primary characteristics of this phase of works include the following:

- Duration – Approximately 6 months.
- The riverside walk will be closed to all persons with the unaffected riverside only accessible from the pedestrian access over the rail line.
- Pedestrian access between the riverside walk and Coomie Lane will be closed.
- Construction and general public access will be via River Lane (West) and around Arklow Town car park.

### Traffic Generation

Stage A does not include any significant diversion of traffic from the local street network and the primary impact during this stage will be associated with the physical works themselves.

The projected increase in traffic associated with Stage A is noted in Table 7.4 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and
- Approximately 15 construction staff will be employed at the working areas.

Table 7.4: Traffic Generation – Stage A: River Walk (West)

	Staff	Deliveries	Service
Daily	25 pcu	9 pcu	15 pcu
AM Peak	7 pcu	2 pcu	2 pcu
PM Peak	7 pcu	2 pcu	2 pcu

pcu = passenger car units

### 7.4.3.2 Stage B: River Walk (Central)

#### Overview

Stage B includes the construction of the proposed sewer network along the south side of the Avoca River along River Walk. The extent of Stage B works is noted in Figure 7.9.

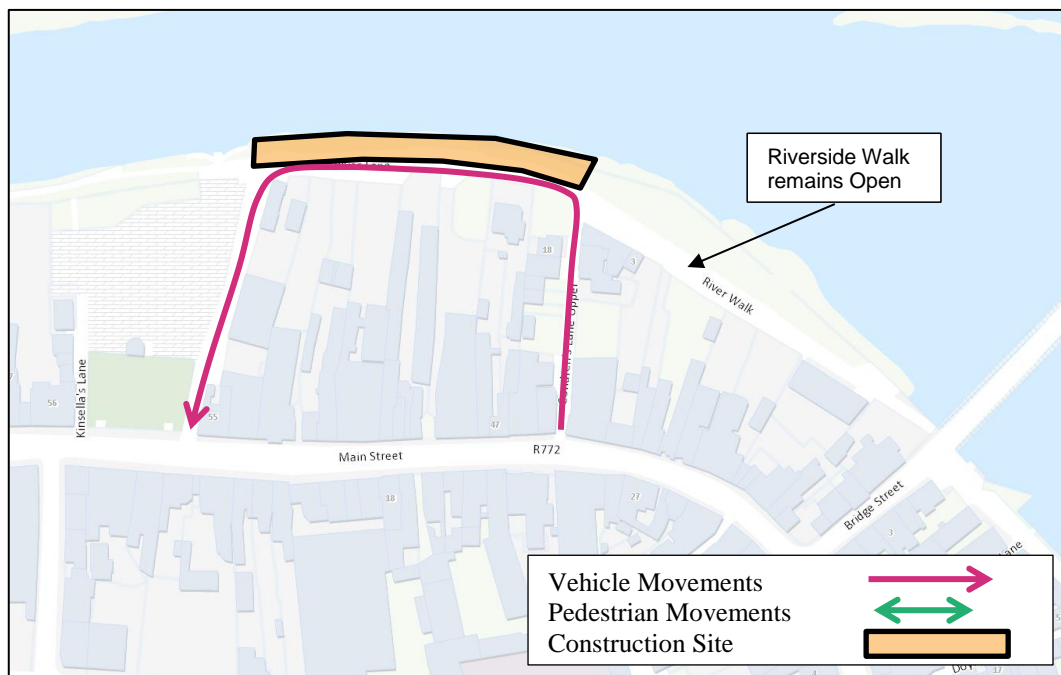


Figure 7.9: Proposed Sewer Network – Stage B

The primary characteristics of this phase of works include the following:

- Duration – Approximately 2 months.
- Riverside Walk east of the Stage B works remains open to two-way traffic at all times.
- Any required road closures will be either carried out at night and/or managed by a stop/go system to ensure access is maintained at all times.
- There will be some loss of parking during the construction of the works with between 5-10 spaces discontinued for the duration of the works.

- A safe pedestrian accessway will be secured along the southside of Riverside Walk for the duration of the construction works.
- Construction access will be via Condren's Lane Upper with traffic exiting via River Lane (West).

### Traffic Generation

Stage B does not include any significant diversion of traffic from the local street network and the primary impact during this stage will be associated with the physical works themselves.

The projected increase in traffic associated with Stage B is noted in Table 7.5 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport; and
- Approximately 5 construction staff will be employed at the working areas.

Table 7.5: Traffic Generation – Stage B: River Walk (Central)

	Staff	Deliveries	Service
Daily	8 pcu	9 pcu	15 pcu
AM Peak	2 pcu	2 pcu	2 pcu
PM Peak	2 pcu	2 pcu	2 pcu

pcu = passenger car units.

### 7.4.3.3 Stage C: River Walk (East)

#### Overview

Stage C includes the construction of the proposed sewer network along the south side of the Avoca River along River Walk. The extent of Stage C works is noted in Figure 7.10.

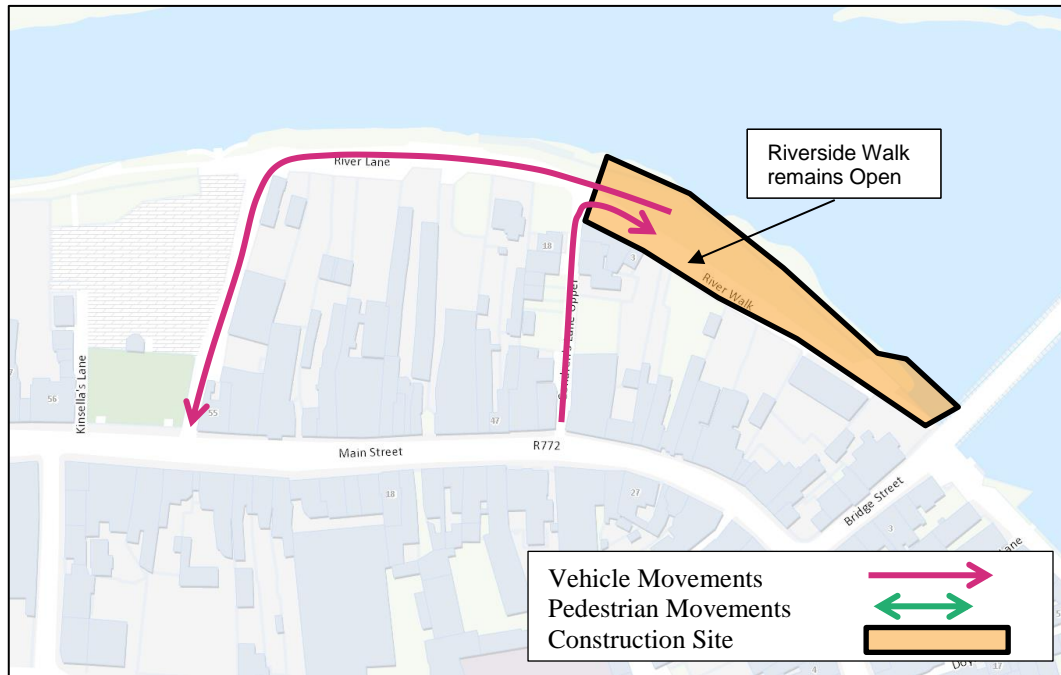


Figure 7.10: Proposed Sewer Network – Stage C

The primary characteristics of this phase of works include the following:

- Duration – Approximately 2 months.
- Riverside Walk east of Condren's Lane Upper will remain accessible for all traffic during the course of the construction works.
- Any required road closures will be either carried out at night and/or managed by a stop/go system to ensure access is maintained at all times.
- There will be some loss of parking during the construction of the works with between 10-15 spaces discontinued for the duration of the works.
- A safe pedestrian accessway will be secured along the southside of Riverside Walk for the duration of the construction works.
- Construction access will be via Condren's Lane Upper with traffic exiting via River Lane (West).

### Traffic Generation

Stage C does not include any significant diversion of traffic from the local street network and the primary impact during this stage will be associated with the physical works themselves.

The projected increase in traffic associated with Stage C is noted in Table 7.6 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport; and
- Approximately 5 construction staff will be employed at the working areas.

Table 7.6: Traffic Generation – Stage C: River Walk (East)

	Staff	Deliveries	Service
Daily	8 pcu	11 pcu	15 pcu
AM Peak	2 pcu	3 pcu	2 pcu
PM Peak	2 pcu	3 pcu	2 pcu

pcu = passenger car units.

### 7.4.3.4 Stage D: Arklow Bridge

#### Overview

Stage D includes the extension of the quay walls into the Avoca River to facilitate the construction of the proposed sewer network along the south side of the Avoca River either side of the Arklow Bridge. The extent of Stage D works is noted in Figure 7.11.

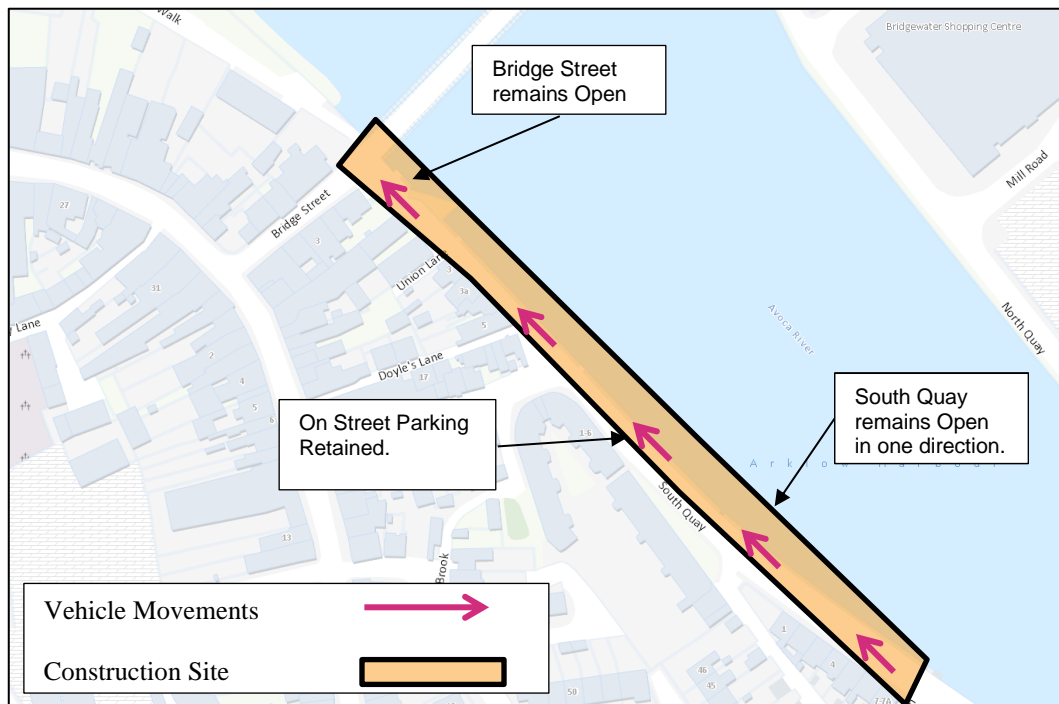


Figure 7.11: Proposed Sewer Network – Stage D

The primary characteristics of this phase of works include the following:

- Duration – Approximately 9 months.
- Riverside Walk remains open to two-way traffic at all times; Stage D works include the construction of a new quay wall and sewer under the existing Arklow Bridge.
- The underpinning of the Arklow Bridge which will require lane closures during the evening and night periods.

- The existing traffic management system will remain along South Quay with one-way traffic permitted between Doyle's Lane and the existing Arklow Bridge and two-way for the remainder of South Quay.
- Any works to the Arklow Bridge may require the temporary closure of one of the lanes.
- On-street parking is retained along South Quay, with the exception of the parking space opposite No. 1 South Quay.
- Construction access will be via South Green.

### Traffic Generation

Stage D does not include any significant diversion of traffic along South Quay with access maintained northbound along the Quay and the primary impact during this stage will be associated with the physical works themselves.

The projected increase in traffic associated with Stage D is noted in Table 7.7 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor;
- Approximately 15 construction staff will be employed at the works area; and
- Approximately 16,400m<sup>3</sup> of extraction and fill required to construct the proposed haul road (3 month duration).

Table 7.7: Traffic Generation – Stage D: Arklow Bridge

	Staff	Deliveries	Service
Daily	25 pcu	46 pcu	15 pcu
AM Peak	7 pcu	6 pcu	2 pcu
PM Peak	7 pcu	6 pcu	2 pcu

pcu = passenger car units.

### 7.4.3.5 Stage E: South Quay/ South Green

#### Overview

Stage E includes the construction of two access chambers to the inceptor sewer on South Quay as well as the tunnelling of the sewer itself. The construction of the access chamber requires the complete closure of South Quay to the south of South Green. The extent of Stage E works is noted in Figure 7.12.

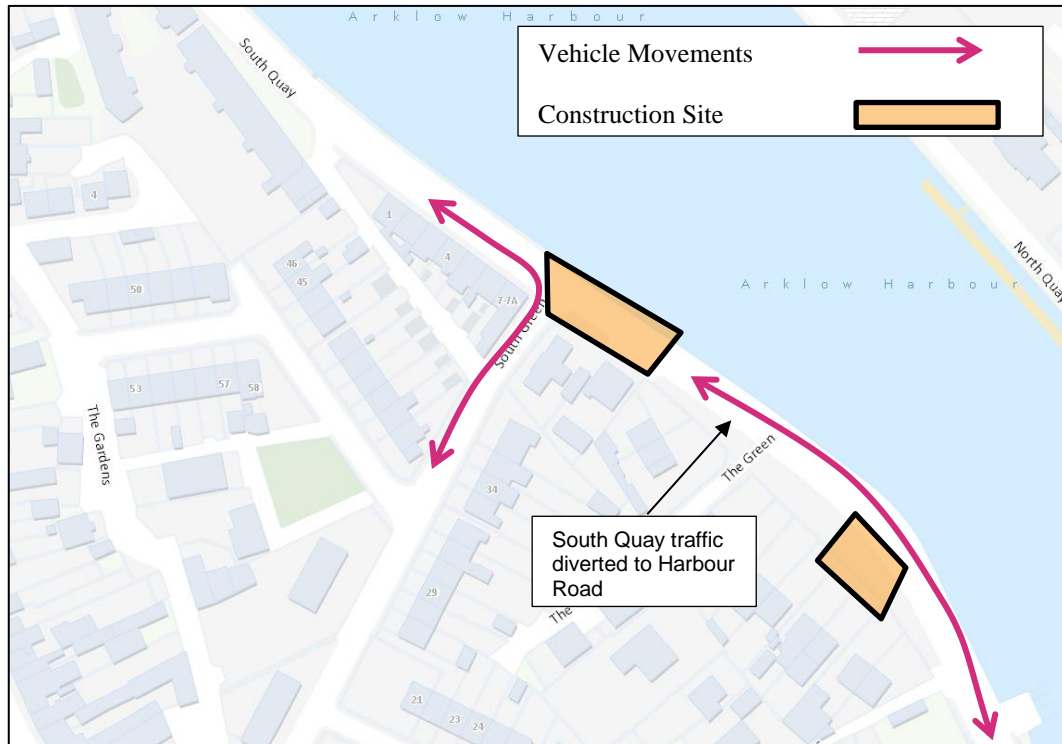


Figure 7.12: Proposed Sewer Network – Stage E

The primary characteristics of this phase of works include the following:

- Duration – Approximately 2 months.
- South Green closed to through traffic; all traffic on South Quay south of South Green diverted to Harbour Road.
- Pedestrian access retained along South Quay to ensure all properties retain access during the course of the works.
- Two temporary parking spaces provided to serve residential properties.
- Construction access to the access chamber construction sites will be via both South Green and Harbour Road.

### Traffic Generation

Stage E does include some traffic diversion along South Quay with traffic having to divert from South Quay onto Harbour Road. The volume of traffic generated by the works themselves is expected to be relatively minimal.

The projected increase in traffic associated with Stage E is noted in Table 7.8 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and
- Approximately 6 construction staff will be employed at the working areas.

Table 7.8: Traffic Generation – Stage E: South Quay/ South Green

	Staff	Deliveries	Service
Daily	8 pcu	11 pcu	15 pcu
AM Peak	2 pcu	3 pcu	2 pcu
PM Peak	2 pcu	3 pcu	2 pcu

pcu = passenger car units.

### 7.4.3.6 Stage F: South Quay/ Harbour Road

#### Overview

Stage F includes the construction of an access chamber for the inceptor sewer on South Quay as well as the tunnelling section across the Avoca River. The construction of the access chamber requires the complete closure of South Quay to the north of Harbour Road. The extent of Stage F works is noted in Figure 7.13.

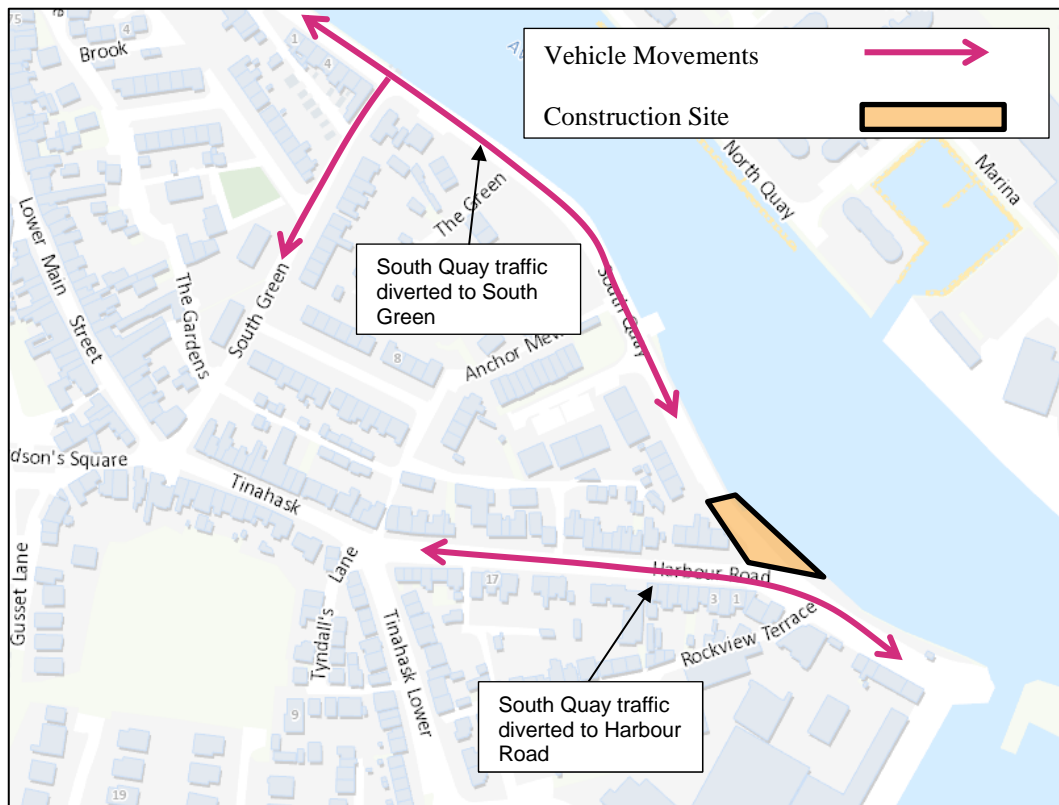


Figure 7.13: Proposed Sewer Network – Stage F

The primary characteristics of this phase of works include the following:

- Duration – Approximately 5 months.
- South Green closed to through traffic; all traffic on South Quay south of Harbour Road diverted to Harbour Road.

- Traffic generated north of Harbour Road along South Green diverted to South Green.
- Pedestrian access retained along South Quay to ensure all properties retain access during the course of the works.
- Any required road closures will be managed by a stop/go system to ensure access is maintained at all times.
- Construction access to and from the construction site via Harbour Road.

### Traffic Generation

Stage F does include some diversion of traffic along South Quay with traffic having to divert from South Quay onto Harbour Road. The volume of traffic generated by the works themselves is expected to be relatively minimal.

The projected increase in traffic associated with Stage F is noted in Table 7.9 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and
- Approximately 6 construction staff will be employed at the working areas.

Table 7.9: Traffic Generation – Stage F: South Quay/ Harbour Road

	Staff	Deliveries	Service
Daily	8 pcu	11 pcu	15 pcu
AM Peak	2 pcu	3 pcu	2 pcu
PM Peak	2 pcu	3 pcu	2 pcu

pcu = passenger car units.

### 7.4.3.7 Stage G: North Quay (East of Bridgewater Shopping Centre)

#### Overview

Stage G includes the construction of the proposed sewer network on North Quay to the east of the entrance to the Bridgewater Shopping Centre and the construction of an access chamber on lands to the east of the existing Ferrybank Roundabout. The construction of the access chambers requires the complete closure of North Quay to the east of the Bridgewater Shopping Centre. Access to Bridgewater Shopping Centre will be via North Quay and the Ferrybank Roundabout while access to areas further east along North Quay will be provided via Mill Road. The extent of Stage G works is noted in Figure 7.14.

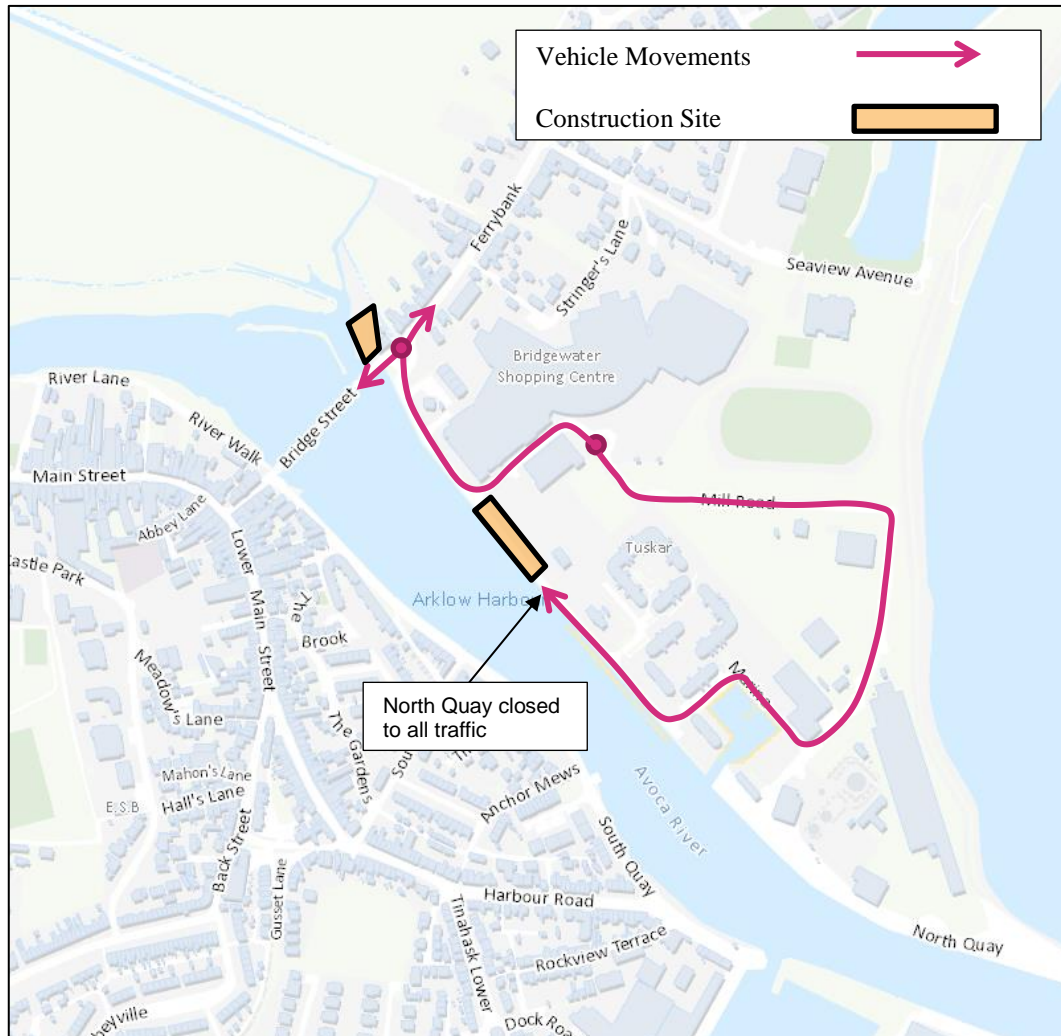


Figure 7.14: Proposed Sewer Network – Stage G

The primary characteristics of this phase of works include the following:

- Duration – Approximately 3 months.
- North Quay closed to all through traffic; all traffic diverted via the Bridgewater Shopping Centre.
- Access from the site west of the Ferrybank Roundabout will be directly from the Ferrybank Roundabout.
- Pedestrian access retained on North Quay.
- Construction traffic will need to be able to access from both sides of North Quay.

### Traffic Generation

Stage G does include some diversion of traffic along North Quay with traffic east of the Bridgewater Shopping Centre having to divert from North Quay onto Mill Road. The volume of traffic generated by the works themselves is expected to be relatively minimal.

The projected increase in traffic associated with Stage G is noted in Table 7.10 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor;
- Approximately 6 construction staff will be employed at the two separate working areas; and
- Both sites will be active simultaneously.

Table 7.10: Traffic Generation – Stage G: North Quay (East of Bridgewater Shopping Centre)

	Staff	Deliveries	Service
Daily	16 pcu	22 pcu	30 pcu
AM Peak	4 pcu	6 pcu	4 pcu
PM Peak	4 pcu	6 pcu	4 pcu

pcu = passenger car units.

#### 7.4.3.8 Stage H: North Quay (East of Ferrybank)

##### Overview

Stage H includes the construction of a single access chamber along North Quay between the Ferrybank Roundabout and the Bridgewater Shopping Centre. The construction of the access chamber requires the complete closure of North Quay to the south of the Ferrybank Roundabout and access to North Quay and the Bridgewater Shopping Centre will be provided via a new road from Seaview Avenue to the shopping centre and then onto North Quay. The extent of Stage H works is noted in Figure 7.15.

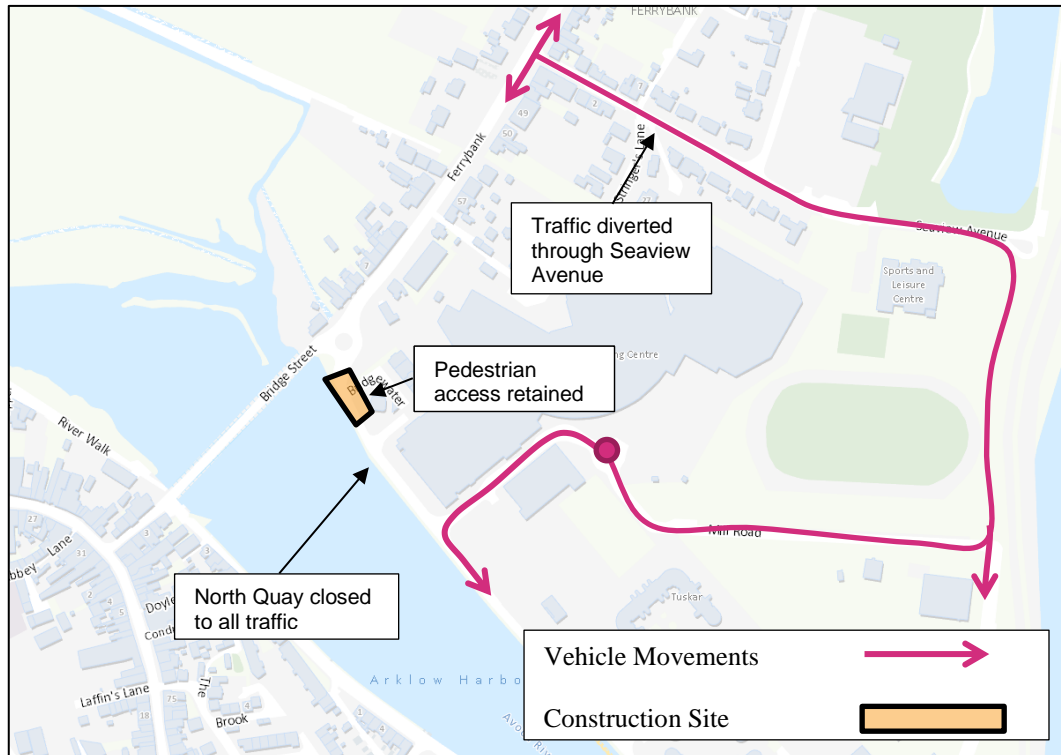


Figure 7.15: Proposed Sewer Network – Stage H

The primary characteristics of this phase of works include the following:

- Duration – Approximately 1 month.
- North Quay closed to all through traffic; all traffic diverted onto Seaview Avenue and Mill Road.
- Pedestrian access retained on North Quay.
- All local access maintained during the course of the construction works.
- Construction Access via the Ferrybank Roundabout and the North Quay via Mill Road and the Bridgewater Shopping Centre.

### Traffic Generation

Stage H includes the diversion of traffic along North Quay with traffic west of the Bridgewater Shopping Centre having to divert from North Quay onto Seaview Avenue. The volume of traffic generated by the works themselves is expected to be relatively minimal and is presented in Table 7.11 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor;
- Approximately 3 construction staff will be employed at the working areas.

Table 7.11: Traffic Generation – Stage H: North Quay (East of Ferrybank)

	Staff	Deliveries	Service
Daily	4 pcu	11 pcu	15 pcu
AM Peak	1 pcu	3 pcu	2 pcu
PM Peak	1 pcu	3 pcu	2 pcu

pcu = passenger car units.

### 7.4.3.9 Stage I: North Quay (West of Ferrybank)

#### Overview

Stage I includes the construction of a single access chamber along North Quay between the Ferrybank Roundabout and the Bridgewater Shopping Centre. The construction of the access chamber requires the complete closure of North Quay to the south of the Ferrybank Roundabout and access to North Quay and the Bridgewater Shopping Centre will be provided via Seaview Avenue. The extent of Stage I works is noted in Figure 7.16.

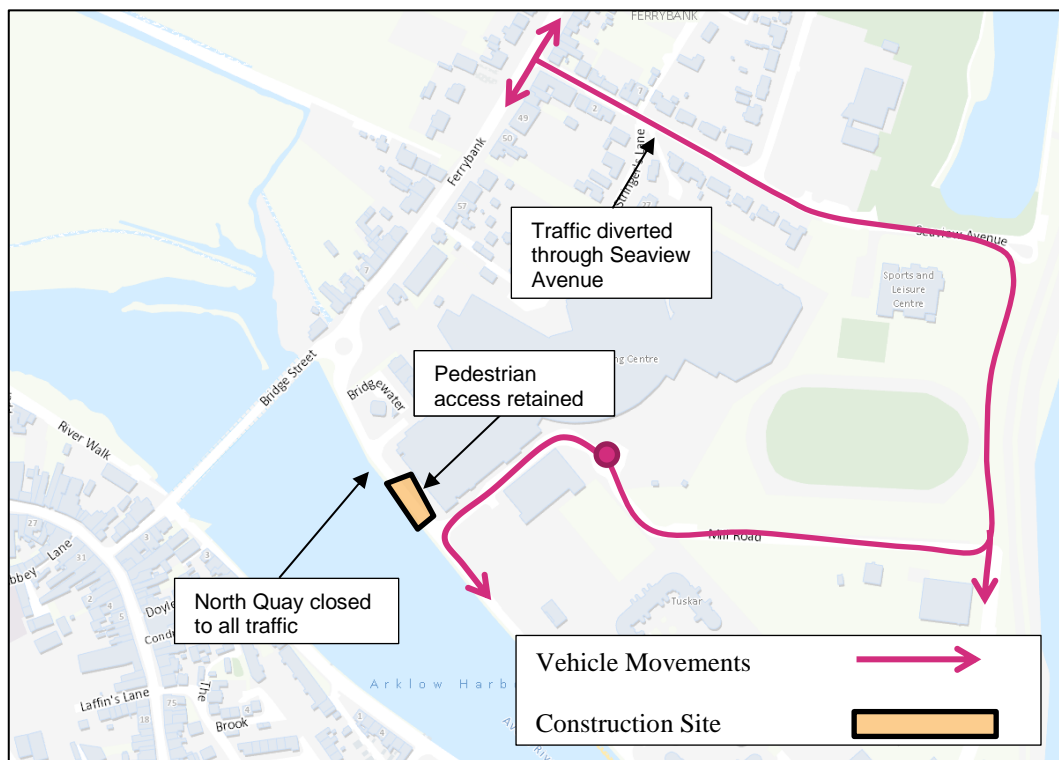


Figure 7.16: Proposed Sewer Network – Stage I

The primary characteristics of this phase of works include the following:

- Duration – Approximately 1 month.
- North Quay closed to all through traffic; all traffic diverted onto Seaview Avenue and Mill Road.

- Pedestrian access retained on North Quay.
- All local access maintained during the course of the construction works.
- Construction access via both the Ferrybank Roundabout and the North Quay via the Bridgewater Shopping Centre.

### Traffic Generation

Stage I includes the diversion of traffic along North Quay with traffic west of the Bridgewater Shopping Centre having to divert from North Quay onto Seaview Avenue. The volume of traffic generated by the works themselves is expected to be relatively minimal and is presented in Table 7.12 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and
- Approximately 3 construction staff will be employed at the working areas.

Table 7.12: Traffic Generation – Stage I: North Quay (West of Ferrybank)

	Staff	Deliveries	Service
Daily	4 pcu	11 pcu	15 pcu
AM Peak	1 pcu	3 pcu	2 pcu
PM Peak	1 pcu	3 pcu	2 pcu

pcu = passenger car units.

#### 7.4.3.10 Stage J: Marina Village

Stage J includes the construction of access chambers and sewers on North Quay and within the Marina Village. The construction of these access chambers requires the complete closure of North Quay to the east of Marina Village and the entrance to the residential development itself. The extent of Stage J works is noted in Figure 7.17.

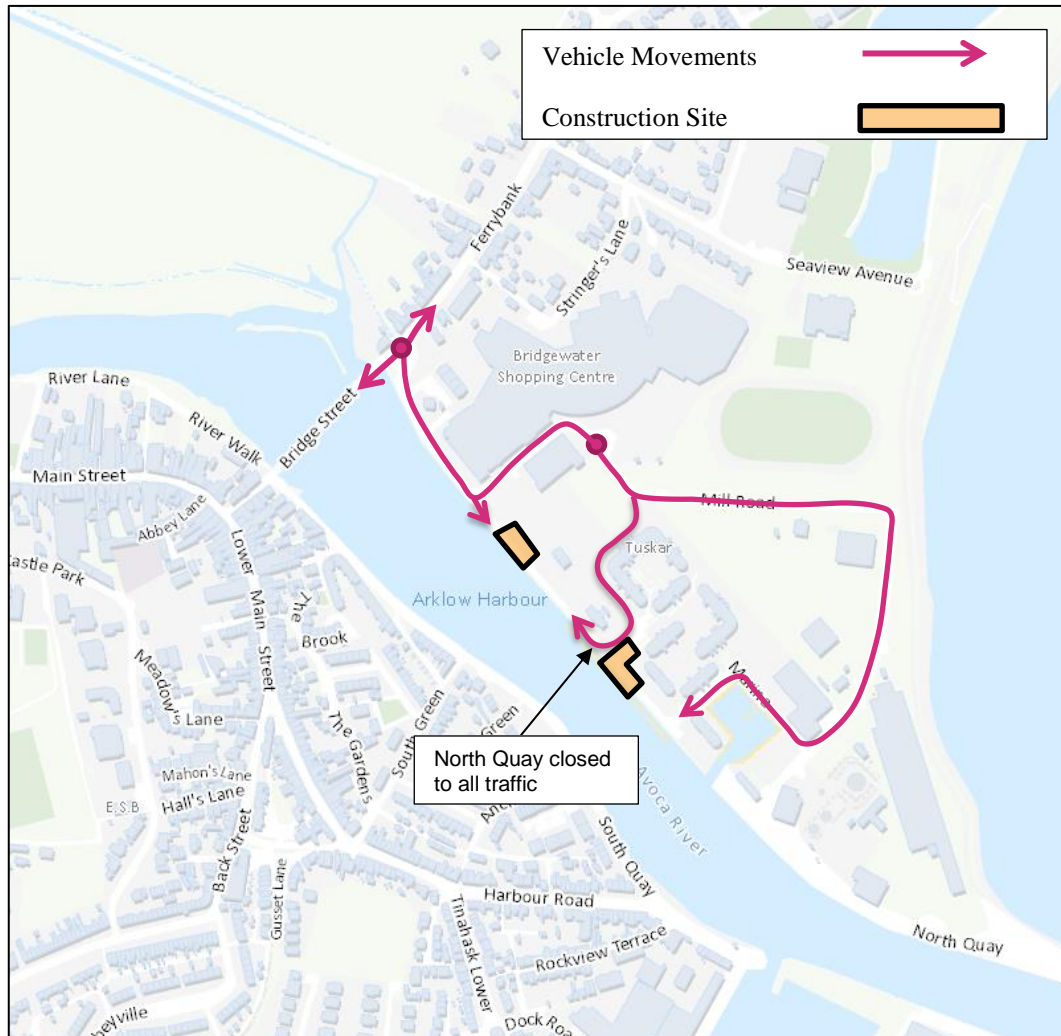


Figure 7.17: Proposed Sewer Network – Stage J

The primary characteristics of this phase of works include the following:

- Duration – Approximately 3 months.
- North Quay closed to all through traffic; all traffic diverted via the Bridgewater Shopping Centre and Mill Road.
- Pedestrian access retained on North Quay
- The temporary relocation of the access serving Marina Village from North Quay to Mill Road
- Temporary provision of 14 parking spaces.
- Construction access will be required from both directions along North Quay.
- No construction access will be permitted through Marina Village.

## Traffic Generation

Stage J includes the diversion of traffic along North Quay with traffic west of the Bridgewater Shopping Centre having to divert from North Quay onto Mill Road.

The volume of traffic generated by the works themselves is expected to be relatively minimal and is presented in Table 7.13 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and
- Approximately 6 construction staff will be employed at the working areas.

Table 7.13: Traffic Generation – Stage J: Marina Village

	Staff	Deliveries	Service
Daily	8 pcu	11 pcu	15 pcu
AM Peak	2 pcu	3 pcu	2 pcu
PM Peak	2 pcu	3 pcu	2 pcu

pcu = passenger car units.

### 7.4.3.11 Stage K: Marina Village

Stage K includes the construction of an access chamber on North Quay to the east of Marina Village. The construction of this access chamber requires the complete closure of North Quay to the east of Marina Village. The extent of Stage K works is noted in Figure 7.18.

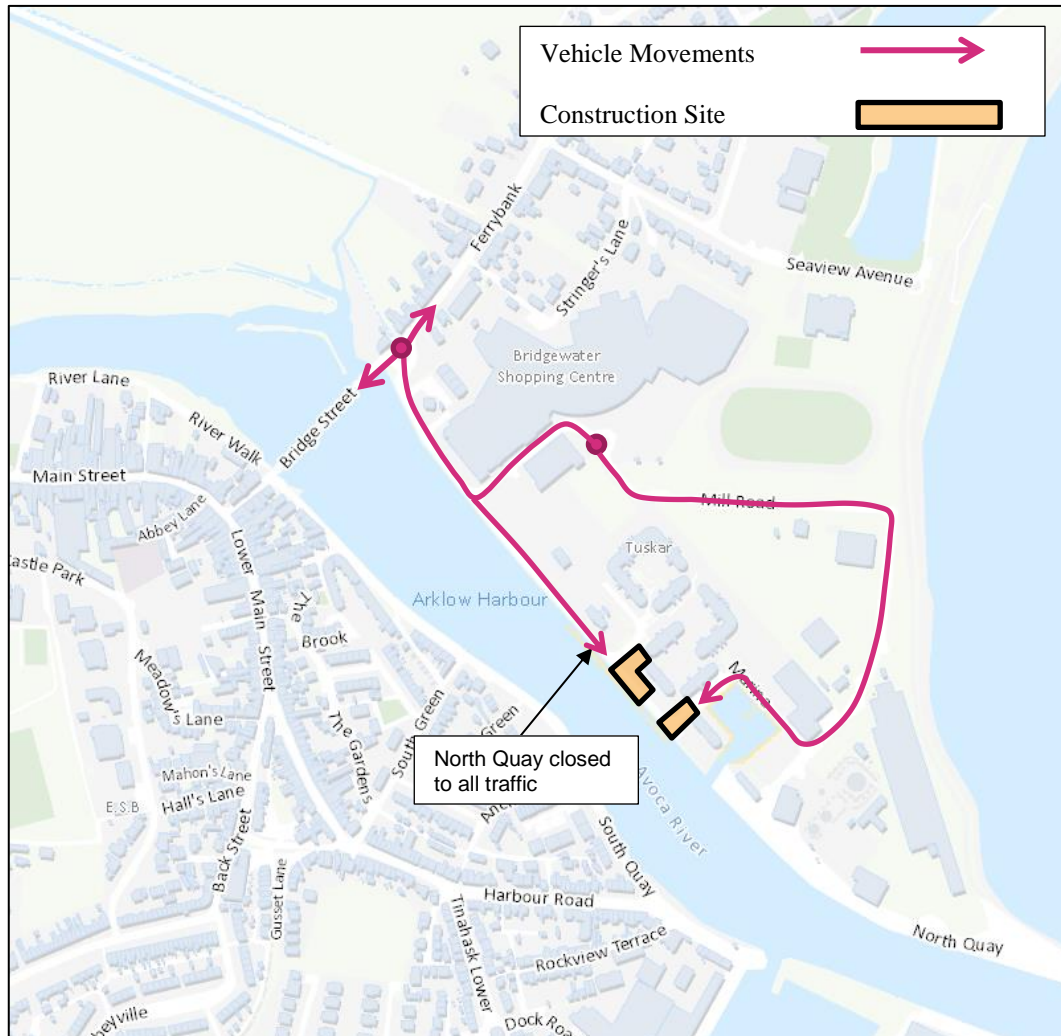


Figure 7.18: Proposed Sewer Network – Stage K

The primary characteristics of this phase of works include the following:

- Duration – Approximately 3 months.
- North Quay closed to all through traffic; all traffic diverted via the Bridgewater Shopping Centre and Mill Road.
- Pedestrian access retained on North Quay.
- Temporary access roads provided to serve the eastern most residential buildings within Marina Village.

### Traffic Generation

Stage K includes the diversion of some traffic along North Quay with traffic west of the Bridgewater Shopping Centre having to divert from North Quay onto Mill Road. The volume of traffic generated by the works themselves is expected to be relatively minimal and is presented in Table 7.14 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and
- Approximately 6 construction staff will be employed at the working area.

Table 7.14: Traffic Generation – Stage K: Marina Village

	Staff	Deliveries	Service
Daily	8 pcu	11 pcu	15 pcu
AM Peak	2 pcu	3 pcu	2 pcu
PM Peak	2 pcu	3 pcu	2 pcu

pcu = passenger car units.

### 7.4.3.12 Stage L: Marina (North)

#### Overview

Stage L includes the construction of a number of access chambers along North Quay to the north of the existing Marina. The construction of these access chambers requires the complete closure of North Quay to the north of the Marina and the construction of a temporary access road to the north of the Marina. The extent of Stage L works is noted in Figure 7.19.

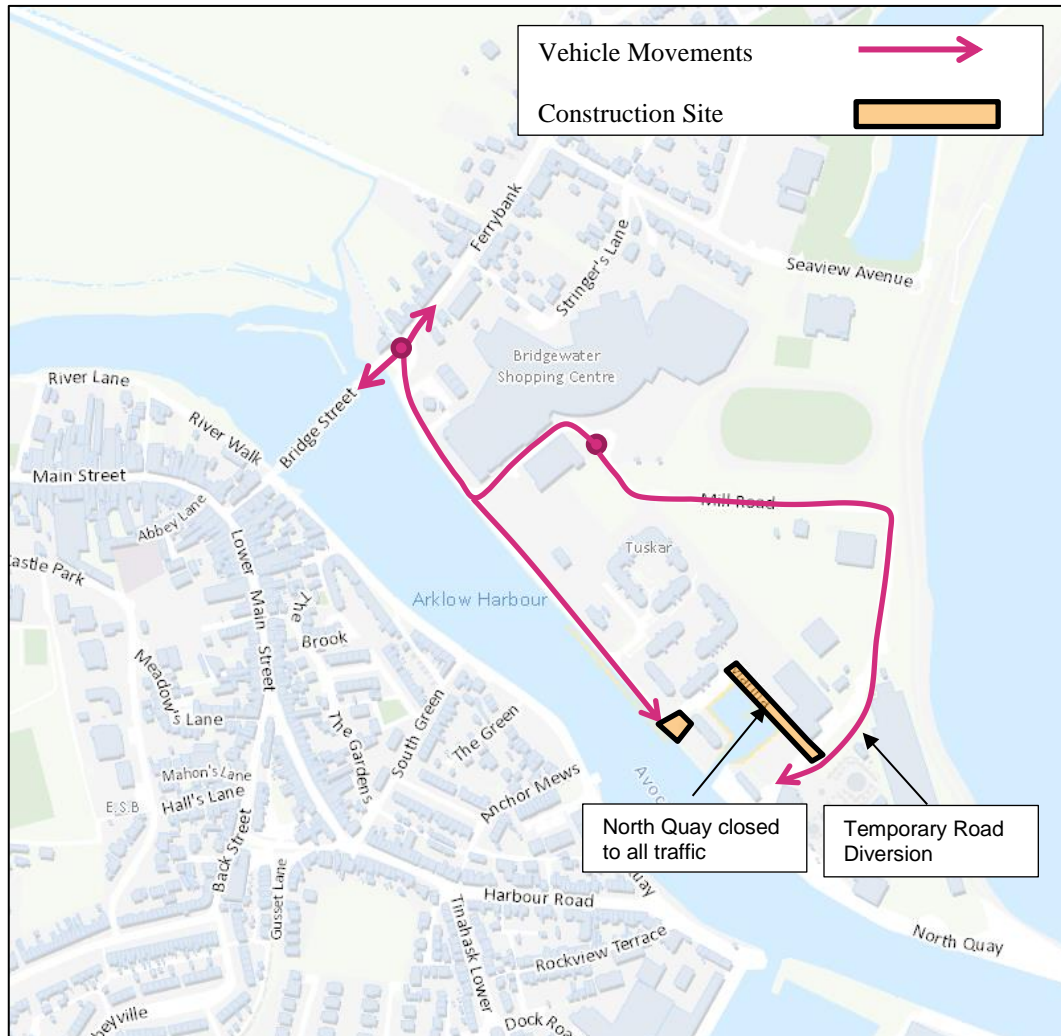


Figure 7.19: Proposed Sewer Network – Stage L

The primary characteristics of this phase of works include the following:

- Duration – Approximately 4 months.
- North Quay closed to all through traffic; all traffic diverted via the Bridgewater Shopping Centre and Mill Road.
- Pedestrian access retained on North Quay.
- Temporary access road provided to serve the eastern end of North Quay.

### Traffic Generation

Stage L includes the diversion of some traffic along North Quay with traffic west of the Bridgewater Shopping Centre having to divert from North Quay onto Mill Road. The volume of traffic generated by the works themselves is expected to be relatively minimal and is presented in Table 7.15 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and

- Approximately 6 construction staff will be employed at the working areas.

Table 7.15: Traffic Generation – Stage L: Marina (North)

	Staff	Deliveries	Service
Daily	8 pcu	11 pcu	15 pcu
AM Peak	2 pcu	3 pcu	2 pcu
PM Peak	2 pcu	3 pcu	2 pcu

pcu = passenger car units.

### 7.4.3.13 Stage M: Marina (North)

#### Overview

Stage M includes the construction of an access chamber along North Quay to the northeast of the existing Marina. The construction of this access chamber (TSN8) requires the complete closure of the eastern end of North Quay and the construction of a temporary access road to the north of the Marina. The extent of Stage M works is noted in Figure 7.19.

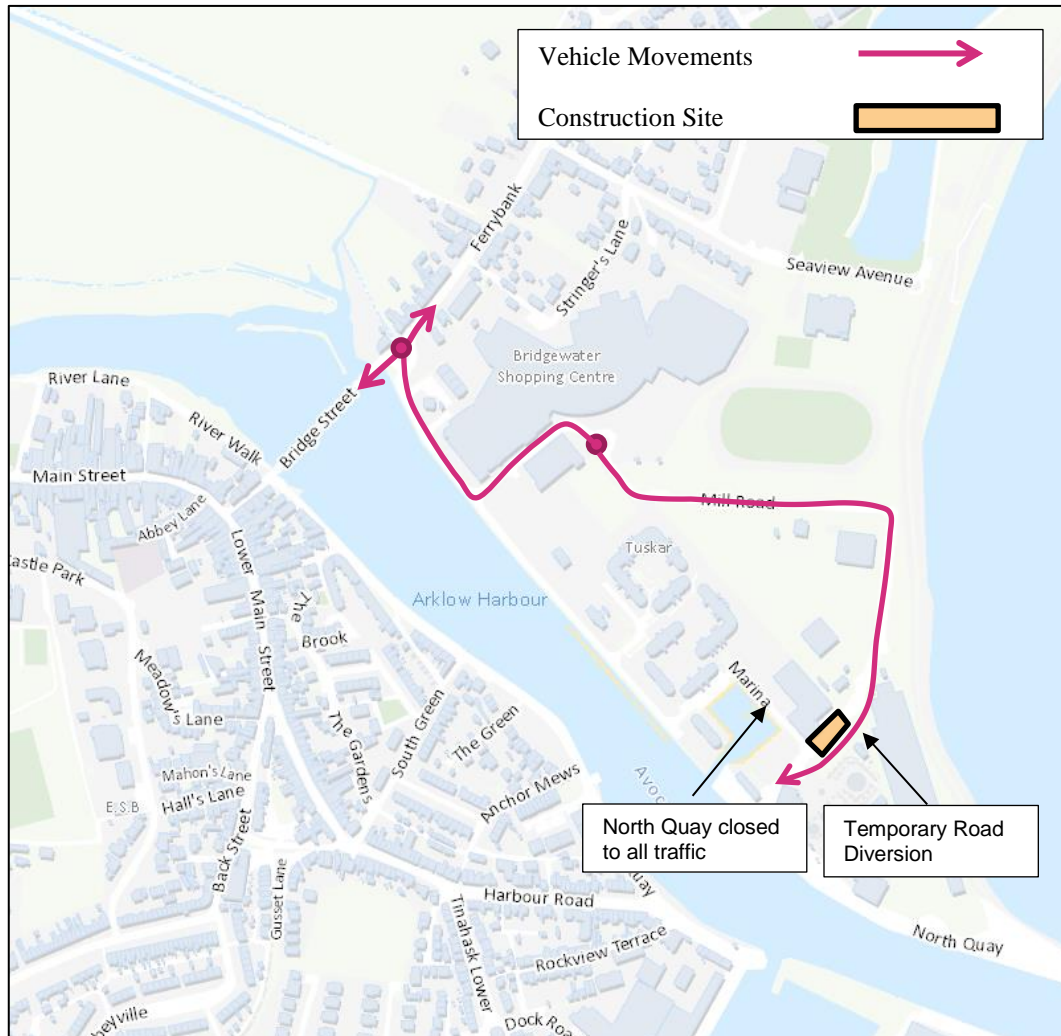


Figure 7.20: Proposed Sewer Network – Stage M

The primary characteristics of this phase of works include the following:

- Duration – Approximately 2 weeks.
- North Quay closed to all through traffic; all traffic diverted via the Bridgegewater Shopping Centre and Mill Road.
- Pedestrian access retained on North Quay.
- Temporary access road provided to serve the eastern end of North Quay.
- Construction access will be via Mill Road.

### Traffic Generation

Stage M includes the diversion of some traffic along North Quay with traffic west of the Bridgegewater Shopping Centre having to divert from North Quay onto Mill Road. The volume of traffic generated by the works themselves is expected to be relatively minimal and is presented in Table 7.16 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and
- Approximately 3 construction staff will be employed at the working areas.

Table 7.16: Traffic Generation – Stage M: Marina (North)

	Staff	Deliveries	Service
Daily	4 pcu	11 pcu	15 pcu
AM Peak	1 pcu	3 pcu	2 pcu
PM Peak	1 pcu	3 pcu	2 pcu

pcu = passenger car units.

## 7.5 Likely Significant Effects

The following sections presents the projected change in traffic flows on the surrounding road network based on the projected additional traffic associated with the construction works including both the WwTP and the interceptor sewer network and associated development. In addition, separate individual assessments will be presented for each of the Stages, presenting the projected change in traffic environment due to the introduction of temporary traffic management measures.

### 7.5.1 Do Nothing Scenario

Under a ‘Do Nothing Scenario’ no temporary increase in traffic is expected and traffic conditions on the surrounding road network will remain as current with some queues and delays evident along Ferrybank Road and approaching Main Street and Arklow Bridge in the town.

### 7.5.2 Assessment of Effects during Construction

#### 7.5.2.1 Traffic Generation

It is envisaged that the construction of the WwTP will occur at the same time as the interceptor sewer network and associated works. In addition, it is likely that one of the construction stages associated with the northern interceptor sewer will be under construction at the same time as the southern interceptor sewer. For the purpose of this assessment it has been assumed that Stage D along the South Quays and Stage G along the North Quays are carried out at the same time, along with the peak construction works envisaged for the WwTP, to provide a robust assessment of the reasonable worst case likely significant effects.

Therefore, the maximum projected increase in traffic associated with this likely construction sequence will result in the following increase in traffic flows.

Table 7.17: Projected Peak Traffic Generation – Construction Phase

	Staff	Deliveries	Service	TOTAL
Daily	401 pcu	388 pcu	145 pcu	934 pcu
AM Peak	56 pcu	50 pcu	18 pcu	124 pcu
PM Peak	56 pcu	50 pcu	18 pcu	124 pcu

pcu = passenger car units.

### 7.5.2.2 Traffic Distribution

It is proposed to restrict the routing of construction deliveries to limit the effects of traffic within the study area. The following restriction will be put in place for the duration of the works:

- All construction deliveries to the WwTP and the sewer network north of the Avoca River will access and egress the works area from Junction 20 on the M11 Motorway.
- All construction deliveries to the sewer network and associated works south of the Arklow Bridge will access the works area from Junction 21 on the M11 Motorway and egress via Junction 20 on the M11 Motorway.

Construction staff will not be subject to the above restrictions and the following distribution of staff traffic has been applied.

Table 7.18: Project Staff Traffic Distribution

Link	Distribution
Ferrybank	45%
Abbey Street	15%
Main Street	40%

### 7.5.2.3 Traffic Assignment

Table 7.19 presents the projected increase in traffic associated with the construction of the proposed development taking into account the envisaged sequencing of construction stages. The projected traffic flows have been calculated for the Year 2020 as this is the time period where construction activity is expected to be at peak.

Table 7.19: Traffic Assignment

Link	09:00-10:00	17:00 – 18:00	Daily
Ferrybank	56 pcu	56 pcu	423 pcu
North Quay	76 pcu	76 pcu	588 pcu
South Quay – One Way Section	15 pcu	15 pcu	63 pcu
South Quay – Two Way Section	15 pcu	15 pcu	63 pcu
Bridge Street	31 pcu	31 pcu	211 pcu
Arklow Bridge	35 pcu	35 pcu	251 pcu
Abbey Street	12 pcu	12 pcu	91 pcu
South Green	4 pcu	4 pcu	30 pcu
Harbour Road	12 pcu	12 pcu	91 pcu
Main Street	22 pcu	22 pcu	160 pcu

### 7.5.2.4 Projected Traffic Increases

The following tables (Table 7.20, Table 7.21 and Table 7.22) present the projected future traffic flows during construction both with and without the proposed development as well as the projected percentage change in traffic flows.

Table 7.20: Projected Traffic Flows - 2020 Without Development

Link	09:00-10:00	17:00 – 18:00	Daily
Ferrybank	1237 pcu	1068 pcu	15840 pcu
North Quay	534 pcu	604 pcu	6639 pcu
South Quay – One Way Section	131 pcu	112 pcu	1496 pcu
South Quay – Two Way Section	84 pcu	87 pcu	1184 pcu
Bridge Street	673 pcu	745 pcu	8765 pcu
Arklow Bridge	1114 pcu	911 pcu	14382 pcu
Abbey Street	298 pcu	353 pcu	4414 pcu
South Green	218 pcu	132 pcu	2644 pcu
Harbour Road	63 pcu	70 pcu	816 pcu
Main Street	852 pcu	839 pcu	12385 pcu

Table 7.21: Projected Traffic Flows - 2020 With Development

Link	09:00-10:00	17:00 – 18:00	Daily
Ferrybank	1181 pcu	1011 pcu	15417 pcu
North Quay	458 pcu	528 pcu	6050 pcu
South Quay – One Way Section	116 pcu	97 pcu	1433 pcu
South Quay – Two Way Section	69 pcu	73 pcu	1121 pcu
Bridge Street	642 pcu	714 pcu	8545 pcu
Arklow Bridge	1079 pcu	876 pcu	14131 pcu
Abbey Street	286 pcu	340 pcu	4324 pcu
South Green	214 pcu	128 pcu	2614 pcu
Harbour Road	50 pcu	58 pcu	726 pcu
Main Street	829 pcu	817 pcu	12225 pcu

Table 7.22: Projected Percentage Change in Traffic Flows - 2020

Link	09:00-10:00	17:00 – 18:00	Daily
Ferrybank	4.8%	5.6%	2.7%
North Quay	16.6%	14.4%	9.7%
South Quay – One Way Section	13.1%	14.6%	4.4%
South Quay – Two Way Section	22.0%	19.4%	5.6%
Bridge Street	4.8%	4.3%	2.6%
Arklow Bridge	3.2%	4.0%	1.8%
Abbey Street	4.3%	3.6%	2.1%
South Green	2.0%	3.3%	1.2%
Harbour Road	24.7%	21.5%	12.5%
Main Street	2.7%	2.7%	1.3%

From the above, it can be seen that the construction of the proposed development is expected to increase traffic flows on the wider road network (i.e. Ferrybank, Abbey Street, Arklow Bridge) by less than 5% during the peak hour periods, and by less than 3% on an all day basis. The two quays (North Quay and South Quay) where the majority of the works are expected to take place are expected to have increases of approximately 15% -20% during the peak hour periods, and between 5% and 10% on an all day basis.

Based on the above it can be concluded that the proposed construction works at a wider network level will have a slight effect on traffic conditions in Arklow, as traffic increases on the primary road/street network (i.e. Ferrybank, Arklow Bridge and Main Street) are all 5% or less during the peak hour periods.

However, at the individual construction sites the effect will be more significant and the following sections describe the likely significant effects of these individual construction stages.

### 7.5.2.5 Likely Significant Effects (Per Stage)

#### Stage A: River Walk (West)

Stage A does not result in any diversion in traffic flows and the potential increase in traffic along River Walk and its approach streets (Condren's Lane Upper and River Lane (West)) will be low and the likely significant effects on traffic flows will be slight.

#### Stage B: River Walk (Central)

Stage B does not result in any diversion in traffic flows and the potential increase in traffic along River Walk and its approach streets will be low and the likely significant effects on traffic flows will be slight and primarily confined to River Walk where some temporary traffic management and loss of on-street parking will be required.

#### Stage C: River Walk (East)

Stage C does not result in any diversion in traffic flows and the potential increase in traffic along River Walk and its approach streets (Condren's Lane Upper and River Lane (West)) will be low and the likely significant effects on traffic flows will be moderate and primarily confined to River Walk where temporary traffic management and loss of on-street parking will be required.

#### Stage D: Arklow Bridge

Stage D includes only a limited diversion of traffic where southeast bound traffic on South Quay will have to exit the quay via Bridge Street. The projected increase in traffic is expected to have a moderate effect on the operation of South Quay where temporary traffic management measures will potentially restrict the free movement of traffic along the Quay.

Stage D also includes the underpinning of the Arklow Bridge which will require lane closures over the bridge with traffic flow operating on a shuttle basis. The required traffic management measures have the potential to result in significant traffic congestion and to manage the likely significant effects. The following measures are proposed:

- No scheduled lane closures should commence before 21:00 and all lane closures should be lifted by 07:00 in the morning.
- The length of lane closure and the required working area needs to be kept as small as possible to reduce the length of the shuttle system.

#### Stage E: South Quay/ South Green

Stage E includes a limited diversion of traffic where South Quay traffic will need to use Harbour Road to access the wider street network. This will result in the projected change in traffic flows on Harbour Road and South Green as outlined in Table 7.23.

Table 7.23: Projected Stage E Diversion Traffic Flows

Link	09:00-10:00		17:00 – 18:00		Daily	
	Without	With	Without	With	Without	With
South Green	214 pcu	283 pcu	128 pcu	201 pcu	2614 pcu	3,735 pcu
Harbour Road	50 pcu	119 pcu	58 pcu	131 pcu	726 pcu	1,847 pcu

The projected increase in traffic is expected to have a moderate effect on the traffic operations along South Quay, South Green and Harbour Road, particularly where traffic has to use longer routes due to the implementation of the temporary traffic diversions. Both South Green and Harbour Road will see an expected increase in traffic flows however these streets currently experience very low traffic flows and have sufficient capacity to accommodate the projected increase in traffic.

### Stage F: South Quay/ Harbour Road

Stage F also includes for the diversion of traffic from South Quay to both Harbour Road and South Green to access the wider street network. This will result in a similar projected change in traffic flows on Harbour Road and South Green as noted in Table 7.23.

This projected increase in traffic is expected to have a moderate effect on traffic operations, particularly where traffic has to use longer routes due to the implementation of the temporary traffic diversions. In addition, both South Green and Harbour Road will see an increase in traffic flows.

### Stage G: North Quay (East of Bridgewater Shopping Centre)

Stage G includes for the diversion of traffic from North Quay (East of Bridgewater Shopping Centre) to Mill Road. This diversion is expected to have a moderate effect on traffic operations, as traffic flows on this section of North Quay are relatively light with daily traffic flows noted at approximately 1,200 passenger car units (pcu) per day.

The primary effects associated with this stage of the works will be longer traffic journeys, traffic on North Quay will have to take, to access the wider street network, however no additional traffic congestion is expected during this stage due to the low level of traffic on Mill Road.

### Stage H: North Quay (East of Ferrybank)

Stage H includes for a major diversion of traffic from North Quay (East of Ferrybank) to Seaview Avenue. The closure of North Quay will result in approximately 6,000 daily trips rerouting through Seaview Avenue and accessing the shopping centre and North Quay via a new road link.

This diversion of traffic is expected to be a significant negative effect on traffic operations, particularly at the junction of Ferrybank Road/ Seaview Avenue with the potential for long queues forming at the junction. To manage these potential likely significant effects and traffic restrictions, the following measures are suggested:

- The works should be carried out during a quiet period of the year, possibly late summer however impacts on tourist traffic will also need to be considered.
- The works should be carried out utilising a longer working day 16 - 24 hour basis, however the impact on adjacent residents would need to be considered to reduce the time North Quay needs to remain closed.
- The junction of Ferrybank/ Seaview Avenue would need to be manned during busy periods to ensure the junction operates efficiently and safely.
- Parking in and around the junction of Ferrybank and Seaview Avenue needs to be managed and controlled.

### **Stage I: North Quay (West of Bridgewater Ferrybank)**

Stage I also includes the diversion of traffic from North Quay (East of Ferrybank) to Seaview Avenue as noted under Stage H. The closure of North Quay is expected to have a significant effect on traffic operations, particularly at the junction of Ferrybank Road/ Seaview Avenue with the potential for long queues forming at the junction. The potential traffic management measures to mitigate this increase in traffic are as presented under Stage H.

### **Stage J: Marina Village**

Stage J includes for the diversion of traffic from North Quay (East of Bridgewater Shopping Centre) to Mill Road. In addition, Marina Village will need to be temporarily accessed via Mill Road. This diversion is expected to have a moderate effect on traffic operations, as traffic flows on this section of North Quay are relatively light with daily traffic flows noted at approximately 1,200 passenger car units (pcu) per day.

The likely significant effects associated with this stage of the works will be longer journeys for traffic on North Quay and residents accessing Marina Village, however no additional traffic congestion is expected during this stage of the works due to the current low level of traffic using Mill Road.

### **Stage K: Marina Village**

Stage K is expected to have very similar effects to that noted under Stage J, however the temporary access to Marina Village from Mill Road will no longer be required. The diversion of traffic is expected to have a slight effect on traffic operations due to longer distances travelled but no additional traffic congestion is expected during this stage of the works due to the current low level of traffic using Mill Road.

### **Stage L: Marina (North)**

Stage L is expected to have a slight effect on traffic operations due to longer distances travelled but no additional traffic congestion is expected during this stage of the works.

## Stage M: Marina (North)

Stage M is expected to have a slight effect on traffic operations as traffic accessing the WwTP site will need to use Mill Road and the new temporary construction road. However, due to the prevailing traffic conditions in the area no additional traffic congestion is expected during this stage of the works.

### 7.5.2.6 Cumulative

The construction works associated with the proposed Arklow Flood Relief Scheme have the potential to impact on the construction of the proposed development. There is the potential that should the projects be carried out simultaneously, co-ordinated traffic management plans will need to be prepared and agreed with Wicklow County Council.

As the proposed Arklow Flood Relief Scheme is still (at the time of writing) in its early design stage it is not possible to carry out a detailed combined assessment on traffic and transport. However the EIAR for the proposed Arklow Flood Relief Scheme will need to address the cumulative effects of it with the proposed development in due course.

At a wider level, the construction of both projects simultaneously will result in greater traffic flows, including Heavy Goods Vehicles on all the streets within Arklow and there is likely to be greater effects along both the North and South Quays where the works themselves will be concentrated.

### 7.5.3 Assessment of Effects during Operation

During the operation of the proposed development the projected increases in traffic flows will be very small, with between 10- 20 additional trips expected per day. This projected increase in traffic will have an imperceptible effect on prevailing traffic conditions.

## 7.6 Mitigation Measures and Monitoring

### 7.6.1 Mitigation

#### 7.6.1.1 Mitigation During Construction

##### Construction Traffic Management Plan

The appointed contractor for the proposed development will prepare a detailed Construction Traffic Management Plan covering all stages of construction. This plan will need to take into account other potential construction works in the area including the proposed Arklow Flood Relief Scheme.

The Construction Traffic Management Plan will demonstrate how pedestrians, cyclists and motorised vehicles can pass through the working areas safely and that measures are in place which ensure traffic operates in as an efficient manner possible.

## Consultation Plan

The Construction Traffic Management Plan will include a detailed Consultation Plan to deal with third party queries from both residents and retail/commercial operators. The Construction Traffic Management Plan will require agreement with both Wicklow County Council and An Garda Síochána.

The contractor will appoint a single point of contact to facilitate the communication of the various traffic management plans and the preparation of a project specific website to aid communications would also be beneficial.

## Mobility Management Plan

As part of the Construction Traffic Management Plan a Mobility Management Plan will be prepared to ensure access to the site by sustainable travel modes is encouraged. The following measures will need to be considered within the Mobility Management Plan:

- The provision of showers/ changing rooms for construction staff;
- The provision of cycle parking for staff; and
- The promotion of car sharing among staff, including van pooling to travel between the different working areas.

## Individual Traffic Management Plans

For Stage H and Stage I the following individual traffic management measures should be considered as part of the Construction Traffic Management Plan:

- The works should be carried out during a quiet period of the year, possibly late summer however impacts on tourist traffic will also need to be considered.
- The works should be carried out utilising a longer working day 16-24 hour basis, however the impact on adjacent residents would need to be considered to reduce the time North Quay needs to remain closed.
- The junction would need to be manned during busy periods to ensure the junction operates efficiently and safely.
- Parking in and around the junction of Ferrybank and Seaview Avenue needs to be managed and controlled by appropriately trained personnel.

For any works to Arklow Bridge that require lane closures the following measures are suggested:

- No scheduled lane closures should commence before 21:00 and all lane closures should be lifted by 07:00 in the morning.
- The length of lane closure and the required working area needs to be kept as small as possible to reduce the length of the shuttle system.

### 7.6.1.2 Mitigation During Operation

No mitigation measures have been proposed with respect to effects from the operation of the proposed development as the projected increase in traffic will have no impact on prevailing traffic conditions.

## 7.6.2 Monitoring

### 7.6.2.1 Monitoring During Construction

For each construction stage the individual traffic management plans need to be continually monitored to ensure the impact on traffic flows on the surrounding street network are minimised and additional mitigation measures are introduced as required to assist the flow of traffic. The monitoring regime needs to consider all modes of traffic including pedestrians, cyclists and car parking provision.

### 7.6.2.2 Monitoring During Operation

No monitoring has been proposed with respect to effects from the operation of the proposed development as the projected increase in traffic will have no impact on prevailing traffic conditions.

## 7.7 Residual Effects

### 7.7.1 Residual Effects during Construction

The construction of the proposed development will result in additional traffic congestion particularly where construction works are taking place on Arklow Bridge and the section of North Quay between the Ferrybank Road and the Bridgewater Shopping Centre. These effects will be temporary in nature and following the completion of the construction works will have no residual effects.

During all construction stages the individual working areas will result in some restrictions and inconvenience to the movement of people and traffic. These restrictions will be temporary in nature and particularly localised to the working areas.

### 7.7.2 Residual Effects during Operation

No residual effects are anticipated during the operation of the proposed development.

## 7.8 References

Environmental Protection Agency (2017) *Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft August 2017)*

Transport Infrastructure Ireland (2016) *Project Appraisal Guidelines for National Roads Unit 5.3 - Travel Demand Projections – October 2016.*

## 8 Air Quality and Climate

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### 8.1 Introduction

This chapter describes the likely significant effects of the proposed development on air quality and climate. Odour is addressed separately in **Chapter 9**.

**Chapter 4** provides a full description of the proposed development and **Chapter 5** describes the Construction Strategy. The following aspects are particularly relevant to the air quality and climate assessment:

- Operation and Design: the use of energy efficient design throughout the scheme design reduces the annual CO<sub>2</sub> emissions of the proposed development. Key energy and resource efficiency measures are outlined in detail in **Section 8.5.1.2** including; WwTP location, gravity sewers, pump efficiencies, the use of PV panels and heat recovery at the WwTP.
- Operation: An emergency generator will be located at the WwTP for use during power outages.
- Construction: A generator will be used to power the TBM during the construction of the proposed development.

### 8.2 Assessment Methodology

#### 8.2.1 General

Air quality assessments are concerned with the presence of airborne pollutants in the atmosphere. The likely significant effects of the proposed development on air quality have been assessed by considering the background concentration levels of pollutants in the atmosphere and the potential for likely significant effects during construction and operation of the proposed development. Predicted concentrations associated with the proposed development are then compared to the relevant limit values which are described in detail in **Section 8.2.2** to determine likely significant effects.

This assessment has also been undertaken with regard to the requirements of the Transport Infrastructure Ireland (TII), (formerly the National Roads Authority, guidelines<sup>1</sup>. These guidelines<sup>1</sup> provide a methodology for the assessment, management and mitigation of air quality at construction sites which can be adapted accordingly depending on the nature of the works.

The guidelines<sup>1</sup> state that increases in Annual Average Daily Traffic (AADT) flows of less than 5% and 10% during the operational and construction phases respectively are unlikely to result in significant air quality effects.

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<sup>1</sup> TII (2011) Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes.

Likely significant effects on air quality are therefore assessed when the AADT flows increase above these thresholds during construction and operation of the proposed development.

Air dispersion modelling of pollutant emissions represents a widely accepted method of assessing potential risk of off-site impacts. To assess the likely significant effects of the construction phase of the proposed development on the ambient environment, dispersion modelling of odorous emissions was undertaken in accordance with the EPA guidance document<sup>2</sup>. The air dispersion modelling methodology is outlined in **Section 8.2.5.2**. There will be no operational air emissions.

The climate assessment for the construction and operational phase estimates the greenhouse gas (GHG) emission levels over the design life of the proposed development.

The results of the assessment have been compared against the EPA's projected GHG emissions for both the non-Emission Trading Scheme (ETS) sector and total emissions for 2030<sup>14</sup>.

An assessment of the potential risk of Asbestos Containing Materials (ACMs) being released to the environment has also been undertaken herein.

## 8.2.2 Guidance and Legislation

### 8.2.2.1 Limit Values

Limit values for a range of air pollutants have been set through European and national legislation. These limit values are set for the protection of human health and ecosystems.

On 12 April 2011, the Air Quality Standards (AQS) Regulations 2011 (S.I. No. 180 of 2011) came into force and transposed EU Directive 2008/50/EC on ambient air quality and cleaner air for Europe into Irish law. The purpose of the AQS Regulations is to:

- Establish limit values and alert thresholds for concentrations of certain pollutants;
- To provide for the assessment of certain pollutants using methods and criteria common to other European Member States;
- To ensure that adequate information on certain pollutant concentrations is obtained and made publicly available; and
- To provide for the maintenance and improvement of ambient air quality where necessary.

The limit values established under the AQS Regulations relevant to this assessment are included in Table 8.1.

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<sup>2</sup> EPA (2010) Air Dispersion Modelling from Industrial Installations Guidance Note AG4

Table 8.1: Limit values in the AQS Regulations

Pollutant	Limit value for the protection of:	Averaging period	Limit value ( $\mu\text{g}/\text{m}^3$ )	Basis of application of limit value	Limit value attainment date
NO <sub>2</sub>	Human Health	1-hour	200	≤ 18 exceedances p.a. (99.79%ile)	1 January 2010
		Calendar year	40	Annual mean	1 January 2010
NO <sub>x</sub>	Vegetation	Calendar year	30	Annual mean	1 January 2010
PM <sub>10</sub>	Human Health	24-hours	50	≤ 35 exceedances p.a. (90%ile)	1 January 2005
		Calendar year	40	Annual mean	1 January 2005
PM <sub>2.5</sub>	Human Health	Calendar year	20 Note 1	Annual mean	1 January 2020

Note 1: Limit value to be reviewed by the Commission in light of further information on health and environmental effects, technical feasibility and experience of the Target Value in Member States.

There are no statutory limits for dust at a European or national level. However, TA Luft<sup>3</sup> provides a guideline for the rate of dust deposition of 350mg/m<sup>2</sup>/day averaged over one year. The EPA concurs<sup>4</sup> that this guideline may be applied, although the EPA typically applies the guideline limit as a 30-day average.

## 8.2.3 Study Area

The proposed development is located in Arklow, County Wicklow. The WwTP site is located on the eastern periphery of Arklow Town, approximately 20m from the coastline. The proposed development is contained within the planning boundary as shown in **Figure 1.1 in Volume 3**.

The closest sensitive receptors to the WwTP are located approximately 100m to the west of the site, approximately 185m to the north-west of the site and approximately 260m to the south of the site (the latter being across the Avoca River). In addition, the lands adjacent to the WwTP are zoned for Waterfront (WZ), which includes for a mix of residential, commercial, employment, leisure and tourism uses. These lands have been included as future sensitive receptors for the operational assessment.

<sup>3</sup> TA Luft (2002) *Technical Instructions on Air Quality*.

<sup>4</sup> EPA (2006) *Environmental Management in the Extractive Industry (Non-Scheduled Minerals)*.

A number of sensitive receptors are also located along the route of the interceptor sewers, at River Walk, South Quay and North Quay (Refer to **Figure 8.1 in Volume 3**).

The proposed development interacts with a number of different zoned areas, as outlined in the Arklow LAP and described in **Section 6.4.2 of Chapter 6**. Along North Quay, the proposed development crosses the Open Space (OS2) and Waterfront (WZ) zoned areas. The proposed development is also adjacent to Community & Education (CE) and Open Space (OS1) zoning objectives.

Along River Walk and South Quay, the proposed development crosses the Town Centre (TC), Open Space (OS1), Open Space (OS2) and Existing Residential (RE) zoning objectives. These have been considered in the assessment herein.

## 8.2.4 Categorisation of the Baseline Environment

A desk-based study of the baseline environment of the proposed development area was undertaken in order to inform this assessment. The EPA's Air Quality Reports<sup>5</sup> were used in order to determine the baseline air quality for the years 2014, 2015 and 2016 (refer to **Section 8.3** for further details).

Traffic modelling (as described in **Section 7.3 in Chapter 7**) was used for existing and projected traffic volumes within the study area.

## 8.2.5 Impact Assessment Methodology

### 8.2.5.1 Significance Criteria

Significance criteria have been adopted from the TII Guidelines and are presented in Table 8.2 through to Table 8.5. These criteria provide a basis for assessing the level of effects due to the additional traffic present during construction.

Table 8.2: Definition of magnitude for changes in ambient pollutant concentrations

Magnitude of Change	Annual Mean NO <sub>2</sub> /PM <sub>10</sub>	No. days with PM <sub>10</sub> greater than 50 ug/m <sup>3</sup>	Annual Mean PM <sub>2.5</sub>
Large	Increase/decrease 4 ≥ μg/m <sup>3</sup>	Increase/decrease >4 days	Increase/decrease ≥2.5 μg/m <sup>3</sup>
Medium	Increase/decrease 2-<4μg/m <sup>3</sup>	Increase/decrease 3 or 4 days	Increase/decrease 1.25 -<2.5μg/m <sup>3</sup>
Small	Increase/decrease 0.4-<2μg/m <sup>3</sup>	Increase/decrease 1 or 2 days	Increase/decrease 0.25-<1.25μg/m <sup>3</sup>
Imperceptible	Increase/decrease <0.4μg/m <sup>3</sup>	Increase/decrease <1 day	Increase/decrease <0.25μg/m <sup>3</sup>

<sup>5</sup>EPA (2018) Annual Air Quality Reports, Available at: <http://www.epa.ie/air/quality/>

Table 8.3: Air quality effect descriptors for changes to annual mean nitrogen dioxide and PM<sub>10</sub> and PM<sub>2.5</sub> concentrations at a receptor

Absolute Concentration in Relation to Objective/Limit Value	Change in Concentration <sup>6</sup>		
	Small	Medium	Large
<b>Increase with Scheme</b>			
Above Objective/Limit Value With Scheme ( $\geq 40\mu\text{g}/\text{m}^3$ of NO <sub>2</sub> or PM <sub>10</sub> ) ( $\geq 25\mu\text{g}/\text{m}^3$ of PM <sub>2.5</sub> )	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme ( $36 \leq 40\mu\text{g}/\text{m}^3$ of NO <sub>2</sub> or PM <sub>10</sub> ) ( $22.5 \leq 25\mu\text{g}/\text{m}^3$ of PM <sub>2.5</sub> )	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme ( $30 \leq 36\mu\text{g}/\text{m}^3$ of NO <sub>2</sub> or PM <sub>10</sub> ) ( $18.75 \leq 22.5\mu\text{g}/\text{m}^3$ of PM <sub>2.5</sub> )	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme ( $< 30\mu\text{g}/\text{m}^3$ of NO <sub>2</sub> or PM <sub>10</sub> ) ( $< 18.75\mu\text{g}/\text{m}^3$ of PM <sub>2.5</sub> )	Negligible	Negligible	Slight Adverse
<b>Decrease with Scheme</b>			
Above Objective/Limit Value Without Scheme ( $\geq 40\mu\text{g}/\text{m}^3$ of NO <sub>2</sub> or PM <sub>10</sub> ) ( $\geq 25\mu\text{g}/\text{m}^3$ of PM <sub>2.5</sub> )	Sight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value Without Scheme ( $36 < 40\mu\text{g}/\text{m}^3$ of NO <sub>2</sub> or PM <sub>10</sub> ) ( $22.5 < 25\mu\text{g}/\text{m}^3$ of PM <sub>2.5</sub> )	Sight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value Without Scheme ( $30 < 36\mu\text{g}/\text{m}^3$ of NO <sub>2</sub> or PM <sub>10</sub> ) ( $18.75 < 22.5\mu\text{g}/\text{m}^3$ of PM <sub>2.5</sub> )	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value Without Scheme ( $< 30\mu\text{g}/\text{m}^3$ of NO <sub>2</sub> or PM <sub>10</sub> ) ( $< 18.75\mu\text{g}/\text{m}^3$ of PM <sub>2.5</sub> )	Negligible	Negligible	Slight Beneficial

<sup>6</sup> Where the magnitude is imperceptible, then the likely significant effect description is negligible.

Table 8.4: Air quality effect descriptors for changes to number of days with PM<sub>10</sub> concentration greater than 50 µg/m<sup>3</sup> at a receptor

Absolute Concentration in Relation to Objective/Limit Value	Changes in Concentration		
	Small	Medium	Large
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥35 days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (32-<35 days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (26-<32 days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<26 days)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value Without Scheme (≥35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value Without Scheme (32-<35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value Without Scheme (26-<32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value Without Scheme (<26 days)	Negligible	Negligible	Slight Beneficial

Table 8.5: Assessment criteria for the effect of dust emissions from construction activities with standard mitigation in place

Source		Potential distance for Significant Effects (Distance from Source)		
Scale	Description	Soiling	PM <sub>10</sub> <sup>7</sup>	Vegetation Effects
Major	Large construction sites, with high use of haul routes	100m	25m	25m
Moderate	Moderate sized construction sites, with moderate use of haul routes	50m	15m	15m
Minor	Minor construction sites, with limited use of haul routes	25m	10m	10m

<sup>7</sup> Significance based on the PM<sub>10</sub> Limit Values specified in SI No. 180 of 2011, which allows 35 daily exceedances/year of 50 µg/m<sup>3</sup>

## 8.2.5.2 Construction Phase

### Dust and Asbestos Assessment Methodology

The TII guidelines<sup>1</sup> state that dust emissions from construction sites can lead to soiling, elevated PM<sub>10</sub> concentrations and can cause effects on vegetation such as reduction in light required for photosynthesis and an increase in leaf temperature due to changed surface optical properties.

The likely significant effects of dust emissions during construction are assessed by considering the proximity of sensitive receptors to the construction works. The likely significant effects of construction dust on sensitive habitats are also considered.

During the construction phase of the proposed development it is possible that disturbance of Asbestos Containing Materials (ACMs) on site could cause asbestos fibres to be released into the ambient environment. The likely significant effects of ACM disturbance during construction are therefore also assessed.

### Air Dispersion Modelling

There is the potential for elevated ground level concentrations of Nitrogen Dioxide (NO<sub>2</sub>) and Particulate Matter (PM) to be generated from the generator powering the Tunnel Boring Machine (TBM) during the construction phase of the proposed development. Detailed air dispersion modelling has been undertaken for the generator using the EPA approved Breeze AERMOD software package<sup>8</sup>. As outlined in **Section 8.2.1**, the air dispersion modelling has been undertaken in accordance with the EPA Guidance<sup>2</sup>.

The model was used to predict ground level concentrations over a 1-hour averaging period for Nitrogen Dioxide and a 24-hour averaging period for Particulate Matter.

As the generator will be located within various work areas, the modelling assessment was undertaken to represent any working area by locating sensitive receptors between 15m and 200m from the generator at 10m grid intervals.

Meteorological data from Met Éireann's station at Dublin Airport was used for the years 2011 to 2015 inclusive. The meteorological data includes hourly values for wind speed, wind direction, atmospheric stability, ambient temperature and mixing height.

A CAT C32 100kVA diesel generator, or equivalent, will be used for powering the TBM. **Table 8.6** outlines the emission source data for this generator.

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<sup>8</sup> Breeze AERMOD version 16216r, released January 2017.

Table 8.6: Emission source input data

Parameter	Unit	Generator
Stack Height	m	4.5
Stack Diameter	m	0.4
Flow Rate	m <sup>3</sup> /s	3.2
Temperature	°C	464
NO <sub>x</sub> concentration	mg/Nm <sup>3</sup>	2,928
NO <sub>x</sub> emission rate	g/s	3.47
PM <sub>10</sub> concentration	mg/Nm <sup>3</sup>	11.9
PM <sub>10</sub> emission rate	g/s	0.014

### Traffic Assessment Methodology

The air quality assessment utilises traffic data outlined in **Chapter 7** to assess the likely significant effects of construction traffic on air quality.

As noted in **Section 8.2.1**, the TII guidelines<sup>1</sup> state that increases in AADT flows during the construction phase of less than 10% are unlikely to result in significant effects on air quality. As described in **Section 8.4.2.3**, there are four construction stages where construction traffic will result in a significant increase (>10%) in AADT flows due to traffic diversions and two locations where a significant increase will occur due to construction vehicles.

The UK Design Manual for Roads and Bridges (DMRB) Screening Method spreadsheet<sup>9</sup> is used in this assessment to assess the likely significant effects of construction traffic on sensitive receptors. This spreadsheet calculates annual average concentrations of NO<sub>x</sub>, NO<sub>2</sub> and PM.

The DMRB spreadsheet method computes concentrations of pollutants based on factors including:

- Distance of receptors to the centreline of each road;
- Annual Average Daily Traffic (AADT) flows;
- Design speed of each road;
- Heavy Goods Vehicle (HGV) percentage;
- Road type; and
- Background pollutant concentrations.

Annual average concentrations for the traffic related pollutants NO<sub>x</sub>, NO<sub>2</sub> and PM were modelled at each sensitive receptor identified in **Section 8.4.2.3**. The predicted concentrations of each pollutant are compared to the AQS limit values, as outlined in Table 8.1.

<sup>9</sup> DMRB (2007) Design Manual for Roads and Bridges (DMRB) Screening Method (Version 1.03c) spreadsheet.

## Climate Assessment Methodology

In October 2014, the European Council reached political agreement on headline greenhouse gas emissions reduction targets in the context of the 2030 Climate and Energy Framework. An overall EU reduction of at least 40% in greenhouse gas emissions by 2030 compared to 1990 levels is to be delivered collectively by the EU.

EU greenhouse gas emission reduction targets and reduction obligations for Ireland are split into two broad categories. The first category covers the large energy and power (i.e. energy intensive) industry which have their emissions controlled under the EU Emissions Trading Scheme (ETS). The second category deals with the non-Emissions Trading Scheme (non-ETS) sectors such as agriculture, transport, residential, commercial, waste and non-energy intensive industry. The proposed development will operate within the non- ETS sector.

Ireland's 2030 target is to achieve a 30% reduction of non-Emissions Trading Scheme sector emissions on 2005 levels with annual binding limits set for each year over the period 2021-2030.

A climate impact assessment was carried out in order to determine the likely significant effects of greenhouse gas emissions (Mt CO<sub>2</sub> equivalent) predicted due to the construction phase of the proposed development, relative to Ireland's projected baseline for 2020, as reported by the EPA.

### 8.2.5.3 Operational Phase

#### Process Operations Assessment Methodology

Operational emissions to the atmosphere from the proposed development will be solely restricted to emissions from the Inlet Works Building and Process Building vent stacks. Detailed odour emission dispersion modelling has been carried out for the proposed development. Based on the level of detail involved, this assessment is described in detail in **Chapter 9**.

The WwTP will have an emergency power supply from a standby diesel generator located in the Process Building which will provide up to 24 hours' backup supply. The intention is that the generator would operate in the event of power outages. Preliminary estimates suggest a generator set of 1,250kVA will be used.

As this generator is the same size as the generator proposed to power the TBM (1,250kVA), in the event of power outages, the impact rating associated with its use is not considered significant. Refer to **Section 8.4.2.2** for details of the assessment of the TBM generator.

#### Traffic Assessment Methodology

As described in **Section 8.2.1**, and in accordance with TII guidance, likely significant effects on air quality are assessed where there is a significant (>5%) increase in AADT flows during the operation of the proposed development.

## Climate Assessment Methodology

A climate assessment was carried out in order to determine the likely significant effects of greenhouse gas emissions (Mt CO<sub>2</sub> equivalent) predicted due to the operation of the proposed development, relative to Ireland's projected baseline for 2020, as reported by the EPA.

## 8.3 Baseline Conditions

### 8.3.1 Air Quality

As outlined in **Section 8.2.3**, the proposed development is located along the north and south quays of the Avoca river, with the WwTP site located on the eastern periphery of Arklow Town, adjacent to the coast. The AQS Regulations describe the air quality zoning adopted in Ireland as follows:

- Zone A (Dublin Conurbation);
- Zone B (Cork Conurbation);
- Zone C (16 Cities and Towns with population greater than 15,000); and
- Zone D (Rural Ireland: areas not in Zones A, B and C).

The proposed development falls within 'Rural Ireland' and is therefore located in Zone D.

The annual mean background concentration levels of NO<sub>x</sub>, NO<sub>2</sub>, PM<sub>2.5</sub> and PM<sub>10</sub> from EPA monitoring undertaken during 2014 - 2016 are presented in Table 8.7. Concentrations of each pollutant recorded in Zone D are averaged to represent typical background levels. Average concentrations were obtained from all stations where data is captured for at least 90% of the time, in accordance with the AQS Regulations.

Table 8.7: Annual mean background pollutant concentrations for Zone D

Background Values	Annual Average NO <sub>x</sub> (µg/m <sup>3</sup> )	Annual Average NO <sub>2</sub> (µg/m <sup>3</sup> )	Annual Average PM <sub>10</sub> (µg/m <sup>3</sup> )	Annual Average PM <sub>2.5</sub> (µg/m <sup>3</sup> )
2014	7.5	5.5	10.5	5
2015	7.3	4	12	8
2016	10.0	6.3	13.1	9
<b>Average</b>	<b>8.3</b>	<b>5.3</b>	<b>11.9</b>	<b>7.3</b>
<b>Limit</b>	<b>30</b>	<b>40</b>	<b>40</b>	<b>20</b>

## 8.3.2 Climate

In November 2017, the EPA reported<sup>10</sup> that total national greenhouse gas emissions in 2016 were estimated to be 61.19 million tonnes carbon dioxide equivalent (Mt CO<sub>2eq</sub>). This is 3.5% higher (2.06 Mt CO<sub>2eq</sub>) than emissions in 2015 and returns greenhouse gas emissions to 2009 levels. Ireland's greenhouse gas emissions for non-ETS sectors were recorded to be 43.80 Mt CO<sub>2 eq</sub> in 2016.

The EPA projects<sup>10</sup> total greenhouse gas emissions and non-ETS sector emissions (Mt CO<sub>2 eq.</sub>) to 2035, refer to **Table 8.8**.

Table 8.8: Projected Emissions for the ETS Sector and Total Emissions (Source: EPA<sup>10</sup>)

Projections (with existing measures) <sup>11</sup>	Year	Non-ETS Sector Only (MT CO <sub>2 eq.</sub> )	Total (Mt CO <sub>2eq</sub> )
	2020	45.64	61.56
	2025	47.74	65.39
	2030	47.14	66.49
	2035	47.31	69.21
Projections (with additional measures) <sup>12</sup>	2020	44.83	59.09
	2025	46.78	62.27
	2030	46.04	62.89
	2035	46.04	64.84

Current projections by the EPA indicate that Ireland will exceed its greenhouse gas emissions reduction targets.

## 8.4 Likely Significant Effects

### 8.4.1 Do-Nothing Scenario

In the scenario where the proposed development did not proceed as planned, none of the likely significant construction or operational effects as set out in this chapter would occur.

<sup>10</sup> EPA (2017) Ireland's Provisional Greenhouse Gas Emissions 1990-2016

<sup>11</sup> *With Existing Measures* scenario assumes that no additional policies and measures, beyond those already in place by the end of 2015, are implemented. (EPA, 2017)

<sup>12</sup> *With Additional Measures* scenario assumes further implementation of Government renewable and energy efficiency targets for 2020, as set out in the National Renewable Energy Action Plan (NREAP) and the National Energy Efficiency Action Plan (NEEAP). (EPA, 2017)

## 8.4.2 Assessment of effects during construction

### 8.4.2.1 Dust and Asbestos

**Chapter 5** provides a description of the proposed strategy and methods of construction for the proposed development. Dust emissions are likely to arise from the following construction activities:

- Site excavation;
- Rock breaking;
- Tunnelling;
- Trenching;
- Crushing;
- Stockpiling of separated particles;
- Demolition;
- Handling of construction materials;
- Construction traffic movements; and
- Landscaping.

In general, any additional airborne concentrations of particulate matter arising from construction would be small and very local to the construction site (minimising human exposure). Particles generated by most construction activities tend to be larger than 10µm in diameter which are too large to enter the human lung.

The construction phase of the proposed development is considered to be of a moderate scale, based on the greatest level of construction along the proposed development, refer to **Table 8.5**. This has the potential to result in soiling effects within 50m and PM<sub>10</sub> and vegetation effects within 15 m of the works with standard mitigation in place.

As shown in **Figure 8.1 of Volume 3**, a number of sensitive receptors are located along the route of the interceptor sewers, at the North and South Quays; the closest of which is located approximately 10m from the proposed construction works.

As the closest of these sensitive receptors is located approximately 10m away from the proposed interceptor sewer there is potential for soiling, PM<sub>10</sub> and vegetation effects arising from construction activities along the North and South Quays. However, with the implementation of the standard mitigation measures outlined in **Section 8.5.1**, no significant negative effects are envisaged.

An Asbestos Demolition Survey Report has been undertaken for the proposed development, and known ACMs have been identified on site, largely in the form of asbestos cement. This survey has identified asbestos in the following areas on the site:

- The wall and roof cladding of the Old Wallboard building comprises asbestos cement sheets;
- The wall and roof cladding of the Stores building is asbestos sheet cladding;
- The ceiling of the stores building is asbestos sheet cladding;
- The roof cladding to the high section of the Wallboard building is asbestos cement sheets;
- The wall and roof cladding of the Masterglaze building is asbestos cement sheets;
- Rope seals to the lights in the Masterglaze building contain asbestos;
- Lino with asbestos paper backing is present in the electrical room of the Wallboard building;
- Vinyl floor tiles and bitumen containing asbestos are present in the locker room of the Wallboard building;
- Rain water goods in the buildings contain asbestos;
- The internal walls and ceiling of the prefab building contain asbestos;
- Asbestos cement debris is present around and within all of the buildings on the site; and
- Asbestos cement debris is present in the existing rock armour revetment on the seaward side of the site.

During the construction phase of the proposed development it is possible that disturbance of ACMs on site could cause asbestos fibres to be released into the ambient environment. However, with the implementation of the standard mitigation measures outlined in **Section 8.5.1**, no significant negative effects are envisaged.

#### 8.4.2.2 Generator Emissions for Tunnelling

A CAT C32 1,250kVA diesel generator, or equivalent, will be used for powering the TBM. The location of the generator will vary throughout the works, whilst always remaining within a working area. An air dispersion modelling assessment was carried out to assess the short-term effects of the emissions associated with the operation of the generator.

Table 8.9 presents the results of the assessment.

Table 8.9: Predicted ground level concentrations of pollutants from construction generator

Parameter	Background Concentration ( $\mu\text{g}/\text{m}^3$ )	Predicted Concentration ( $\mu\text{g}/\text{m}^3$ )	Total Concentration ( $\mu\text{g}/\text{m}^3$ )	Limit Value ( $\mu\text{g}/\text{m}^3$ )	Distance of highest concentration from generator (m)
Nitrogen Dioxide (1 hour)	10.6 <sup>13</sup>	175.3	185.9	200	50m
Particulate Matter (24-hour)	11.9	0.4	12.3	50	60m

The results in Table 8.9 show that compliance with the AQS Regulations can be achieved using the input data presented in Table 8.6. Additional measures, such as increasing the stack height or increasing the exit velocity can reduce the ground level concentrations of pollutants even further.

As the generator will only be operational during the construction phase of the proposed development and will be relocated throughout the working area as the tunnel progresses, the predicted air quality effects are not considered significant.

### 8.4.2.3 Traffic

The traffic assessment predicts pollutants where construction traffic increases by more than 10% and where significant traffic increase due to diversions are proposed.

Table 8.10 presents the locations where construction traffic will increase by more than 10%, as described in **Chapter 7**.

Table 8.10: Significant traffic increases from construction traffic.

Location	Traffic volume - existing	Traffic volume – due to construction vehicles
North Quay	6,050	6,639
Harbour Road	726	816

For locations where significant changes to traffic are predicted due to diversions, Table 8.11 outlines the stages, durations and predicted increases.

<sup>13</sup> Double the annual background concentration for 1-hr values, in accordance with EPA Guidance.

Table 8.11: Significant traffic increases due to diversions during construction.

Construction Stage	Duration	Traffic volume - existing	Traffic volume – due to rerouting	Road effected
Stage E South Quay / South Green	2 months	2,614	3,735	South Green Harbour Road
Stage F South Quay / Harbour Road	5 months	2,614	3,735	South Green Harbour Road
Stage H North Quay (East of Ferrybank)	2 weeks	Estimated at 3,000	9,000 (6,000 above baseline)	Seaview Avenue
Stage I North Quay (West of Bridgewater Ferrybank)	2 weeks	Estimated at 3,000	9,000 (6,000 above baseline)	Seaview Avenue

**Table 8.12** presents the results for the predicted air quality increases from traffic during the construction phase due to construction vehicles and diversions.

Table 8.12: Predicted air quality increases during the construction phase

Road Location	Scenario	NO <sub>2</sub> (µg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )	PM <sub>2.5</sub> (µg/m <sup>3</sup> )	PM <sub>10</sub> (Days > 50 µg/m <sup>3</sup> )
	<i>Limit Values</i>	40	40	25	35
North Quay	Existing	7.0	12.3	8.6	<1
	From construction vehicles	7.1	12.3	8.6	<1
	Increase	0.1	0.1	0.1	0
	Impact Rating	Negligible	Negligible	Negligible	Negligible
Harbour Road	Existing	5.6	12.0	8.4	<1
	From construction vehicles	5.7	12.0	8.4	<1
	Increase	0.1	0.1	0	0
	Impact Rating	Negligible	Negligible	Negligible	Negligible
South Green	Existing	6.3	12.1	8.5	<1
	During diversions	6.7	12.2	8.5	<1
	Increase	0.4	0.1	0	0
	Impact Rating	Negligible	Negligible	Negligible	Negligible
Harbour Green	Existing	6.3	12.1	8.5	<1
	During diversions	6.7	12.2	8.5	<1
	Increase	0.4	0.1	0	0
	Impact Rating	Negligible	Negligible	Negligible	Negligible

Road Location	Scenario	NO <sub>2</sub> (µg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )	PM <sub>2.5</sub> (µg/m <sup>3</sup> )	PM <sub>10</sub> (Days > 50 µg/m <sup>3</sup> )
	<i>Limit Values</i>	40	40	25	35
Seaview Avenue	Existing	6.5	12.1	8.5	<1
	During diversions	8.2	12.6	8.8	<1
	Increase	1.7	0.5	0.3	0
	Impact Rating	Negligible	Negligible	Negligible	Negligible

Negligible effects on air quality are predicted at all receptors as a result of the change in traffic emissions due to the proposed scheme.

#### 8.4.2.4 Climate

The likely significant effects of the construction phase of the proposed development is outlined in **Section 8.5.2.3**.

### 8.4.3 Assessment of effects during operation

#### 8.4.3.1 Process Operations

Normal operational impacts on air quality are solely generated from odour emissions from the vent stacks. This is assessed in **Chapter 9**.

As outlined in **Section 8.2.5.3**, the proposed generator for use in emergency situations at the WwTP is the same size (1,250kVA), as the generator proposed to power the TBM (1,250kVA). The likely significant effects associated with its use is considered as not significant. Refer to **Section 8.5.1.2** for details of the assessment of the TBM generator.

#### 8.4.3.2 Traffic

As outlined in **Section 8.2.6**, emissions from operational vehicles are assessed where operational traffic results in a significant (>5%) increase in AADT (annual average daily traffic) flows near sensitive receptors.

Traffic levels during the operational phase will be light, as detailed in **Chapter 7**. As no increase in traffic >5% is likely to be generated during the operational phase of the proposed development, a negligible effect on air quality is predicted.

#### 8.4.3.3 Climate

As outlined in **Section 8.3.2**, the EPA reported in 2017 that total national greenhouse gas emissions were estimated to be 61.19 Mt CO<sub>2</sub> eq. in 2016. Greenhouse gas emissions for non-ETS sectors were recorded to be 43.80 Mt CO<sub>2</sub> eq. in 2016.

**Table 8.8** outlines a range of future projections for both total carbon emissions and ETS carbon emissions in Ireland (Mt CO<sub>2</sub> eq), as set out by the EPA<sup>14</sup>.

The predicted annual CO<sub>2</sub> emissions from the proposed development, including the construction phase, as outlined in the Carbon Footprint Analysis carried out by the project design team is 3,968 tonnes CO<sub>2</sub> eq per annum (198,400 CO<sub>2</sub> eq over the 50-year design life of the proposed development).

The projected increase of CO<sub>2</sub> upon full implementation of the proposed development is 0.009% of Ireland's Non-ETS Sector projections for 2020, and 0.006% of Ireland's total projections for 2020. Note that the projections 'with existing measures' (as defined in Table 8.8) are used as a worst-case scenario comparison assessment. This likely significant effect is considered to be an imperceptible on climate. This impact rating is based on EPA guidelines which defines an imperceptible impact as an effect capable of measurement but without significant consequences.

#### 8.4.4 Cumulative

This section considers the potential for cumulative effect arising from the proposed development in association with other developments. Specifically, it considers a worst-case scenario, where both the proposed development and the proposed Arklow Flood Relief Scheme (or section thereof) are under construction at the same time.

The construction of the proposed Arklow Flood Relief Scheme is considered to be of a moderate scale based on the greatest level of construction as it is currently understood (Refer to **Table 8.5** for further detail). This has the potential to result in soiling effects within 50 m and PM<sub>10</sub> and vegetation effects within 15m of the works with standard mitigation in place.

During the construction phase of the proposed Arklow Flood Relief Scheme, a temporary diesel generator may also be used to power equipment. As outlined in **Section 8.5.1.2**, the effects associated with its use are not considered significant.

In relation to construction traffic, the proposed Arklow Flood Relief Scheme is not considered to give rise to any additional effects over and above those stated in **Section 8.5.1.3** for the proposed development (Refer to **Chapter 7** for further detail).

The proposed development and the proposed Arklow Flood Relief Scheme is not likely to give rise to any significant effects during construction or operation phase once mitigation measures, as outlined in **Section 8.5**, are implemented.

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<sup>14</sup> Ireland's Greenhouse Gas Emission Projections 2016-2035, EPA, 2017. Available at [http://www.epa.ie/pubs/reports/air/airemissions/ghgprojections2016-2035/EPA\\_2017\\_GHG\\_Emission\\_Projections\\_Summary\\_Report.pdf](http://www.epa.ie/pubs/reports/air/airemissions/ghgprojections2016-2035/EPA_2017_GHG_Emission_Projections_Summary_Report.pdf)

## 8.5 Mitigation Measures and Monitoring

### 8.5.1 Mitigation

#### 8.5.1.1 Mitigation During Construction

The assessment of likely significant effects during construction (contained in **Section 8.4.2**) includes for the implementation of ‘standard mitigation’, as stated in the TII guidance<sup>1</sup>. This includes the following measures:

- Spraying of exposed earthwork activities and site haul roads during dry weather;
- Provision of wheel washes at exit points;
- Covering of stockpiles;
- Control of vehicle speeds, speed restrictions and vehicle access; and
- Sweeping of hard surface roads.

In addition, the following measures will be implemented for the proposed development:

- A c. 2.4m hoarding will be provided around the site works to minimise the dispersion of dust from the working areas;
- Generators will be located away from sensitive receptors in so far as practicable;
- Stockpiles will be located as far as possible from sensitive receptors and covered and/or dampened during dry weather.

Employee awareness is also an important way that dust may be controlled on any site. Staff training and the management of operations will ensure that all dust suppression methods are implemented and continuously inspected.

Where asbestos is uncovered on site during construction, the ACM will be double-bagged and removed from the site by a competent contractor and disposed of in accordance with the relevant procedures and legislation.

#### 8.5.1.2 Mitigation During Operation

As there are no significant effects on air quality predicted during the operational of the proposed development, no mitigation measures are proposed.

In relation to climate, the use of energy efficient design throughout the WwTP reduces the annual CO<sub>2</sub> emissions of the proposed development. Key energy and resource efficiency measures incorporated include:

- The WwTP has been located as close as possible to the load centre in Arklow town; and adjacent to the Irish Sea (i.e. the target location for final discharge of effluent) and all treated effluent discharges will be conveyed to the long sea outfall via gravity flow to minimise pumping requirements (and thus associated energy use).

- All wastewater in the interceptor sewer network and the WwTP will be conveyed by gravity to the WwTP to minimise pumping requirements (and thus associated energy use).
- Soft start pumps/efficient pump selection will be utilised throughout;
- On-site renewable energy in the form of PV panels that use solar energy have been incorporated into the plant design to optimise the generation and use of renewable energy at the WwTP.
- The buildings on the WwTP site will be naturally ventilated where possible, with heating limited to mitigate the effects of frost and condensation in the Inlet Works and Process Building only. Occupied spaces would have heat recovery ventilation systems. The combination of these HVAC elements would minimise associated energy use in the building during operation.

## 8.5.2 Monitoring

### 8.5.2.1 Monitoring During Construction

Dust monitoring will be undertaken at a range of nearest sensitive receptors during the construction phase. The TA Luft dust deposition limit values of 350 mg/m<sup>2</sup>/day (averaged over one year) will be applied as a 30-day average.

### 8.5.2.2 Monitoring During Operation

As no significant effects are predicted to occur during the operation of the proposed development, therefore no monitoring measures are required.

## 8.6 Residual Effects

No significant residual effects are predicted on air quality and climate during the construction or operation of the proposed development with the implementation of the mitigation measures outlined herein.

## 8.7 References

Air Quality Standards Regulations (AQS), 2011 (S.I. No. 180 of 2011). The Stationery Office, Dublin, Ireland.

Climate Action and Low Carbon Development Act, 2015. Houses of the Oireachtas, Dublin.

Design Manual for Roads and Bridges (DMRB), 2007. *Design Manual for Roads and Bridges Screening Method (Version 1.03c) spreadsheet*.

European Commission (EC), 2014. *2030 Climate and Energy Framework*. Available at [http://ec.europa.eu/clima/policies/strategies/2030/index\\_en.htm](http://ec.europa.eu/clima/policies/strategies/2030/index_en.htm).

EC Directive, 2008. *2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe*. European Parliament and European Council, Strasbourg, France.

Environmental Protection Agency (EPA), 2006. *Environmental Management in the Extractive Industry (Non-Scheduled Minerals)*. EPA, Wexford, Ireland.

EPA (2018) *Annual Air Quality Reports*. Available at:  
<http://www.epa.ie/air/quality/>

EPA (2017) *Ireland's Provisional Greenhouse Gas Emissions 1990-2016*

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[http://www.epa.ie/pubs/reports/air/airemissions/ghgprojections2016-2035/EPA\\_2017\\_GHG\\_Emission\\_Projections\\_Summary\\_Report.pdf](http://www.epa.ie/pubs/reports/air/airemissions/ghgprojections2016-2035/EPA_2017_GHG_Emission_Projections_Summary_Report.pdf)

EPA, 2017. *Air Quality in Ireland 2016 –Key Indicators of Ambient Air Quality*. EPA, Wexford, Ireland.

EPA, 2017. *National Renewable Energy Action Plan (NREAP) and the National Energy Efficiency Action Plan (NEEAP)*.

EPA, 2016. *Air Quality in Ireland 2015 –Key Indicators of Ambient Air Quality*. EPA, Wexford, Ireland.

EPA, 2015. *Air Quality in Ireland 2014 –Key Indicators of Ambient Air Quality*. EPA, Wexford, Ireland.

EPA, 2010. *Air Dispersion Modelling from Industrial Installations Guidance Note AG4*

TA Luft, 2002. *Technical Instructions on Air Quality*.

Transport Infrastructure Ireland (TII), (formerly the National Roads Authority (NRA)) (2011). *Guidelines for the Treatment of Air Quality during the Planning and Construction of National Roads Schemes*. TII, Dublin, Ireland.

## 9 Odour

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### 9.1 Introduction

This chapter describes the likely significant effects of the proposed development on odour. Air quality and climate are addressed separately in **Chapter 8**.

### 9.2 Assessment Methodology

#### 9.2.1 General

The generation and dispersion of odorous emissions have been assessed due to the nature and scale of the proposed development. This assessment considers the potential for likely significant odour effects during the operation of the proposed development. There will be no significant odour emission sources during construction and therefore no construction assessment or mitigation is considered necessary.

Air dispersion modelling of odorous emissions represents a widely accepted method of assessing potential risk of off-site impacts<sup>1</sup>. In order to assess the likely significant effects of the proposed development on the ambient environment during operation, dispersion modelling of odorous emissions has been undertaken. The dispersion modelling methodology for the operational assessment is outlined in **Section 9.2.5.1**.

#### 9.2.2 Limit Values

Currently, there is no general statutory odour standard in Ireland relating to industrial installations. Two reference documents have been cited herein and have been used to determine appropriate limit values. Table 9.1 outlines the odour limits used for this assessment based on the UK's Environment Agency Odour Management Guidance<sup>2</sup> and the Institute of Air Quality Management (IAQM) Guidance<sup>3</sup>.

These guidance documents recommend that odour standards should be between 1.5 and 6.0 OU/m<sup>3</sup> as a 98<sup>th</sup> percentile of one-hour averaging periods at all receptors. This 98<sup>th</sup> percentile limit allows for exceedances for 176 1-hour values over a full year (8,760 hours).

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<sup>1</sup> CIWEM (2016) *Policy Position Statement – Control of Odour*.

<sup>2</sup> Environment Agency (2011) *H4 Odour Management How to comply with your environmental permit*

<sup>3</sup> Institute of Air Quality Management (IAQM) (2018) *Guidance on the assessment of odour for planning*

The guidance allows limits to be set based on the offensiveness of the odour and allows adjustments for local factors such as proximity to sensitive receptors and population density. A summary of the indicative limit criteria for various industrial sectors is given in Table 9.1.

Table 9.1: Indicative odour criteria for various industrial sectors

Industrial Sectors	Relative Offensiveness of Odour	Indicative Criterion
Processes involving decaying animal or fish remains Processes involving septic effluent or sludge Biological landfill odours	Most Offensive	1.5 OU/m <sup>3</sup> as a 98 <sup>th</sup> percentile of hourly averages at the worst-case sensitive receptor
Intensive livestock rearing Sugar beet processing Fat frying (food processing) Well aerated green waste composting	Moderately offensive	3.0 OU/m <sup>3</sup> as a 98 <sup>th</sup> percentile of hourly averages at the worst-case sensitive receptor
Brewery, Confectionery, Coffee roasting, Bakery	Less offensive	6.0 OU/m <sup>3</sup> as a 98 <sup>th</sup> percentile of hourly averages at the worst-case sensitive receptor

Considering the surrounding environment, proximity to sensitive receptors and the treatment of wastewater within the WwTP, an odour limit value of 3.0 OU/m<sup>3</sup> of the 98<sup>th</sup> percentile of 1-hour value at both the site boundary and the nearest sensitive receptor is proposed. As such, the proposed development is considered to generate moderately offensive odours.

In order to carry out a reasonable worst-case scenario assessment, the limit value of 3.0 OU/m<sup>3</sup> of the 98<sup>th</sup> percentile of 1-hour value has been applied herein.

### 9.2.3 Study Area

The proposed development is located in Arklow, County Wicklow and has been described in detail in **Chapter 4**. The WwTP site is located on the eastern periphery of Arklow Town, adjacent to the Irish Sea. The existing site area layout is illustrated in **Figure 1.1 in Volume 3**. The interceptor sewers will be located along the north and south quays.

The closest existing sensitive receptors to the proposed WwTP site are the residential complex known as the Marina Village located approximately 100m to the west of the site and 185m to the north-west of the site. On South Quay, the closest residential receptor to the WwTP is approximately 260m to the south of the site.

A number of sensitive receptors are also located within 15m of the interceptor sewers, at River Walk, South Quay and North Quay, as outlined in **Section 2.6.5.1 in Chapter 2**.

In addition, the lands adjacent to the WwTP are zoned for Waterfront (WZ), which includes for a mix of residential, commercial, employment, leisure and tourism uses. These lands have been included as future sensitive receptors for the operational assessment. The proposed WwTP site boundary is therefore considered the most suitable location to apply the operational odour limits.

The proposed development interacts with a number of different zoned areas, as outlined in the Arklow LAP<sup>4</sup> and described in **Section 6.4.2**. Along North Quay, the proposed development crosses the Open Space (OS2) and Waterfront (WZ) zoned areas. The proposed development is also adjacent to Community & Education (CE) and Open Space (OSI) zoning objectives.

Along River Walk and South Quay, the proposed development crosses the Town Centre (TC), Open Space (OS1), Open Space (OS2) and Existing Residential (RE) zoning objectives. These have been considered in the assessment herein.

## 9.2.4 Categorisation of the Baseline Environment

A desk-based study has been undertaken in order to establish the baseline environment and inform this assessment. In addition, a site visit undertaken in April 2018 to ascertain if there are any prominent existing odour sources in the area. Baseline conditions are outlined in **Section 9.3**.

## 9.2.5 Impact Assessment Methodology

### 9.2.5.1 Air Dispersion Modelling

There is the potential for odour to be generated from the proposed development during operation due to discharge venting from the emission vent stacks along the interceptor sewers and from the vent stacks on the Inlet Works building and Process building. Detailed air dispersion modelling has been undertaken for the vent stacks using the industry standard Breeze AERMOD software package<sup>5</sup>. As outlined in **Section 9.2.1**, the air dispersion modelling has been undertaken in accordance with the EPA guidance<sup>6</sup>.

AERMOD models the ground level concentration level of odours that are emitted from specified sources. In order to undertake the modelling, the following information is inputted:

- The location, size and scale of any on-site buildings;
- The location of the boundary line for sensitive receptors;
- Meteorological conditions in the study area; and
- The number, type and location of emission sources.

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<sup>4</sup> <https://www.wicklow.ie/Living/Services/Planning/Development-Plans-Strategies/Local-Area-Town-Settlement-Plans/Arklow/Arklow-and-Environs-Local-Area-Plan-2018-2024>

<sup>5</sup> Breeze AERMOD software package – version 1612r, released January 2017.

<sup>6</sup> EPA (2010) *Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)*

The model was used to predict ground level odour concentrations over a 1-hour averaging period and relevant percentiles.

### **Meteorological Conditions**

Meteorological data from Met Éireann's synoptic station at Dublin Airport was used for the years 2011 to 2015 inclusive. The meteorological data includes hourly values for wind speed, wind direction, atmospheric stability, ambient temperature and mixing height.

### **Location, Size and Scale of On-Site Buildings**

The length, width and height of the Inlets Works Building and Process Building was included in modelling. AERMOD includes a software utility called Building Profile Input Program (BPIP) to calculate direction-specific building downwash factors using the relative positions and dimensions of sources and neighbouring buildings.

### **Location of Sensitive Receptors**

Receptors are locations where AERMOD computes an odour concentration. As the distance from the subject site increases, the receptor grid density decreases. As such, three nested, Cartesian receptor grids were used for both modelling the Inlet Works Building and Process Building and the Interceptor Sewer Vents, centred on the emission source. The size of each grid is as follows;

- The largest grid has receptors covering a 10km by 10km area at 250m intervals;
- The medium sized grid has receptors covering a 1.5km by 1.5km area at 50m intervals; and
- The smallest grid has receptors covering a 2km by 2km area at 15m intervals.

For the Inlet Works Building and Process Building a dense receptor grid was placed around the development's site boundary to predict odour concentrations.

For the Interceptor Sewer Vents a dense receptor grid was placed around one of the vents, which is representative of the other vents, to predict odour concentrations.

By using this approach, a more dense receptor grid is placed closer to the source(s) where the highest concentrations are likely to be, and a less dense grid is used further from the source(s) to account for any high concentrations that may be located further away from the site.

Elevations were taken from Ordnance Survey mapping.

### **Emission Sources**

As noted in **Chapter 4**, odour control measures have been incorporated as part of the design of the proposed development. The proposed development includes an odour treatment unit (OTU), as depicted in **Drawing No.247825-00-STE-001in Volume 3**.

**Drawing No.'s 247825-00-MP-001 to 247825-00-MP-010 and Drawing No.'s 247825-00-C-IS-700 to 247825-00-C-IS-716 in Volume 3** show the locations of the vent stacks for the OTU Vent Stack, Process Building Vent Stack and the Interceptor Sewer Vents.

**Table 9.2** outlines an indicative, reasonable worst case emission source data for the proposed OTU vent stack at the Inlet Works building, vent stack at the Process building and interceptor sewer vent stacks, as extracted from the design specification. It should be noted that during the detailed design stage, efficient design may result in further improvements in emissions at the Inlet Works Building and the Process Building. However, at a minimum, compliance with limit values outlined in **Section 9.2.2** will be achieved.

A centralised OTU has been designed for the WwTP, that would comprise biological and carbon filters and the treated air would discharge through a vent stack on the Inlet Works Building. The Process building will be sealed and mechanically ventilated and therefore odour treatment is not required. The Process building will be vented via a vent stack located on the building.

Table 9.2: Emission source input data

Parameter	Unit	OTU Vent Stack	PB Vent Stack	Interceptor Sewer Vent(s)
Stack Height	m	17.5	15.5	7.6
Stack Diameter	m	0.6	0.6	0.33
Flow Rate	m <sup>3</sup> /s	8.7	1.43	1.28
Velocity	m/s	30.79	5.06	15.0
Temperature	°C	15	15	15
Odour Concentration	OU/m <sup>3</sup>	183	1,323	1,323
Odour Emission Rate	OU/s	1,592	1,890	1,696.5

### 9.3 Baseline Conditions

As outlined in **Section 9.2**, the proposed development is located in Arklow town. The proposed WwTP is located on the eastern periphery of Arklow town, approximately 20m from the coastline with the proposed interceptor sewers located primarily along the Avoca River at River Walk, North Quay and South Quay.

As outlined in **Section 2.3 of Chapter 2**, the existing wastewater network in Arklow town discharges untreated wastewater from homes and business to the Avoca River. It has been reported that this existing practise gives rise to a negative odour emanating from the Avoca River<sup>7,8</sup>. The sailing, rowing clubs and the marina have each reported odour problems along the Avoca River.

<sup>7</sup><http://wiclownews.net/2017/05/not-all-sunshine-in-arklow/>

<sup>8</sup><https://www.independent.ie/regionals/wicklowpeople/news/residents-fume-at-stinking-river-30470608.html>

No other known existing odour sources were present in the area during a site visit on 12 April 2018.

## 9.4 Description of the Proposed Development

**Chapter 4** provides a full description of the proposed development. The following aspects are particularly relevant to the odour assessment.

The main sources of odour at a WwTP are generally associated with either sludge or septic wastewater and hence, the priority for odour treatment is the inlet works, sumps and sludge tanks. The Process Building tanks, which form the secondary treatment, will not have the same potential sources of odour and therefore mechanical ventilation is considered appropriate for the Process building.

A centralised OTU has been designed for the WwTP, with an odour concentration of 183 odour units (OU)/m<sup>3</sup> and an emission rate of approximately 1,592 OU/sec. The OTU would comprise biological and carbon filters and the treated air would discharge through a 600mm diameter, 17.5 m high vent stack, in the Inlet Works Building (i.e. terminating 1m above the roof).

Air from the following areas would be treated in the OTU:

- Inlet pump sump;
- Stormwater holding tanks;
- Inlet works – screenings and grit disposal skips;
- Sludge holding tanks;
- Sludge thickeners;
- Sludge dewatering;
- Dewatered sludge skips; and
- Supernatant sump.

As the Process building will be sealed and mechanically ventilated, odour treatment is not required. The design odour concentration for the Process building is 1,323 OU/m<sup>3</sup> with an emission rate of 1,890 OU/sec. The Process building will be vented via a 600mm diameter vent stack at 15.5m height (i.e. terminating 1m above the roof).

12 vent stacks will be located along the interceptor sewer at each of the tunnel shafts. A reasonable worst-case odour concentration of 1,323 OU/m<sup>3</sup> has been assumed with an emission rate of 1,697 OU/sec. The vent stacks along the interceptor sewer network will be vented via a 330mm diameter vent stack at 7.6m height.

The odour control system for the WwTP has been designed to comply with an odour limit offsite of 3.0 OU/m<sup>3</sup>.

## 9.5 Likely Significant Effects

### 9.5.1 Do-Nothing Scenario

In the scenario where the proposed development does not proceed as planned, none of the likely significant effects during operation, as set out in this chapter, would occur.

However, the current odours that are experienced across Arklow town, would continue, as described in **Section 9.3**.

### 9.5.2 Assessment of Effects during Construction

The proposed development will require excavation of soils and subsoils, to accommodate pipelines and structures, however, no significant negative effects on odour are predicted during construction of the proposed development. Furthermore, no significant effects are predicted during the excavation of any contaminated soil encountered during construction of the WwTP at the Old Wallboard site at Ferrybank.

### 9.5.3 Assessment of Effects during Operation

An odour modelling assessment has been undertaken in accordance with the methodology outlined in **Section 9.2**, and using emission data provided by the design team (Refer to Table 9.2). Predicted concentrations are compared to the limit value outlined in **Section 9.2.2**.

#### 9.5.3.1 Inlet Works and Process Building

The highest predicted ground level concentrations of odour are presented in **Table 9.3** for the worst-case modelled results. **Figure 9.1 in Volume 3** shows an isopleth for the 98<sup>th</sup> percentile of 1-hour values for odour units.

Table 9.3: Modelling results for Inlet Works and Process Building Vents

Limit Value 98 <sup>th</sup> percentile of 1-hour value (OU/m <sup>3</sup> )	Highest Predicted Ground Level Concentration (g/m <sup>3</sup> )	Distance from source to predicted highest ground concentration level (m)	Grid Reference (ITM)	
			Easting	Northing
3	0.48	98m	725339	673134

The result for the highest 98<sup>th</sup> percentile 1-hour values is predicted to be 0.51 OU/m<sup>3</sup> which is 16% of the limit value of 3.0 OU/m<sup>3</sup> and occurs at the site boundary of the proposed development. This is in good compliance with the limit value.

As stated in **Section 9.2.5.1**, during the detailed design stage, efficient design may result in further improvements in odorous emissions at the Inlet Works Building and the Process Building. This assessment shows that compliance with the limit value is capable of being achieved on the basis of the specimen design.

### 9.5.3.2 Interceptor Sewer Vents

The results for the highest predicted concentration of odour in proximity to an interceptor sewer vent are presented in **Table 9.4** for the worst-case modelled results. Meteorological data from 2011 was found to give rise to the highest predicted ground level concentration of odour.

Table 9.4: Modelling results for Interceptor Sewer Vents

Limit Value 98 <sup>th</sup> percentile of 1-hour value (OU/m <sup>3</sup> )	Highest Predicted Ground Level Concentration (g/m <sup>3</sup> )	Distance from source to predicted highest ground concentration level (m)
3	0.34	33

The result for the highest 98<sup>th</sup> percentile 1-hour values was predicted to be 0.34 OU/m<sup>3</sup> which is 11% of the limit value of 3.0 OU/m<sup>3</sup>. This shows good compliance with the limit value.

As the results in Table 9.4 show, the highest predicted concentration of odour occurs at a distance of 33m from an interceptor sewer vent.

The 12 vent stacks will each be located at the tunnel shafts. The two closest shafts are TSS2A and TSS3, approximately 25m apart. In the unlikely worst-case scenario of the highest predicted ground level concentration values from both vents occurring at the same location, a cumulative value of 0.68g/m<sup>3</sup> is estimated. This value is 22% of the limit value and shows good compliance with the limit value.

Given the low predicted ground level concentration from each vent, as well as the distance between vents, any cumulative effects are not predicted to be significant and will still be well below the limit value of 3OU/m<sup>3</sup>.

### 9.5.4 Cumulative

This section considers the potential for cumulative effects arising from the proposed development in association with other developments as described in **Section 2.6 in Chapter 2**.

The proposed development is not considered to give rise to significant odour effects during the construction phase, therefore cumulative odour effects will not occur during construction of the proposed development.

Gas Networks Ireland (GNI) have planning permission granted for a 3m high 'lamp post' style relief vent stack servicing the existing above ground district regulating installation located on North Quay adjacent to the planning boundary. This development, in combination with the proposed development will not give rise to any significant cumulative odour effects.

## 9.6 Mitigation Measures and Monitoring

### 9.6.1 Mitigation

#### 9.6.1.1 Mitigation during Construction

No mitigation measures are considered necessary during the construction of the proposed development with regard to odour.

#### 9.6.1.2 Mitigation during Operation

No mitigation measures other than those inherent design measures described in **Chapter 4** are required during the operation of the proposed development with regard to odour.

### 9.6.2 Monitoring

#### 9.6.2.1 Monitoring during Construction

No monitoring measures are required during the construction of the proposed development with regard to odour.

#### 9.6.2.2 Monitoring during Operation

The proposed development will be required to apply for a WWDA to the EPA prior to operation as outlined in **Section 4.5 of Chapter 4**. This licence will only apply to the wastewater discharged from the WwTP. All other environmental emissions, including odour, will be regulated by Wicklow County Council. Although the WwTP will not be formally regulated by the EPA, Irish Water will be operating the plant in accordance with EPA licensing standards. Monitoring of the OTU will be undertaken during commissioning and at predetermined frequencies over the life time of the proposed development.

Emissions from the WwTP and interceptor sewer vent stacks will be measured with continuous monitors to indicate the performance levels of the abatement measures. Furthermore, independent performance checks will be carried out by an ISO17025 accredited testing laboratory at quarterly intervals during the first two years of operation to verify the effectiveness of control measures and ongoing compliance with the odour limits.

## 9.7 Residual Effects

### 9.7.1 Residual Effects during Construction

No significant residual effects are anticipated during the construction of the proposed development with regard to odour.

### 9.7.2 Residual Effects during Operation

As outlined in **Section 9.5.3**, the odour levels are predicted to be in compliance with the limits presented in **Section 9.2.2**. No significant residual effects are therefore expected to occur at any of the receptor locations during the operation of the proposed development.

## 9.8 References

Chartered Institute of Water and Environmental Management (CIWEM), 2016. *Policy Position Statement – Control of Odour*.

Environmental Protection Agency (EPA), 2010. *Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)*. Co. Wexford, Ireland

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Wicklow News, 2017. <http://wicklownews.net/2017/05/not-all-sunshine-in-arklow/>

Wicklow County Council, 2018. *Local Area Plan 2018 - 2024*.

## 10 Noise and Vibration

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### 10.1 Introduction

This chapter describes the likely significant noise and vibration effects resulting from the construction and operation of the proposed development. Where necessary, mitigation measures are identified to reduce effects and the likely residual construction and operational effects are described.

**Chapter 4** provides a description of the proposed development and **Chapter 5** describes the Construction Strategy. The following aspects are particularly relevant to the noise and vibration assessment:

- Construction:
  - Noise and vibration associated with construction activities at the WwTP site;
  - Noise associated with the revetment construction;
  - Noise associated with the sea outfall construction;
  - Noise and vibration associated with construction activities at the interceptor sewer locations; and
  - Noise associated with construction traffic.
- Operation:
  - New sources of noise associated with the operation of the WwTP; and
  - Noise associated with operational traffic.

### 10.2 Assessment Methodology

#### 10.2.1 General

This assessment considers the potential for generating significant noise and vibration impacts during the construction and operation of the proposed development and the likely significant effects of noise and vibration on sensitive receptors. Vibration has been considered during the construction phase only as there is not considered to be the potential for significant sources of vibration during the operation of the proposed development.

## 10.2.2 Guidance and Legislation

The noise and vibration assessment has been undertaken in accordance with the overarching EIA guidance identified in **Section 1.4.3 of Chapter 1** and in accordance with the following:

- EPA (2016) *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)*<sup>1</sup>;
- Transport Infrastructure Ireland (TII, formerly NRA) (2014) *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes*<sup>2</sup>;
- TII (2004) *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*<sup>3</sup>; and
- British Standards Institution (BSI) (2014) 5228-1 and 2:2009+A1:2014. *Code of practice for noise and vibration control on construction and open sites. Noise and Vibration*<sup>4</sup>.

These guidance documents, have set out noise and vibration limits during construction which are generally applied by planning authorities to all construction projects in Ireland.

## 10.2.3 Categorisation of the Baseline Environment

### 10.2.3.1 Overview of the Surveys

The baseline noise environment was determined by conducting surveys on 12 and 13 April 2018 at sensitive receptors (residential properties) in the vicinity of the proposed development. The surveys were undertaken in accordance with ISO 1996-1:2016<sup>5</sup>.

### 10.2.3.2 Survey Locations

Attended noise measurements were conducted in Arklow town at three locations in the vicinity of the WwTP site and at five locations in the vicinity of the proposed interceptor sewers. These eight locations are representative of the types of receptors encountered across the proposed development.

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<sup>1</sup> EPA (2016) *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)*. Available from:

<http://www.epa.ie/pubs/advice/noise/guidancenotefornoiseng4.html> [Accessed 24 April 2018]

<sup>2</sup> TII (2014) *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes*. Available from: [http://www.tii.ie/technical-services/environment/planning/Good\\_Practice\\_Guidance\\_for\\_the\\_Treatment\\_of\\_Noise\\_during\\_the\\_Planning\\_of\\_National\\_Road\\_Schemes.pdf](http://www.tii.ie/technical-services/environment/planning/Good_Practice_Guidance_for_the_Treatment_of_Noise_during_the_Planning_of_National_Road_Schemes.pdf) [Accessed 24 April 2018]

<sup>3</sup> TII (2004) *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*.

<sup>4</sup> British Standards Institution (BSI) (2014) 5228-1 and 2:2009+A1:2014. *Code of practice for noise and vibration control on construction and open sites. Noise and Vibration*.

<sup>5</sup> ISO (2016) *Acoustics – Description, measurement and assessment of environmental noise (Part 1 & Part 2)*.

The coordinates and descriptions of each of the survey locations are presented in **Table 10.1** and illustrated in **Figure 10.1 in Volume 3**.

Table 10.1: Description of baseline noise survey locations

Survey Location	Description	Coordinates	
		Easting	Northing
S01	Three storey residential apartment complex located on the North Quay, c. 150m west of the proposed WwTP site boundary.	325119	173280
S02	Three storey residential apartment complex located on the North Quay, c. 130m west of the proposed WwTP site boundary.	325116	173212
S03	Two storey residential dwelling located on the South Quay, c. 180m southwest of the proposed WwTP site boundary.	325114	172999
S04	Two storey residential dwelling located on the South Quay, c. 40m southwest of the nearby proposed interceptor sewer.	324922	173212
S05	Three storey residential dwelling located on the South Quay, c. 10m southwest of the proposed interceptor sewer.	324702	173445
S06	Two storey residential dwelling located adjacent to the roundabout to the northeast of Arklow bridge, c. 30m northeast of the proposed interceptor sewer.	324800	173628
S07	Three storey residential dwelling located on the South Quay, c. 25m south of the proposed interceptor sewer.	324560	173554
S08	Three storey residential dwelling located on the South Quay, c. 30m south of the nearby proposed interceptor sewer.	324293	173538

### 10.2.3.3 Instrumentation

A Brüel & Kjær 2250 Light Class 1 Sound Level Meter was used to carry out the baseline noise surveys. This meter complies with applicable industry standards<sup>6</sup>. The noise meter was calibrated before and after each measurement at each survey location using a Brüel & Kjær 4231 Acoustic Calibrator. A windshield was used to provide the microphone with effective wind protection to ensure that local meteorological conditions did not impact on the monitoring.

### 10.2.3.4 Meteorological Conditions

Meteorological conditions over the monitoring periods are set out in Table 10.2. Meteorological data has been taken from Johnstown Castle, Co. Wexford weather station data (the nearest weather station) for each day the surveys occurred.

Table 10.2: Meteorological conditions for survey periods

Date	Rainfall (mm)	Max Temp (°C)	Min Temp (°C)	Mean Wind Speed (m/s)
12 April 2018	0	9.9	7	3.0
13 April 2018	0	11.3	5.8	2.7

### 10.2.3.5 Measurement Parameters

The following parameters were recorded and reported as part of the baseline surveys:

- $L_{Aeq}$  – this is the continuous steady sound level during the sample period and effectively represents an average value;
- $L_{A10}$  – this is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise; and
- $L_{A90}$  – this is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

The ‘A’ suffix denotes the fact that the sound levels are “A-weighted” in order to account for the non-linear nature of human hearing.

### 10.2.3.6 Survey Periods

Measurements were conducted at the survey locations during the following survey periods:

- Between 7am and 7pm on 12 April 2018 for daytime;
- Between 7pm and 11pm on 12 April 2018 for evening time; and
- Between 11pm on 12 April 2018 and 7am on 13 April 2018 for night-time.

<sup>6</sup> International Electro-Technical Commission (IEC) (2002) *Specification for Sound Level Meters*.

All surveys were carried out on a week day and during time periods that were selected in order to provide a typical snapshot of the existing baseline noise environment in the vicinity of the sensitive receptors.

The results were initially noted onto a survey record sheet immediately following each sample and were also saved to the instrument memory for later analysis where appropriate. Survey personnel also noted all primary noise sources contributing to the baseline noise environment.

## 10.2.4 Impact Assessment Methodology

### 10.2.4.1 Traffic Volumes (Construction and Operation)

The TII guidance<sup>2</sup> states that routes should be considered for assessment where the flow of traffic volumes is likely to increase or decrease by 25% or more during construction and/or operation.

As outlined in **Section 7.4 of Chapter 7**, the operation of the proposed development will not result in offsite traffic increases of greater than 25%, therefore a detailed assessment of noise and vibration associated with traffic is not required.

During construction, there will be increases in traffic volumes due to the presence of construction vehicles and traffic diversions. These diversions will be in place for periods of between two weeks to nine months. **Chapter 4** and **Chapter 7** outlines the full details of the traffic diversions during the construction of the proposed development. Table 10.3 outlines the classification of magnitude of noise impacts in the short term for traffic noise, as stated in DMRB guidance<sup>7</sup>.

Table 10.3: Classification of magnitude of noise impacts in the short term

Noise change, $L_{A10,18h}$	Magnitude of Impact
0	No change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

<sup>7</sup> Design Manual for Roads and Bridges, Vol 11 Section 3 Part 7 HD 213/11 Noise and Vibration. Highways Agency.

For traffic noise predictions, the Calculation of Road Traffic Noise (CoRTN)<sup>8</sup> was used to calculate road traffic noise as receptors are located in close proximity to the road. The noise levels are calculated based on the following inputs;

- Traffic volumes;
- Vehicle speeds and road gradient;
- Angle of view of road (degrees);
- Location of receptors;
- Road surface; and
- Any obstacles, such as screens or barriers.

### 10.2.4.2 Construction Noise – Limits and Significance Criteria

#### Airborne Construction Noise

BS 5228<sup>4</sup> outlines guidance on construction noise criteria with reference to the existing noise environment, as well as prediction methodologies to estimate impacts. This guidance is considered the most appropriate to apply in this instance as they consider the existing baseline noise environment and include night-time limits. BS 5228<sup>4</sup> states that:

*“a potential significant effect is indicated if the  $L_{Aeq, T}$  noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.”*

Table 10.4 sets out the ABC method for establishing the impact criteria of construction noise as presented in BS5228.

Table 10.4: BS5228 (Part 1) ABC assessment categories and thresholds at dwellings <sup>4</sup>

Assessment Category and Threshold Value Period $L_{Aeq, 1 \text{ hour}}$	Threshold Value in Decibels (dB)		
	A <sup>A)</sup>	B <sup>B)</sup>	C <sup>C)</sup>
Night (23:00-07:00hrs)	45	50	55
Evening and weekends <sup>D)</sup>	55	60	65
Day (07:00-19:00hrs) and Saturdays (08:00-14:00)	65	70	75

A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than category A 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 – 23:00hrs weekdays, 14:00-23:00hrs Saturdays and 07:00-23:00hrs Sundays.

<sup>8</sup> Department of Transport UK, (1988) The Calculation of Road Traffic Noise (CoRTN)

The construction noise criteria outlined in Table 10.5 has been applied at the nearest sensitive receptor to the construction works based on the BS5228<sup>4</sup> criteria. Sensitive receptors are defined in BS5228<sup>4</sup> as any occupied premises outside a site used as a dwelling, place of worship, educational establishment, hospital or similar institution or any other property likely to be adversely affected by an increase in noise level.

Table 10.5: Noise limits to be applied based on BS5228 criteria

Assessment Category and Threshold Value Period $L_{Aeq}$	Standard noise limits at sensitive receptors $L_{Aeq, 1 \text{ hour}}$	Noise limit at S05 $L_{Aeq, 1 \text{ hour}}$
Night (23:00-07:00hrs) ( $L_{Aeq}$ , dB)	(Cat B)50	(Cat B)50
Evening (19:00-23:00hrs) ( $L_{Aeq}$ , dB)	(Cat A) 55	(Cat A) 55
Day (07:00-19:00hrs) ( $L_{Aeq}$ , dB)	(Cat A) 65	(Cat A) 70 <sup>9</sup>

Where an exceedance of the construction noise criteria, as outlined in Table 10.5, is predicted, the impact associated with the noise increase is rated in accordance with Table 10.6.

Table 10.6: Likely impact associated with exceedance of construction noise criteria

Extent of Noise Impact (Exceedance of Assessment Criteria)	Noise Impact Magnitude	Magnitude Rating
Less than 3dB	No significant change/Imperceptible	Neutral to Slight Impact
Increase of 3-5dB	Slight increase	Slight to Moderate Impact
Increase of 6-10dB	Moderate Increase	Moderate to Major Impact
Increase of more than 10dB	Substantial Increase	Significant Impact

Table 10.7 outlines the duration and frequency of effect based on EPA guidance<sup>10</sup>.

Table 10.7: Duration and frequency of effects

Effect Type	Duration
Momentary Effects	Effects lasting from seconds to minutes
Brief Effects	Effects lasting 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

<sup>9</sup> Based on Table 10.4, a daytime noise limit of 70 dB $L_{Aeq}$  can be applied at S05 as baseline noise levels at that location (when rounded to the nearest 5 dB), are the same as Category A values.

<sup>10</sup> EPA (2017) Guidelines on the information to be contained in Environmental Impact Assessment Reports.

## Groundborne Construction Noise

Groundborne noise is generated as a result of propagation of vibration at various frequencies. Underground tunnelling has the potential to generate such frequencies and therefore an assessment for ground borne noise has been undertaken. BS 5228<sup>4</sup> provides the empirical formula to estimate groundborne noise for tunnelling works.  $L_p = 127 - 54\log_{10}r$

where;

$L_p$  is the room sound pressure level, in decibels (dB) and  $r$  is the slope distance from the pile toe or tunnel crown, in metres (m).

This formula has been adapted to the formula below based on average ground conditions that are expected to be encountered across the proposed development<sup>11</sup>.

$$L_p = 117 - 54\log_{10}r$$

There are no relevant national or international standards setting criteria for groundborne noise. The impact criteria set out in Table 10.8 and Table 10.9 have been drawn from projects in the UK and Ireland that have required tunnelling works e.g. Crossrail, the Jubilee Line extension, DART Underground and High-Speed 2.

Absolute criteria, rather than noise change criteria, apply for groundborne noise as there is rarely any appreciable ambient groundborne noise at a receptor and the character and nature of groundborne noise differs from other ambient noise heard inside buildings.

Table 10.8: Groundborne noise impact criteria for residential receptors

Impact Classification	Groundborne Noise Level (dB $L_{Amax}$ ) measured indoors, near the centre of any dwelling room on the ground floor <sup>12</sup>	
Negligible	< 35	Not Significant
Low	35-39	
Medium	40-44	Significant Impact
High	45-49	
Very High	>49	

<sup>11</sup> The information for vibration prediction in BS5228-2 is based on the empirical data within Transport Research Laboratory paper 429 (Groundborne vibration caused by mechanised construction works), which contains vibration data for construction processes in a number of soil types. The updated formula is based on data for tunnelling through clay.

<sup>12</sup> The centre of any dwelling room on the ground floor has been assumed to be 2m from the façade of any building.

Table 10.9: Groundborne noise impact criteria for non-residential receptors

Building	Significant Impact Threshold (dB L <sub>Amax</sub> )
Theatres / Large Auditoria & Concert Halls	25
Sound Recording / Broadcast Studios	30
Places of meeting for Religious Worship / Courts / Lecture Theatres / Museums / Small Auditoria or Halls	35
Offices / Schools / Colleges / Hospitals / Hotels / Libraries	40
Factories / Warehouses	50

### 10.2.4.3 Construction Vibration – Limits and Significance Criteria

#### Sheet Piling

Sheet piling is proposed during two construction phases of the proposed development to enable the construction of the interceptor sewer via trench works (that require piling) and at the WwTP during the installation of the below ground structures and the cofferdam for the SWO. The piling works at the WwTP will not give rise to any significant vibration impacts at the nearest sensitive receptor as these receptors are located at over 100m from the works. In contrast, due to the close proximity of sensitive receptors during the interceptor sewer piling works, this construction activity has therefore been assessed as a reasonable worst case.

Sheet piling will be carried out along the southern banks of the Avoca River; from in the vicinity of Arklow Bridge to approximately the South Green – South Quay intersection. BS 5228-2<sup>4</sup> provides an empirical formula to estimate groundborne vibration for vibratory sheet piling,  $v_{res} = k_v/x^\delta$ ; where;

- $v_{res}$  is the resultant PPV (peak particle velocity) in mm/s;
- $k_v$  is a scaling factor (60 – 266 depending on probability of predicted values being exceeded. A value of 126 has been applied for screening);
- $\delta$  is an operations factor (assumed as 1.3, the average factor over both steady state and start up/rundown operations); and
- $x$  is the distance measured along the ground surface in metres.

#### Tunnelling

Tunnelling will be carried out along the entire interceptor sewer route along North Quay and for approximately 350m of the interceptor sewer route on South Quay. BS 5228-2<sup>4</sup> provides an empirical formula to estimate groundborne vibration for tunnelling works,  $v_{res} \leq 180/x^{1.3}$  where;

$v_{res}$  is the resultant PPV in mm/s and  $x$  is the distance measured along the ground surface in metres.

This formula has been adapted to the formula below based on average ground conditions that are expected to be encountered across the proposed development<sup>13</sup>.

$$v_{res} \leq 18/x^{1.3}$$

The main source of vibration during construction will be due to tunnelling and sheet piling. The TII guidance<sup>2</sup> recommends that in order to ensure that there is no potential for vibration damage during construction, vibration from construction activities should be limited to 8mm/s at frequencies of less than 10Hz, to 12.5mm/s for frequencies of 10 to 50Hz and to 20mm/s at frequencies of 50Hz and above.

Separately, Table 1 in BS 7385-2<sup>14</sup> and Table B.2 in BS5228-2<sup>4</sup> outline vibration limit values for transient vibration for cosmetic damage<sup>15</sup>. Both standards state that:

*“where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 1 may need to be reduced by up to 50%.”*

As the BS 7385-2 limits are directly applicable to vibration in buildings, for continuous and transient vibration, and are also more onerous at lower frequencies compared to the TII limits, they have been carried through for assessment purposes.

Table 10.10 outlines the limits for transient vibration, applied in this assessment and recommend for the construction phase of the proposed development.

Table 10.10: Vibration limits at the nearest sensitive receptor

Type of building	Peak component particle velocity in frequency range of predominant pulse			
	Transient		Continuous	
	4 Hz to 15 Hz	15 Hz and above	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures (Industrial and heavy commercial buildings)	50 mm/s		25 mm/s	
Unreinforced or light framed structures (Residential or light commercial type buildings)	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above	7.5 mm/s at 4 Hz increasing to 10 mm/s at 15 Hz	10 mm/s at 15 Hz increasing to 25mm/s at 40 Hz and above

<sup>13</sup> Transport Research Laboratory paper 429: Groundborne vibration caused by mechanised construction works.

<sup>14</sup> BS 7385-2 (1993) Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from groundborne vibration

<sup>15</sup> ‘Cosmetic’ damage is defined in BS ISO 4866:2010 as *The formation of hairline cracks on drywall surfaces or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick/concrete block construction.*

BS 5228-2<sup>4</sup> outlines guidance on the effects of vibration levels for humans. Vibration levels above 0.3mm/s PPV are likely to be perceptible but significantly higher values can be tolerated which will not cause annoyance. Table 10.11 outlines the likely human response to vibration levels.

Table 10.11: Human perception to vibration levels

Vibration level	Significance Level
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level

#### 10.2.4.4 Operation – Limits and Significance Criteria

The effects of the proposed development during operation are assessed through the application of significance criteria based on predicted changes in noise level due to the proposed development. This was achieved by calculating the change in  $L_{Aeq}$  and applying a significance level as defined in Table 10.12.

Table 10.12: Significance criteria for changes in noise levels during operation <sup>1,16,17</sup>

Change in Sound Level (dB)	Subjective Reaction	Significance Level
None	No change	No change
<3	Inaudible	Imperceptible
4-5	Perceptible	Slight
6-10	Up to doubling of loudness	Moderate
11-15	Over a doubling of loudness	Significant
>16		Profound

<sup>16</sup> BSI (2014) 4142:2014. *Methods for rating and assessing industrial and commercial sound*.

<sup>17</sup> Department of Communications and Local Government (1994) *Planning Policy Guidance 24 (PPG24): Planning and Noise*.

The EPA guidance<sup>1</sup> sets out permissible levels for industrial facilities. Typical limit values (free field) for noise from industrial sites at sensitive receptors are:

- Daytime (07:00 to 19:00hrs) – 55dB  $L_{Ar,T}$ ;
- Evening time (19:00 to 23:00hrs) – 50dB  $L_{Ar,T}$ ; and
- Night-time (23:00 to 07:00hrs) – 45dB  $L_{Aeq,T}$ .

$L_{Ar,T}$  is the rated noise level, equal to the  $L_{Aeq}$  during a specified time interval (T), plus specified adjustments for tonal character and/or impulsiveness of the sound.

$L_{Aeq,T}$  is the equivalent continuous sound level. It is an average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T).

The proposed development will operate on a 24-hour basis. The limits above are applied to assess the effect of operational noise sources at the site boundary.

In addition, the lands adjacent to the WwTP are zoned for Waterfront (WZ), which includes for a mix of residential, commercial, employment, leisure and tourism uses (Refer to **Section 2.6.7 of Chapter 2** for further detail). These lands have therefore been included as future sensitive receptors for the operational assessment. The site boundary of the WwTP site is therefore considered the most suitable location to apply the operational noise limits.

### 10.3 Baseline Conditions

Table 10.13 presents the results of the baseline noise survey at each location. The results of the survey have indicated that baseline noise levels at all locations that have been assessed are dominated by passing traffic on the local road network. No sources of vibration were noted during the surveys.

Table 10.13: Baseline noise survey results

Survey Date and Time		Survey Location	L <sub>Aeq</sub> (dB)	L <sub>Amax</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	Qualitative Description
Day – 12 April 2018	18:19 – 18:49	S01	55	82	52	40	The dominant noise source at this location was local traffic on North Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians, noise from a nearby playing pitch and birdsong.
	17:48 – 18:18	S02	51	80	52	44	The dominant noise source at this location was local traffic on North Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians and birdsong.
	16:56 – 17:12	S03	56	76	57	49	The dominant noise source at this location was local traffic on South Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians and birdsong.
	17:28 – 17:43	S04	55	72	58	45	The dominant noise source at this location was local traffic on South Quay. Other sources of noise included distant industrial noise from Arklow marina, noise from pedestrians and birdsong.
	16:11 – 16:26	S05	63	81	65	60	The dominant noise source at this location was local traffic on South Quay. Other sources of noise included water flow under Arklow bridge, noise from pedestrians and birdsong.
	16:29 – 16:44	S06	61	83	63	56	The dominant noise source at this location was local traffic on the adjacent roundabout. Other sources of noise included water flow under Arklow bridge and noise from pedestrians.
	15:53 – 16:08	S07	51	65	53	48	The dominant noise source at this location was local traffic. Other sources of noise included distant traffic, noise from pedestrians and birdsong.
	15:28 – 15:43	S08	44	68	45	40	The dominant noise source at this location was birdsong. Other sources of noise included distant traffic and noise from pedestrians.
Evening – 12 April 2018	19:00 – 19:30	S01	52	86	48	39	The dominant noise source at this location was local traffic on North Quay. Other sources of noise included industrial noise from Arklow marina, noise from a nearby playing pitch and birdsong.

Survey Date and Time		Survey Location	L <sub>Aeq</sub> (dB)	L <sub>Amax</sub> (dB)	L <sub>A10</sub> (dB)	L <sub>A90</sub> (dB)	Qualitative Description
	19:32 – 20:02	S02	48	66	50	43	The dominant noise source at this location was local traffic on North Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians and birdsong.
	20:21 – 20:51	S03	53	72	54	44	The dominant noise source at this location was local traffic on South Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians and birdsong.
Night – 12 /13 April 2018	23:47 – 00:02	S01	45	65	46	43	Noise sources included occasional local traffic on North Quay, distant traffic noise and the movement of water in the Avoca River.
	23:30 – 23:45	S02	45	64	47	42	Noise sources included occasional local traffic on North Quay, distant traffic noise and the movement of water in the Avoca River.
	23:01 – 23:16	S03	47	68	47	44	Noise sources included occasional local traffic on South Quay, distant traffic noise and the movement of water in the Avoca River.
	23:19 – 23:24	S04	47	69	48	42	Noise sources included occasional local traffic on South Quay, distant traffic noise and the movement of water in the Avoca River.

## 10.4 Likely Significant Effects

### 10.4.1 Do-Nothing Scenario

In the scenario where the proposed development does not proceed as planned, none of the effects as set out in this chapter would occur. Under the ‘do nothing’ scenario, the noise and vibration baseline as presented in **Section 10.3** would persist and no significant effects would arise.

### 10.4.2 Assessment of Effects During Construction

#### 10.4.2.1 Construction Phasing and Plant

The construction of the proposed development will involve construction activities within each of the working areas including WwTP site works, interceptor sewer trench construction works and tunnelling and construction of a sea outfall.

It is not possible at this stage to predict the exact equipment that will be chosen by the contractor(s) and predicted calculations are indicative only and used for the purposes of comparison with the adopted criteria. Based on the indicative construction programme (Refer to **Appendix 5.2**), a reasonable worst-case assessment has been undertaken. For the purposes of this assessment, the following construction phases are considered for the construction of the WwTP and the interceptor sewers:

- WwTP
  - Site preparation;
  - General site activities;
  - Building construction;
  - Revetment construction; and
  - Sea outfall construction.
- Interceptor Sewer
  - Open trench works (soil stripping, excavation, piling, rock breaking, pipe laying, backfilling, reinstatement);
  - Shaft construction;
  - Tunnelling; and
  - Sheet Piling.

The calculations assume that plant and equipment are operating simultaneously, as outlined in the following sections. Mitigation, in the form of a 2.4m hoarding, has been applied to each of the modelling scenarios. In practice, a reduction up to 10dB(A) can be achieved for hoarding of this height.

For the construction of the WwTP, open trench works and construction of the tunnelling shafts, a 10dB(A) reduction has been assumed on the basis that the noise sources are completely screened from sensitive receptors<sup>4</sup>. For the outfall and revetment upgrade works a 5dB(A) reduction has been assumed on the basis that the noise sources are partially screened from sensitive receptors<sup>4</sup>.

The calculations also assume that all plant and equipment associated with the individual phases are operating simultaneously and at the distance specified in Table 10.14, Table 10.16, Table 10.18, Table 10.21, Table 10.22 and Table 10.23

Typically, construction will be from 7am to 7pm, Monday to Friday and 8am to 2pm on Saturday. However, during the construction of tunnel section of the interceptor sewer, the Tunnel Boring Machine (TBM) equipment (including generator) will operate continuously. Tunnelling will occur 24-hours a day, seven days per week and has been conservatively estimated to take 20-25 days per 100m section (including setup and removal), although this is dependent on the rate of progress of tunnelling. It is envisaged that a tunnelling rate of up to 10m per day can be achieved but for assessment purposes the conservative rate of progress has been assumed herein.

It is anticipated that the tunnelling works will take approximately one year and the construction of the subsurface and above ground structures, as well as the outfalls and the revetment for the WwTP will take approximately 22 months.

No additional works other than tunnelling are anticipated on Sundays and Bank Holidays. Notwithstanding the 24-hour use of the tunnelling equipment, it is anticipated that there may be times due to exceptional circumstances that construction activities may be necessary outside of the standard hours. This will be agreed in advance with Wicklow County Council and communicated to local residents with an estimation of the timing and duration.

#### 10.4.2.2 WwTP

Table 10.14 outlines the number and type of plant and equipment assumed to be required during construction of the WwTP, along with the percentage time in operation, during the site preparation, general activities and building construction.

Table 10.14: Specification and number of equipment for each construction phase of the WwTP

Plant and equipment included in assessment	BS 5228 <sup>4</sup> reference	Number	Sound Power Level (L <sub>w</sub> ) dB	Percentage time in operation (%)
<b>Site Preparation</b>				
Tracked Excavator	C.1.12	3	110	66
Dump Truck	C.2.30	2	107	66
Crusher	C.1.14	1	110	66
Tower Crane	C.4.48	1	104	66
Breaker Mounted on Excavator	C.1.9	1	118	66
<b>General Activities</b>				
Piling	C.3.14	1	111	66
Tracked Excavator	C.1.12	2	110	66
Dump Truck	C.2.30	2	107	66
Angle Grinder	C.4.93	1	108	66
Tower Crane	C.4.48	1	104	66
Generator	C.4.84	2	102	66
<b>Building Construction</b>				
Cement Mixer Truck	C.4.18	2	103	66
Poker Vibrator	C.4.33	2	106	66
Tower Crane	C.4.48	1	104	66
Generator	C.4.84	1	102	66
Tracked Excavator	C.1.12	2	110	66
Circular Saw	C.4.72	1	107	66
Water Pump	C.2.46	2	93	66

Table 10.15 outlines the results for the site preparation, general site activities and construction phases at the three nearest sensitive receptors to the WwTP site (Refer to **Figure 10.2 in Volume 3**).

Table 10.15: Predicted sound pressure levels at the nearest sensitive receptors to the WwTP during daytime

Phase	Receptor ID (see Figure 10.2)	Baseline Noise Level daytime (dBA)	Predicted Noise Level ( $L_{Aeq, 1 \text{ hr}}$ ) dB(A)	Total predicted noise level dB(A)	Impact Rating (refer to Table 10.6)
Site Preparation	R52	55	59	60	Moderate
	R51	51	57	58	Moderate
	R36	56	56	59	Slight
General Activates	R52	55	55	58	Slight
	R51	51	54	56	Slight
	R36	56	52	57	Imperceptible
Building Construction	R52	55	54	58	Slight
	R51	51	53	55	Slight
	R36	56	51	57	Imperceptible

The results of the assessment indicate that for the site preparation, general activities and construction of the WwTP, the daytime noise limit of 65 dB  $L_{Aeq}$  can be complied with at the nearest sensitive receptors to the WwTP site. The impact ratings associated with these works range from short term imperceptible negative impact to short term moderate negative impact.

The above calculations are indicative and are used for the purposes of comparison only with the adopted criteria.

### 10.4.2.3 Revetment

Table 10.16 outlines the number and type of plant and equipment assumed to be required during construction of the revetment upgrade, along with the percentage time in operation, during the revetment upgrade works adjacent to the WwTP.

Table 10.16: Specification and number of equipment for revetment construction works

Plant and equipment included in assessment	BS 5228 <sup>4</sup> reference	Number	Sound Power Level ( $L_w$ ) dB	Percentage time in operation (%)
Tracked Excavator	C.1.12	3	110	66
Dump Truck	C.2.30	2	107	66
Crusher	C.1.14	2	110	66
Tower Crane	C.4.48	2	104	66
Breaker Mounted on Excavator	C.1.9	1	118	66
Generator	C.4.84	2	102	66
Water Pump	C.2.46	2	93	66

Table 10.17 outlines the results for the revetment upgrade works at the three nearest sensitive receptors to the WwTP site (refer to **Figure 10.2 in Volume 3**).

Table 10.17: Predicted sound pressure levels at the nearest sensitive receptors to the WwTP for revetment works

Phase	Receptor ID (see Figure 10.2)	Baseline Noise Level (dBA)	Predicted Noise Level ( $L_{Aeq, 1 \text{ hr}}$ ) dB(A)	Total predicted noise level dB(A)	Impact Rating (refer to Table 10.6)
Revetment Construction	R52	55	60	61	Slight
	R51	51	60	61	Significant
	R36	56	58	60	Slight
	R55	55	61	62	Moderate

The results of the assessment indicate that for the revetment upgrade works, the daytime noise limit of 65 dB  $L_{Aeq}$  can be complied with at the nearest sensitive receptors to the WwTP site. The impact ratings associated with these works range from short term slight negative impact to short term significant negative impacts.

The above calculations are indicative and are used for the purposes of comparison only with the adopted criteria.

#### 10.4.2.4 Outfall

Construction of the long sea outfall will include works from both the land and sea. It is expected that several vessels may be required during the construction of the outfall and that diving support is likely to be required at times.

**Section 5.6.5.1 of Chapter 5** outlines in detail the potential methods for the construction of the marine outfall. Based on current practice and site constraints/characteristics there are considered to be three potential construction methodologies:

- Horizontal directional drilling method;
- Flood and float method; and
- Bottom-pull method.

As the flood and float method and bottom pull method are deemed to generate more noise than the directional drilling option, these works have been assessed as a worst case.

Table 10.18 outlines the number and type of equipment assumed to be required for construction of the outfall, along with the percentage time in operation, during the sea outfall construction works adjacent to the WwTP site in the Irish Sea. Specification for the equipment and operational times have been taken from BS 5228-1<sup>4</sup>

Table 10.18: Specification and number of equipment for construction of the outfall

Plant and equipment included in assessment	BS 5228 <sup>4</sup> reference	Number	Sound Power Level ( $L_w$ ) dB	Percentage time in operation (%)
Dredging	D.12.1	1	124	100
Loading dredged aggregates	D.12.4	1	112	100
Grab – hopper dredging ship	C.7.2	1	110	100

Table 10.19 outlines the results for the outfall construction works at the three nearest sensitive receptors to the WwTP site (refer to **Figure 10.2 in Volume 3**).

Table 10.19: Predicted sound pressure levels at the nearest sensitive receptors to the WwTP for construction of the outfall

Phase	Receptor ID (see Figure 10.2)	Baseline Noise Level (dBA)	Predicted Noise Level ( $L_{Aeq, 1 hr}$ ) dB(A)	Total predicted noise level dB(A)	Impact Rating (refer to Table 10.6)
Outfall Construction	R52	55	62	59	Moderate
	R51	51	63	58	Significant
	R36	56	63	60	Moderate

The results of the assessment indicate that for the outfall construction works, the daytime noise limit of 65 dB  $L_{Aeq}$  can be complied with at the nearest sensitive receptors to the WwTP site. The impact ratings associated with these works range from short term moderate negative impact to short term significant negative effects.

The construction of the outfall has the potential for impacting marine mammals. Without mitigation, these impacts may have a short term significant impact on mammals, however, with the mitigation measures outlined in **Section 10.5.1.2**, the effects will not be significant.

#### 10.4.2.5 Impact of WwTP, Sea Outfall and Revetment Construction

Table 10.20 outlines the results of the cumulative assessment for works ongoing at the WwTP, outfall and revetment simultaneously.

Table 10.20: Predicted sound pressure levels at the nearest sensitive receptors to the WwTP for works ongoing at the WwTP, outfall and revetment simultaneously

Phase	Receptor ID (see Figure 10.2)	Baseline Noise Level daytime (dBA)	Predicted Noise Level ( $L_{Aeq, 1 hr}$ ) dB(A)	Total predicted noise level dB(A)	Impact Rating (refer to Table 10.6)
WwTP Site Preparation with Revetment and sea outfall construction	R52	55	65	65	Significant
	R51	51	65	65	Significant
	R36	56	65	65	Moderate
WwTP General Activities with Revetment and sea outfall construction	R52	55	65	65	Significant
	R51	51	65	65	Significant
	R36	56	64	64	Moderate
WwTP Building Construction with Revetment and sea outfall construction	R52	55	65	65	Significant
	R51	51	65	65	Significant
	R36	56	64	65	Moderate

The results of the assessment indicate that for the simultaneous WwTP works, the revetment works and outfall construction, the daytime noise limit of 65dB  $L_{Aeq}$  can be complied with at the nearest sensitive receptors to the WwTP site. The impact ratings associated with these works range from short term moderate negative impact to short term significant negative effects.

### 10.4.2.6 Interceptor Sewer Works (Airborne Noise)

Table 10.21 to Table 10.23 outlines the number and type of equipment assumed to be in operation, along with the percentage time in operation, during open trench works, construction of shafts and the operation of the tunnelling equipment.

Table 10.21: Specification and number of equipment in use for open trench works

Plant included in site preparation assessment	BS 5228 <sup>4</sup> reference	Number	Sound Power Level (L <sub>w</sub> ) dB	Percentage time in operation (%)
<b>Open trench works (soil stripping)</b>				
Tracked Excavator	C.2.18	1	103	50
Dozer	C.5.12	1	105	50
<b>Open trench works (excavation)</b>				
Tracked Excavator	C.2.18	1	103	50
Articulated Dump Truck	C.5.16	1	104	50
<b>Open trench works (sheet piling)</b>				
Mobile Crane	C.3.29	1	98	50
Sheet Piling	C.3.6	1	96	50
<b>Open trench works (rock breaking)</b>				
Tracked Excavator	C.2.18	1	103	50
Articulated Dump Truck	C.5.16	1	104	50
Hydraulic Rock Breaker	C.1.8	1	102	50
<b>Open trench works (pipe laying)</b>				
Mobile Crane	C.3.29	1	98	50
Lorry	C.2.34	1	108	30 <sup>Note 1</sup>
<b>Open trench works (backfilling)</b>				
Tracked Excavator	C.2.18	1	103	50
Articulated Dump Truck	C.5.16	1	104	50
<b>Open trench works (reinstatement)</b>				
Tracked Excavator	C.2.18	2	103	50
Dozer	C.5.12	1	105	50

Note 1 – limited operational time required during pipe laying

Table 10.22: Specification and number of equipment in use for shaft construction

Plant and equipment included in assessment	BS 5228 <sup>4</sup> reference	Number	Sound Power Level (L <sub>w</sub> ) dB	Percentage time in operation (%)
<b>Shaft construction</b>				
Piling Rig	C.3.17	1	104	50
Hydraulic Rock Breaker	C.1.8	1	102	50
Excavator	C.2.18	1	103	50
Dozer	C.5.12	1	105	50
Articulated Dump Truck	C.5.16	1	104	50
Water Pump	C.5.40	1	96	50
Mobile Crane	C.3.29	1	98	50

Table 10.23: Specification and number of equipment in use for tunnelling<sup>18</sup>

Plant and equipment included in assessment	Number	Sound Power Level (L <sub>w</sub> ) dB	Percentage daytime in operation (%)	Percentage evening time and night time in operation (%)
<b>TBM</b>				
Base Tanks and Pump	1	99	25	25
Screens	2	90	100	100
Desilter	1	92	100	100
Centrifuge	1	91	100	100
Cascade	1	92	100	100
Setting tanks and pumps	2	94	100	100
Compressor	1	100	100	100
Generator	1	87	100	100
Dump Truck	1	102	100	0
Excavator	1	99	25	0
Water Pump	1	93	100	100
Mobile Crane	2	95	20	5

Table 10.24 to Table 10.27 outline the results for the open trench works, launch and retrieval shaft construction and tunnelling construction phases at various distances from the proposed interceptor sewer locations.

<sup>18</sup> Dublin City Council (2012) Ringsend Wastewater Treatment Works Extension Environmental Impact Statement.

Banded distances have been selected to reflect the moving nature of the works with the closest sensitive receptor along the scheme approximately 10m from open trench works and 15m from shaft construction and tunnelling.

Table 10.24: Predicted sound pressure levels at banded distances for open trench works

Phase	Predicted Noise Level ( $L_{Aeq, 1 \text{ hr}}$ ) at various distances			
	10m	20m	30m	40m
Open Trench Works – Soil Stripping	66	60	57	54
Open Trench Works – Excavation	66	60	56	53
Open Trench Works – Piling	59	53	50	47
Open Trench Works – Rock Breaking	67	61	57	55
Open Trench Works – Pipe Laying	65	59	56	53
Open Trench Works – Backfilling	66	60	56	53
Open Trench Works – Reinstatement	66	60	57	54

The predicted results for the open trench works for the interceptor sewer, show slight exceedances of 1 to 2 dB for the daytime noise limit of 65 dB  $L_{Aeq}$  at 10m distance from the works.

Table 10.25: Predicted sound pressure levels at banded distances for open shaft construction

Phase	Predicted Noise Level ( $L_{Aeq, 1 \text{ hr}}$ ) at various distances			
	15m	30m	45m	60m
Shaft construction	67	61	57	54

The predicted results for shaft construction works for the interceptor sewer, show slight exceedances of 2dB for the daytime noise limit of 65 dB  $L_{Aeq}$  at 15m from the works.

As stated in **Section 10.5.1.1**, it is not possible at this stage to select the exact plant and equipment that will be chosen by the contractor(s) and so the above calculations are indicative and are used for the purposes of comparison only with the adopted criteria, using conservative estimates for plant, equipment and expected attenuation due to mitigation measures. It will be the responsibility of the contractor to minimise significant negative effects at nearby receptors for the duration of the construction works.

Table 10.26: Predicted sound pressure levels at banded distances for tunnelling – daytime

Phase	Predicted Noise Level ( $L_{Aeq, 1 \text{ hr}}$ ) at various distances			
	15m	30m	45m	60m
TBM tunnelling	65	59	55	53

Table 10.27: Predicted sound pressure levels at banded distances for tunnelling evening time and night-time

Phase	Predicted Noise Level ( $L_{Aeq, 1 \text{ hr}}$ ) at various distances			
	15m	30m	45m	60m
TBM tunnelling	63	57	54	51

The predicted results in Table 10.26 for airborne noise for tunnelling works during daytime for the interceptor sewer, show compliance with the daytime noise limit of 65 dB  $L_{Aeq}$ . Furthermore, as the tunnelling works progress away from the launch shaft noise levels will reduce further due to ground attenuation i.e. sound being contained and absorbed by the soil surrounding the TBM. Noise levels will likely reduce by up to 10dB during tunnelling works at distance from the launch shafts. The time predicted is based on a conservative tunnelling progress rate of 4m/day (25 days for 100m, as referred to in **Section 10.4.2.1**). It is envisaged that a tunnelling rate of up to 10m per day can be achieved.

The predicted results in Table 10.27 for airborne noise for tunnelling works during evening time and night-time for the interceptor sewer, show exceedances with the evening time and night-time noise limit of 55 dB  $L_{Aeq}$  and 50 dB  $L_{Aeq}$ , respectively. These exceedances are predicted to be short term significant negative impacts. Again, noise levels will likely reduce by up to 10dB during tunnelling works at distance from the launch shafts.

#### 10.4.2.7 Impact Assessment for Residential receptors – Trench Works

Table 10.28 outlines the predicted sound pressure levels and impact ratings at each of the monitoring locations during trench works. Green shaded results indicate compliance.

The results of the assessment outlined in Table 10.28 indicate that at two of the three receptors assessed (S07 and S08), the predicted daytime noise at both receptors can comply with the daytime noise limit of 65 dB  $L_{Aeq}$ . Table 10.28 also indicates that at S05, predicted noise levels are compliant with the daytime noise limit of 70 dB  $L_{Aeq}$ .

The impact rating for these works show that two of the three receptors modelled (S07 and S08) may experience significant short term negative impacts.

Table 10.28: Predicted sound pressure levels and impact ratings at monitoring locations during trench works.

Receptor Number	Measured Daytime Noise Level (dBA <sub>L<sub>Aeq</sub></sub> )	Soil Stripping	Excavation	Piling	Rock Breaking	Pipe Laying	Backfilling	Reinstatement
Predicted noise level from works (dB(A))								
S05		68	67	61	69	67	67	68
S07		63	62	56	63	62	62	63
S08		60	60	53	61	59	60	60
Total noise level (dB(A))								
S05	63	69	68	65	70	68	68	69
S07	51	63	62	57	63	62	62	63
S08	44	60	60	54	61	59	60	60
Predicted increase in noise levels (dBA)								
S05	63	6	5	2	7	5	5	6
S07	51	12	11	6	12	11	11	12
S08	44	16	16	10	17	15	16	16
Impact rating (refer to <b>Table 10.6</b> )								
S05	63	Moderate	Moderate	Imperceptible	Moderate	Slight	Slight	Moderate
S07	51	Significant	Significant	Moderate	Significant	Significant	Significant	Significant
S08	44	Significant	Significant	Moderate	Significant	Significant	Significant	Significant

### 10.4.2.8 Impact Assessment for Residential Receptors – Shaft Construction and Tunnelling

Table 10.29 outlines the predicted sound pressure levels and impact ratings at each of the monitoring locations during shaft construction and tunnelling. Green shaded results indicate compliance while red shaded results indicate exceedances.

The results of the assessment outlined in Table 10.29 indicate that at each of the five receptors assessed, for shaft construction and tunnelling, the daytime noise limit of 65 dB  $L_{Aeq}$  can be complied with at three of the five receptors (S01, S02 and S03). Two receptors (S02 and S04) may potentially experience significant short term negative impacts during shaft construction.

During evening time works for tunnelling, one of the three receptors modelled (S02) may exceed the evening time noise limit of 55 dB  $L_{Aeq}$ . S02 may potentially experience significant short term negative impacts during tunnelling. Table 10.29 also indicates that at S03, predicted noise levels are compliant with the evening time noise limit of 55 dB  $L_{Aeq}$ .

During night time works for tunnelling, all four of the receptors modelled may exceed the night time noise limit of 50 dB  $L_{Aeq}$ . All four receptors will also experience a significant short term negative impacts during tunnelling.

Table 10.29: Predicted sound pressure levels and impact ratings at monitoring locations during shaft construction and TBM operation.

Time	Receptor Number	Baseline Noise Level (dBA)	Predicted Construction Noise Level (dBA)		Predicted Total Noise Level (dBA)		Predicted Increases in Noise Levels (dBA)		Impact Rating (refer to Table 10.6)	
			Shaft construction	TBM	Shaft construction	TBM	Shaft construction	TBM	Shaft construction	TBM
Day time	S01	55	60	57	61	59	6	4	Moderate	Slight
	S02	51	63	60	63	61	12	10	Significant	Moderate
	S03	56	58	55	60	59	4	3	Slight	Slight
	S04	55	67	64	67	65	12	10	Significant	Moderate
	S06	61	64	61	66	64	5	3	Slight	Slight
Evening Time	S01	52	No shaft construction during evening or night time	55		57		5		Slight
	S02	48		59		59		11		Significant
	S03	53		54		57		4		Slight
Night Time	S01	45		55		55		10		Significant
	S02	45		59		59		14		Significant
	S03	47		54		55		8		Significant
	S04	47		62		62		15		Significant

### 10.4.2.9 Interceptor Sewer (Groundborne Noise)

Table 10.30 presents the predicted results for the groundborne noise assessment at sensitive receptors and are compared to the values in Table 10.8 and Table 10.9.

Table 10.30: Predicted groundborne sound pressure levels for tunnelling

Nearest sensitive receptor to tunnelling works	Receptor type	Approximate slope distance to TBM (m)	Predicted Noise Level $dBL_{Amax}$	Impact Classification (refer to Table 10.6)
R01	Residential	40	30	Negligible
R02	Residential	56	22	Negligible
R03	Residential	25	42	Medium
R04	Residential	44	28	Negligible
R05	Residential	15	54	Very High
R06	Residential	19	48	High
R07	Residential	23	45	High
R08	Residential	25	42	Medium
R09	Residential	26	41	Medium
R10	Residential	59	21	Negligible
R11	Residential	27	40	Medium
R12	Residential	27	40	Medium
R13	Residential	57	22	Negligible
R14	Residential	26	41	Medium
R15	Residential	25	42	Medium
R16	Residential	21	46	High
R17	Residential	57	22	Negligible
R18	Residential	17	51	Very High
R19	Residential	31	36	Low
R20	Residential	18	50	Very High
R21	Residential	16	52	Very High
R22	Residential	17	51	Very High
R23	Residential	46	27	Negligible
R24	Residential	37	32	Negligible
R25	Residential	18	50	Very High
R26	Residential	16	52	Very High
R27	Residential	12	59	Very High
R28	Residential	42	29	Negligible
R29	Residential	39	31	Negligible
R30	Residential	36	33	Negligible

Nearest sensitive receptor to tunnelling works	Receptor type	Approximate slope distance to TBM (m)	Predicted Noise Level $dBL_{Amax}$	Impact Classification (refer to Table 10.6)
R31	Residential	34	35	Low
R32	Residential	30	38	Low
R33	Residential	26	41	Medium
R34	Commercial	12	58	Very High <sup>19</sup>
R35	Commercial	23	43	Negligible <sup>19</sup>
R36	Residential	42	29	Negligible
R37	Residential	47	27	Negligible
R38	Residential	40	30	Negligible
R39	Residential	33	35	Low
R40	Residential	28	39	Medium
R41	Church	55	23	Negligible <sup>20</sup>
R42	Residential	45	28	Negligible
R43	Doctor Surgery	18	50	High <sup>21</sup>
R44	Residential	51	25	Negligible
R45	Residential	20	47	High
R46	Commercial	25	42	Negligible <sup>19</sup>
R47	Sailing club	29	38	Negligible <sup>19</sup>
R48	Commercial	14	55	Medium <sup>19</sup>
R49	Residential	36	33	Low
R50	Residential	24	43	Medium
R51	Residential	14	54	Very High
R52	Residential	15	53	Very High
R53	Residential	34	34	Low
R54	Commercial	12	59	High <sup>19</sup>

The results in Table 10.30 have been summarised in Table 10.31 for assessment purposes.

<sup>19</sup> Using a significance threshold of  $50dBL_{Amax}$  as outlined in Table 10.9, a factored rating is applied to this receptor.

<sup>20</sup> Using a significance threshold of  $35dBL_{Amax}$  as outlined in Table 10.9, a factored rating is applied to this receptor.

<sup>21</sup> Using a significance threshold of  $40dBL_{Amax}$  as outlined in Table 10.9, a factored rating is applied to this receptor.

Table 10.31: Summary of impact classifications for groundborne noise

Impact Classification (see Table 10.8)		Number of receptors	List of receptors
Not significant	Negligible	20	R1,2,4,10,13,17, 23,24,28,29,30,35,36,37,38,41 ,42,44,46,47.
	Low	6	R19,31,32,39,49,53
Significant	Medium	11	R3,8,9,11,12,14,15,33,40,48,5 0.
	High	6	R6, 7,16,43,45,54.
	Very High	11	R5,18,20,21,22,25,26,27,34,51 ,52.

The results presented in Table 10.31 show that of the 54 receptors assessed, the impact at 26 of these are considered not significant, 11 are considered of medium significance, 6 of high significance and 11 of very high significance. All impacts are considered short term negative, see Table 10.7.

Based on the results in Table 10.31, Table 10.32 predicts the length of time before the impact associated with groundborne noise at each receptor (identified in Table 10.31) is rated as not significant due to the movement of the TBM away from each the receptor. The time predicted is based on a conservative tunnelling progress rate of 4m/day (25 days for 100m, as referred to in **Section 10.4.2.1**). It is envisaged that a tunnelling rate of up to 10m per day can be achieved.

Table 10.32: Time required (in days) to reduce groundborne noise impact to not significant

Receptor	Receptor type	Approximate slope distance to TBM (m)	Approximate slope distance required before compliant with appropriate limit (m)	Time required for TBM to reach required slope distance from a receptor (days)
R05	Residential	14	23	<5
R06	Residential	18		<3
R07	Residential	21		<1
R16	Residential	20		<2
R18	Residential	16		<4
R20	Residential	17		<3
R22	Residential	16		<4
R25	Residential	17		<3
R26	Residential	15		<4
R27	Residential	11		<6
R34	Residential	12		<6

Receptor	Receptor type	Approximate slope distance to TBM (m)	Approximate slope distance required before compliant with appropriate limit (m)	Time required for TBM to reach required slope distance from a receptor (days)
R45	Residential	19		<2
R51	Residential	12		<5
R52	Residential	13		<4
R27	Residential	12		<6
R54	Commercial	12	18	<3
R43	Doctors	18	23	<3

In such circumstances, projects have considered using noise insulation or temporary re-housing as mitigation measures to prevent unacceptable levels of noise affecting receptors. In the case of groundborne noise, noise insulation will not mitigate against this type of noise, as the path of transmission is not through the windows, and so only temporary re-housing is an option in this case.

BS5228-1<sup>4</sup> provides an example of noise insulation and temporary rehousing policy, based on those adopted by several large infrastructure schemes in the UK. In addition to defining the threshold value of eligibility, this recommends a minimum number of days before a resident may be eligible. Where minimum durations of *a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months*, are predicted, BS 5228-1<sup>4</sup> recommends re-housing as an appropriate mitigation measure.

It is important to note that the predicted groundborne levels are an estimate based on the BS 5228<sup>4</sup> empirical formula, while in practice it is possible that the impact may be lower. The finalised construction details, plant and equipment for the proposed development are not known at present. The appointed contractor(s) will outline the specific construction methodologies and agree a schedule that minimises the impact on the effected receptors.

Any requirement for temporary re-housing will be confirmed by the contractor(s) in consultation with Irish Water and the affected stakeholder. The determination for such mitigation will be made after detailed construction methodologies, phasing and detailed equipment are known. This information will be presented in the Noise and Vibration Management Plan (NVMP), a template for which is included an appendix to the Outline CEMP (Refer to Appendix 5.1).

As outlined in **Section 10.6.2.1**, continuous noise monitoring will be undertaken at the three nearest receptors during the construction phase of the proposed development to measure compliance with the limit values presented in Table 10.5.

### 10.4.2.10 Interceptor Sewer (Vibration)

Table 10.33 presents the calculated groundborne vibration levels that may be experienced at the nearest sensitive receptor and compares these to the values in Table 10.10.

Table 10.33: Predicted vibration levels for tunnelling

Nearest sensitive receptor to tunnelling works	Receptor type	Distance measured along the ground surface (m)	PPV (mm/s)
R01	Residential	38	0.16
R02	Residential	54	0.10
R03	Residential	22	0.32
R04	Residential	42	0.14
R05	Residential	12	0.71
R06	Residential	16	0.49
R07	Residential	19	0.39
R08	Residential	22	0.32
R09	Residential	23	0.31
R10	Residential	57	0.09
R11	Residential	24	0.29
R12	Residential	24	0.29
R13	Residential	55	0.10
R14	Residential	23	0.31
R15	Residential	22	0.32
R16	Residential	18	0.42
R17	Residential	55	0.10
R18	Residential	14	0.58
R19	Residential	29	0.23
R20	Residential	15	0.53
R21	Residential	13	0.64
R22	Residential	14	0.58
R23	Residential	44	0.13
R24	Residential	35	0.18
R25	Residential	15	0.53
R26	Residential	13	0.64
R27	Residential	8	1.03
R28	Residential	40	0.15
R29	Residential	37	0.16
R30	Residential	33	0.19
R31	Residential	31	0.21

Nearest sensitive receptor to tunnelling works	Receptor type	Distance measured along the ground surface (m)	PPV (mm/s)
R32	Residential	27	0.25
R33	Residential	23	0.31
R34	Residential	10	0.90
R35	Residential	21	0.34
R36	Residential	40	0.15
R37	Residential	45	0.13
R38	Residential	38	0.16
R39	Residential	30	0.22
R40	Residential	25	0.27
R41	Church	53	0.10
R42	Residential	43	0.14
R43	Doctor Surgery	15	0.53
R44	Residential	49	0.11
R45	Residential & commercial	17	0.45
R46	Commercial	22	0.32
R47	Sailing club	26	0.26
R48	Commercial	11	0.80
R49	Residential	33	0.19
R50	Residential	21	0.34
R51	Residential	10	0.90
R52	Residential	11	0.80
R53	Residential	31	0.21
R54	Commercial	7	1.43

The result of the assessment show that at all receptors the predicted vibration levels will be in good compliance with the vibration limits as presented in Table 10.10. The potential impact is assessed as negligible in terms of potential for building damage. All impacts are considered short term, see Table 10.7.

Table 10.33 shows that the tunnelling works may exceed the level of 1mm/s at two receptors (R27 and R54). In general, it is recommended that prior notice be given to local residents before tunnelling commences. The proposed development will involve open trench works underneath Arklow Bridge. Based on the results for tunnelling, the impact of the trench works is not considered significant.

It should be noted that the predicted groundborne levels are an estimate based on the BS 5228 empirical formula, while in practice it is possible that the impact may be lower.

As stated in **Section 10.5.1.1**, it is not possible at this stage to select the exact plant and equipment that will be chosen by the contractor(s) and so the above calculations are indicative and used for the purposes of comparison only with the adopted criteria. It will be the responsibility of the contractor to minimise impacts at nearby receptors for the duration of construction.

#### 10.4.2.11 Sheet Piling (Vibration)

Table 10.34 presents the calculated groundborne vibration levels that may be experienced at the nearest sensitive receptor and compares these to the values in **Table 10.10**.

Table 10.34: Predicted vibration levels for sheet wall piling

Nearest sensitive receptor to tunnelling works (see Figure 10.3)	Receptor type	Distance measured along the ground surface (m)	PPV (mm/s)
V01	Residential	11	5.9
V02	Commercial	12	5.0
V03	Commercial	13	4.7
V04	Residential	14	4.0
V05	Residential	12	5.3
V06	Residential	10	6.2
V07	Residential	14	4.2
V08	Residential	16	3.5
V09	Residential	16	3.5
V10	Residential	18	2.9
V11	Residential	23	2.2
V12	Residential	17	3.2
V13	Residential	17	3.2

The result of the assessment shows that at all residential and commercial receptors the predicted vibration levels are in compliance with the vibration limits as presented in Table 10.10 for transient vibration. All impacts are considered short term, see Table 10.7

Table 10.34 shows that the tunnelling works may exceed the level of 1mm/s at all receptors which may cause residential complaints. As outlined in Table 10.10, vibration above 10mm/s is likely to be intolerable for any more than a very brief exposure to this level. In general, it is recommended that prior notice be given to local residents before tunnelling commences.

It should be noted that the predicted groundborne levels are an estimate based on the BS 5228 empirical formula, while in practice it is possible that the impact may be lower.

### 10.4.2.12 Arklow Bridge Works

The proposed interceptor sewer will pass under the most southern arch of Arklow Bridge. At this point, the sewer will be approximately 3m-3.5m below ground level and approximately 1m below the existing river bed. **Chapter 5** outlines in details the various methodologies which may be used for the underpinning works including:

- Grouting and traditional underpinning;
- Mini piling; and
- Load bearing pile.

The underpinning and lowering of the floor of the bridge is likely to entail the following activities:

- Grouting each of the piers and the abutments of Arklow Bridge and the river bed to a depth of up to 2m below the piers and abutments, including drilling of holes to accommodate the grouting from the bridge deck, in order to stabilise the bridge and its formation during the underpinning works (Refer to **Figure 5.6 in Chapter 5**);
- Construction of a temporary causeway from the river bank to provide access to each of the piers and abutments;
- Creation of a bund around each pier or group of piers to allow works to be carried out in a dry environment;
- Removal of existing formation in a phased manner from the underside of each pier and abutment to a depth of approximately 1.6m below existing bed level and replacement with concrete (Refer to **Figure 5.7 in Chapter 5**); OR
- Construction of mini-piles around each pier to support the pier foundation (Refer to **Figure 5.8 in Chapter 5**); OR
- Construction of piles through the piers and abutments from the bridge deck to support the bridge during the underpinning works (Refer to **Figure 5.9 in Chapter 5**);
- Demolition of the existing concrete scour protection slabs and lowering of the floor of the bridge by approximately 1m on average (It should be noted that the floor of the second arch will be lowered by approximately 1.2m); and
- Construction of a new concrete scour protection slab between approximately 10m upstream to approximately 15m downstream of the bridge and beneath the arches of the bridge and the placement of riprap along the upstream and downstream edges of the concrete slab.

The proposed works have the potential to give rise to structural damage to Arklow Bridge. In terms of risks, it is considered that settlement, tilt and the torsional effects of the works are more likely to result in structural stress to the bridge than vibration.

The use of the empirical formula in order to estimate vibration levels is not deemed suitable as the distance  $x$  is less than  $5m^4$ .

However, it has been conservatively assumed that there is potential for significant effects. At such close distances the most effective method of mitigation is through real-time vibration monitoring at the nearest piers along the bridge in compliance with the limit values set out in Table 10.10. Vibration limits will be monitored on a continual basis during works at Arklow Bridge and in the event of vibration limits being exceeded, works will cease, be reassessed and where possible, alternative construction methods will be used. Monitoring locations will be specified in the Contractors NVMP.

#### 10.4.2.13 Construction Traffic

No routes will experience increases of more than 25% in traffic volumes due to construction traffic, solely. For locations where significant changes to traffic are predicted due to diversions, Table 10.35 outlines the stages, durations and predicted increases.

Table 10.35: Significant traffic increases during construction phase.

Construction Stage	Duration	Traffic volume - existing	Traffic volume – due to rerouting	Road effected
Stage E South Quay / South Green	2 months	2,614	3,735	South Green Harbour Road
Stage F South Quay / Harbour Road	5 months	2,614	3,735	South Green Harbour Road
Stage H North Quay (East of Ferrybank)	2 weeks	Estimated at 3,000	9,000 (6,000 above baseline)	Seaview Avenue
Stage I North Quay (West of Bridgewater Ferrybank)	2 weeks	Estimated at 3,000	9,000 (6,000 above baseline)	Seaview Avenue

Table 10.36 presents the results for the predicted noise level increases from traffic during the construction phase.

Table 10.36: Predicted noise increases during construction phase.

Location	Distance to centre of road	Predicted existing noise level (L <sub>A10,18hr</sub> )	Predicted construction noise level (L <sub>A10,18hr</sub> )	Predicted increase (dB)	Impact Rating (refer to Table 10.3)
South Green	5m	63.0	64.8	1.8	Minor
Harbour Road	5m	63.0	64.8	1.8	Minor
Seaview Avenue	5m	63.8	68.6	4.8	Moderate

Receptors along South Green and Harbour Road may experience minor temporary negative impacts during traffic rerouting.

Receptors along Seaview Avenue may experience moderate temporary negative impacts during traffic rerouting.

### 10.4.3 Assessment of Effects During Operation

All equipment will be housed within buildings/chambers which will limit noise breakout to atmosphere. The acoustic performance data provided in Table 10.37 is based on predicted operational noise sources. The values quoted are for the highest noise emitters.

Table 10.37: Details of noise sources modelled

Location	Source	Number	Sound Power Level (dB) of Source	% of time in operation
Inlet Works Building	Fresh air fans	2	60	100%
	Pump	3	83	100%
	Fans	4	80	100%
Sludge Building	Pump	2	83	100%
	Fans	2	80	100%
Process Building	Fresh air fans	2	60	100%
	Pump	3	83	100%
	Transformer	1	85	100%
	Fans	4	80	100%
Admin Building	Air handling unit	1	60	25%
External	Generator <sup>22</sup>	1	100	100% <sup>22</sup>

The noise sources presented in Table 10.37 will be subject to noise attenuation that will reduce the overall noise levels at nearby receptors. This may be in the form of internal ducting, internal and external acoustic enclosures and cladding on external walls. The overall effect of these measures has been conservatively assumed to provide a Weighted Sound Reduction Index ( $R_w$ ) of 15dB.

An assessment of the above noise sources was undertaken to predict noise levels at the proposed WwTP site boundary during night time, which is the most stringent noise limit. Assuming full-time operation, noise levels at the proposed WwTP site boundary are predicted at two locations and results presented in Table 10.38.

Changes in noise level have been given an impact rating.

<sup>22</sup> As the generator will only operate in emergency conditions, it has not been included in the operational noise assessment.

Table 10.38: Predicted operational noise levels at WwTP site boundary

Location (see Figure 10.1)	Predicted operational noise levels (L <sub>Aeq</sub> , dB)	Background noise level (night-time) (L <sub>Aeq</sub> ) <sup>23</sup>	Total noise level (L <sub>Aeq</sub> )	Change in noise level	Impact rating
L01	43.8	45	47.5	2.5	Imperceptible
L02	42.9	45	47.1	2.1	Imperceptible

Predicted noise levels are in compliance with the night time noise limit of 45dB at the proposed WwTP site boundary. The impact rating associated with the addition of the new noise sources is imperceptible over the long term, see Table 10.7. During the commissioning of the proposed WwTP noise monitoring will confirm compliance with the limit values.

### 10.4.3.1 Operational Traffic

No routes are predicted to experience increases of more than 25% in total traffic flows during the operational phase (refer to **Chapter 7**). Therefore, no detailed assessment is required, refer to **Section 10.3.1.1**.

### 10.4.4 Cumulative Assessment

This section considers the potential for in combination impacts arising from the proposed development in association with other developments. Specifically, it considers a worst-case scenario, where both the proposed development and the proposed Arklow Flood Relief Scheme (or section thereof) are under construction at the same time.

Based on the current level of understanding, construction of the Arklow Flood Relief Scheme (FRS) will consist of local river widening, construction of a flood containment embankment and flood wall and river dredging. While there may be physical and temporal cross over between the schemes, certain works will not be able to occur simultaneously e.g. the flood wall along the South Quay will be constructed after the sheet piling for the interceptor sewer. Table 10.39 outlines indicative equipment that may be used during the construction of the proposed Arklow Flood Relief Scheme. All the works outlined in Table 10.39 can occur at the edge of the Arklow River, therefore a minimum distance of 15m has been used for calculating the impacts.

<sup>23</sup> Background noise data has been taken from the nearest monitoring location.

Table 10.39: Estimated plant and equipment to be used during construction of proposed Arklow Flood Relief Scheme

Construction Phase for Arklow Flood Relief Scheme	Plant and Equipment	Location of Works	BS 5228 <sup>4</sup> reference	Number	Sound Power Level (L <sub>w</sub> ) dB	Percent age time in operation (%)
River Widening	Tracked Excavator	From R03 to R19 (see Figure 10.2)	C.2.18	1	103	50
	Articulated Dump Truck		C.5.16	1	104	50
Flood Wall Construction	Cement Mixer Truck	Along entire South Quay	C.4.18	1	103	50
	Water Pump		C.2.46	1	93	50
	Poker Vibrator		C.4.33	1	106	50
	Tracked Excavator		C.1.12	1	103	50
Flood Containment Embankment	Tracked Excavator	Western end of the proposed development north and south of the Arklow River	C.2.18	1	103	50
	Articulated Dump Truck		C.5.16	1	104	50
	Dozer		C.5.12	1	105	50
River Dredging	Digging out river bed	Along much of Arklow River.	D.12.2	1	112	50
	Tracked Excavator		C.2.18	1	103	50
	Articulated Dump Truck		C.5.16	1	104	50

Table 10.40 outlines the predicted construction noise levels from the proposed Arklow Flood Relief Scheme based on the data provided in Table 10.39.

Table 10.40: Predicted construction noise levels from the proposed Arklow Flood Relief Scheme

Phase	Predicted Noise Level (L <sub>Aeq, 1 hr</sub> ) at various distances			
	15m	30m	45m	60m
River Widening	62	56	52	50
Flood Wall Construction	65	59	55	53
Flood Containment Embankment	64	58	55	52
River Dredging	69	63	63	57

Table 10.40 outlines the predicted construction noise levels from the proposed Arklow Flood Relief Scheme.

As identified in Table 10.40, the activity that is predicted to cause the greatest impact from works associated with the proposed Arklow Flood Relief Scheme is the river dredging.

Should dredging occur simultaneously with the activity that causes the greatest impact during the proposed development (shaft construction, see Table 10.25), the overall predicted impact would be 71 dB ( $L_{Aeq, 1 \text{ hr}}$ ), 6 dB above the proposed noise limit, and categorised as a temporary significant impact.

In relation to construction traffic, the impacts associated with the proposed Arklow Flood Relief Scheme will not add significantly to the overall impact from the proposed development which includes the diversion of approximately 1,000 vehicles along South Quay and 6,000 vehicles along Seaview Avenue.

## 10.5 Mitigation Measures and Monitoring

### 10.5.1 Mitigation

#### 10.5.1.1 Management Plans & Method Statements

As outlined in **Section 10.4.2.9**, detailed construction methodologies, phasing and equipment, mitigation measures and method statements, will be set out in the Noise and Vibration Management Plan NVMP, as part of the Outline CEMP. An outline NVMP is appended to Appendix 5.1.

The NVMP will outline how the appointed contractor(s) will comply with the noise criteria set out in this section and will deal specifically with construction activities in a strategic manner to remove or reduce significant noise and vibration impacts associated with the construction of the proposed development. The NVMP will detail the provision and installation of localised acoustic screens, the best practice noise measures that the appointed contractor(s) will be required to adhere to for construction activities and the noise and vibration monitoring programme that the appointed contractor(s) will be required to undertake during the construction works.

In addition, the appointed contractor(s) will prepare detailed method statements addressing the likely groundborne noise and vibration levels that will be generated as a result of the construction activities once the specific details of the proposed plant, equipment and construction methodologies are known.

Where considered necessary, structural surveys will be undertaken at sensitive receptors in close proximity to the works to establish their condition and tolerance for vibration impacts.

#### 10.5.1.2 Mitigation During Construction

##### General

The following section describes measures to minimise the potential for noise and vibration disturbance to the surrounding area which will be employed by the contractor to ensure the construction noise and vibration criteria outlined herein are not exceeded.

The contractor will take specific noise abatement measures and comply with the recommendations of BS 5228-1 and 2:2009+A1:2014<sup>4</sup> and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001<sup>24</sup>.

The following specific measures will be implemented during the construction of the proposed development:

- A site representative shall be appointed to be responsible for matters relating to noise and vibration;
- Construction of temporary infrastructure (e.g. haul roads) will be with materials that minimise noise and vibration and design of haul roads will minimise reversing;
- Internal haul roads shall be well maintained;
- Unnecessary revving of engines should be avoided and equipment should be switched off when not required;
- Rubber linings shall be used in chutes and dumpers etc. to reduce noise;
- Drop heights of materials shall be minimised;
- Generators will be located away from sensitive receivers and will be enclosed;
- Careful selection of equipment, construction methods and programming with the objective of reducing noise and vibration where possible. Only equipment, including road vehicles, conforming to relevant national or international standards, directives and recommendations on noise and vibration emissions, will be used;
- Plant and vehicles shall be started sequentially rather than all together;
- Selecting electrically powered plant that is quieter than diesel or petrol-driven plant, if interchangeable;
- Fitting suitable anti-vibration mountings where practicable, to rotating and/or impacting equipment;
- Avoiding percussive piling, except where there is an overriding justification;
- Using noise-control equipment such as jackets, shrouds, hoods, and doors, and ensuring they are closed;
- Locating plant, as far as is reasonably practicable, away from receptors or as close as possible to noise barriers or hoardings where these are located between the source and receptor;
- Regular and effective maintenance by trained personnel shall be carried out to reduce noise and/or vibration from plant and machinery;
- Ensuring that all plant is maintained regularly to comply with relevant national or international standards and operation of plant and equipment that minimises noise emissions;

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<sup>24</sup> European Communities (2001) *European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001*

- Ensuring that plant is shut down when not in use;
- Ensuring that air lines are maintained and checked regularly to prevent leaks;
- Designing all audible warning systems and alarms to minimise noise. Non-audible warning systems can be used in preference, i.e. cab-mounted CCTV or the use of banksmen.

If required, ensure that audible warning systems are switched to the minimum setting required by the Health and Safety Authority and where practicable use ‘white noise’ reversing alarms in place of the usual ‘siren’ style reversing alert.

- A c. 2.4m hoarding of density of at least 7kg/m<sup>2</sup> shall be provided around construction works, including around the TBM launch site;
- Rotary drills and bursters actuated by hydraulic or electrical power will be used for excavating hard material. In some instances, chemical bursting can be used where nearby sensitive structures are particularly vulnerable to vibration from pneumatic breakers etc.;
- Handling all materials, particularly steelwork, in a manner that minimises noise. For example, storing materials as far as possible away from sensitive receptors and using resilient mats around steel handling areas;
- During construction, regular inspections will be undertaken to ensure that the noise and vibration minimising methods, plant and mitigation identified in the specimen design stage are adopted on site and are working effectively. If applicable, it is proposed that construction method inspections be integrated into any health and safety or quality surveillance regime;
- Typically, site activities shall be limited to 7am – 7pm, Monday to Friday; and 8am – 2pm, Saturday. However, during the interceptor sewer construction works, the TBM equipment (including generator) will operate on a 24-hour basis. No works are anticipated on Sundays and Bank Holidays (with the exception of tunnelling). Aside from the 24-hour use of the TBM equipment, it is anticipated that there will be times due to exceptional circumstances that construction work will be necessary outside of normal construction core working hours. Any such working hours outside the normal construction core working hours will be agreed with Wicklow County Council. The planning of such works will have regard to nearby sensitive receptors;
- A Communications Management Plan shall be prepared to provide for effective community liaison to help ensure the smooth running of construction activities and to address any issues that may arise;

Noise audits shall be carried out by a suitably qualified auditor, appointed by Irish Water in advance, at routine intervals to ensure that the mitigation measures are being correctly implemented.

## Tunnelling

During tunnelling, the most effective pre-emptive measure that to reduce impacts is soil probing prior to tunnelling works. Probing prior to tunnelling will allow hard obstacles or rock to be identified.

If encountered pre-auguring will be undertaken at these locations where hard obstacles have been identified prior to tunnelling to minimise noise and vibration impacts. Where ground conditions may be unknown, this measure will be carried out prior to tunnelling.

Any requirement for temporary re-housing will be confirmed by the Contractor(s) in consultation with Irish Water and the affected stakeholder. The determination for such mitigation will be made after detailed construction methodologies, phasing and detailed equipment are known.

This information will be presented in the NVMP, as outlined in the **Appendix 5.1. Section 10.4.2.9** outlines the process in determining suitability for any temporary re-housing required, as per BS5228-1<sup>4</sup>.

### **Sea Outfall Construction**

During the construction of the long sea outfall, there is the potential for noise impacts on marine mammals. The Department of Arts, Heritage and the Gaeltacht have published guidance<sup>25</sup> on best practice construction mitigation measures that should be followed for construction in Irish waters.

The following summarised measures will be implemented during the construction of the marine outfall in Arklow Bay.

#### Pre- Drilling

A qualified and experienced marine mammal observer (MMO) shall be appointed to monitor for marine mammals and to log all relevant events using standardised data forms.

Drilling activity shall not commence if marine mammals are detected within a 500m radial distance of the drilling sound source, i.e., within the Monitored Zone.

#### Pre- Start Monitoring

Drilling activities shall only commence in daylight hours where effective visual monitoring, as performed and determined by the MMO, has been achieved. Where effective visual monitoring, as determined by the MMO, is not possible the sound-producing activities shall be postponed until effective visual monitoring is possible.

An agreed and clear on-site communication signal must be used between the MMO and the Works Superintendent as to whether the relevant activity may or may not proceed, or resume following a break (see below). It shall only proceed on positive confirmation with the MMO.

In waters up to 200m deep, the MMO shall conduct pre-start-up constant effort monitoring at least 30 minutes before the sound-producing activity is due to commence. Sound-producing activity shall not commence until at least 30 minutes have elapsed with no marine mammals detected within the Monitored Zone by the MMO.

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<sup>25</sup> Department of Arts, Heritage and the Gaeltacht (2014) *Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters*  
[https://www.npws.ie/sites/default/files/general/Underwater%20sound%20guidance\\_Jan%202014.pdf](https://www.npws.ie/sites/default/files/general/Underwater%20sound%20guidance_Jan%202014.pdf)

This prescribed Pre-Start Monitoring shall subsequently be followed immediately by normal drilling operations. The delay between the end of Pre-Start Monitoring and the necessary full drilling output must be minimised.

### Drilling

Once normal drilling operations commence, there is no requirement to halt or discontinue the activity at night-time, nor if weather or visibility conditions deteriorate nor if marine mammals occur within a 500m radial distance of the sound source, i.e., within the Monitored Zone.

### Breaks in Sound Output

If there is a break in drilling sound output for a period greater than 30 minutes (e.g., due to equipment failure, shut-down or location change) then all Pre-Start Monitoring must be undertaken in accordance with the above conditions prior to the recommencement of drilling activity.

## 10.5.1.3 Mitigation During Operation

All equipment will be housed within buildings/chambers which will limit noise breakout to atmosphere. Therefore, a greater level of compliance than that presented in Table 10.38 would be expected and therefore no mitigation measures are considered necessary.

## 10.5.2 Monitoring

### 10.5.2.1 Monitoring During Construction

The contractor(s) shall be required to carry out continuous noise and vibration monitoring at the three closest sensitive receptors to the proposed WwTP and interceptor sewer works during the construction phase.

Vibration monitoring will be undertaken on the piers of the bridge and measured against the limits in Table 10.10. In the event of vibration limits being exceeded, works will cease and alternative construction methods will be used.

Noise and vibration levels will be compared to the limit values outlined in Table 10.5 and Table 10.10, respectively. If exceedances are recorded, the possibility of alternative construction methodologies will be examined to reduce impact at sensitive receptors.

### 10.5.2.2 Monitoring During Operation

Environmental emissions, including noise, will be regulated by Wicklow County Council. Although the WwTP will not be formally regulated by the EPA, Irish Water will be operating the plant in compliance with EPA licensing standards, as set out in **Section 10.2.4.4**. Monitoring at the site boundary will be undertaken during commissioning and at predetermined frequencies over the life time of the proposed development.

## 10.6 Residual Effects

### 10.6.1 Residual Effects During Construction

The noise assessment for the construction of the proposed development has shown that compliance with noise limit values in can be achieved at the nearest sensitive receptors to the WwTP site. However, noise limit values will be exceeded at the nearest sensitive receptor to the proposed interceptor sewer for some types of works.

The implementation of the mitigation measures outlined in **Section 10.6** will assist in reducing the impact on nearby sensitive receptors. Residual short-term, slight to significant negative impacts are predicted during the construction phase of the proposed development. Table 10.41 summaries the residual impacts during the construction phase.

Table 10.41: Summary of residual impacts during construction phase

Construction Phase	Summary of Impact Post Mitigation
WwTP construction.	Range from short term imperceptible negative impact to short term moderate negative impact
Revetment construction.	Range from short term slight negative impact to short term significant negative impacts
Sea Outfall construction. Impact of WwTP, Sea Outfall and Revetment construction.	Range from short term moderate negative impact to short term significant negative impacts
Impact assessment for residential receptors – trench works, shaft construction, tunnelling, ground borne noise and airborne noise	Short term significant negative impacts
Interceptor Sewer (Vibration) and Construction Traffic	Short term slight negative impacts
Sheet Piling (Vibration)	Short term moderate negative impacts
Arklow Bridge Works	Potential for short term significant effects

### 10.6.2 Residual Effects During Operation

It is predicted that the EPA limits will be complied with during the operational phase of the proposed development and that there will be no significant residual impacts.

## 10.7 References

British Standards Institution (BSI) 4142:2014, 2014. *Methods for rating and assessing industrial and commercial sound.*

British Standards Institution (BSI) (2014) 5228-1 and 2:2009+A1:2014. *Code of practice for noise and vibration control on construction and open sites. Noise and Vibration.*

BS 7385-2 (1993) *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from groundborne vibration*

Design Manual for Roads and Bridges (DMRB), *Vol 11 Section 3 Part 7 HD 213/11 Noise and Vibration*. Highways Agency.

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TII (2014) *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes*.

TII (2004) *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*.

BS 7385-2 (1993) *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from groundborne vibration section*

# 11 Biodiversity

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## 11.1 Introduction

This chapter describes the likely significant direct and indirect effects of the proposed development on biodiversity, including flora (plants), fauna (animals), and habitats in both the terrestrial and aquatic environment.

**Chapter 4** provides a full description of the proposed development whilst **Chapter 5** describes the Construction Strategy. The following aspects are particularly relevant to the biodiversity assessment:

- Design:
  - The landscaping at the Alps and along River Walk, and at the WwTP site, will provide some opportunities for habitat creation and mitigation of direct and indirect effects on biodiversity including plants, animals and habitats in the terrestrial environment of Arklow town.
- Operation:
  - Discharge of untreated effluent to the Avoca River and Estuary will cease; and
  - Treated effluent will discharge to the Irish Sea via a 900m long sea outfall fitted with a diffuser. A separate storm water overflow (SWO) will discharge screened stormwater to inshore coastal waters.
- Construction:
  - Construction activities have the potential to impact on terrestrial biodiversity. Specifically, some of the working areas will require tree removal, vegetation clearance and works on structures that are currently used by bats to accommodate construction activities;
  - Construction activities occurring within the Avoca River channel and within the Irish Sea have the potential to impact on aquatic ecology; and
  - Construction activities will be undertaken in the vicinity of invasive plant species.

## 11.2 Assessment Methodology

### 11.2.1 General

The biodiversity assessment addresses the likely significant direct and indirect effects of the proposed development on terrestrial and aquatic (including marine) biodiversity, including flora, fauna and habitats in proximity to the site.

The assessment has been carried out in three stages:

1. Desktop assessment to determine existing information and records in relation to:
  - Sites, species and habitats protected under Council Directive 92/43/EEC (Habitats Directive), and sites and species protected under Council Directive 2009/147/EC (Birds Directive)<sup>1</sup>, within 15km of the proposed development and more distant hydrologically linked sites; and
  - Biodiversity, habitats and species present in the vicinity of the proposed development.
2. Site visits and field surveys by the specialist aquatic and terrestrial ecologist teams (as described in detail below – Refer to **Appendix 1.2** for team competencies), to establish the existing ecological conditions within the footprint of the proposed development and within the vicinity of all of the proposed development elements. The site visits and field surveys include terrestrial, river, estuarine, and marine surveys.
3. Evaluation of the proposed development and determination of the scale and extent of likely direct and indirect significant effects on biodiversity (i.e. flora, fauna and habitats) and the provision of appropriate mitigation and monitoring.

The ecology team that carried out the biodiversity assessment is as follows:

- BEC Consultants carried out marine, estuarine, and freshwater aquatic ecological surveys;
- Brian Keeley Ecologist and bat licensed specialist carried out bat surveys and assessments; and
- Eleanor Mayes Ecological Consultant carried out terrestrial flora and habitat surveys and assessments, invasive plant surveys, and bird surveys and assessments, and is the lead ecologist for the proposed development.

### 11.2.2 Guidance and Legislation

The biodiversity assessment has been prepared with reference to the following legislation and guidance:

- Wildlife Acts 1976 to 2018;
- European Communities (EC) (Birds and Natural Habitats) Regulations 2011 – 2015;
- Council Directive 2009/147/EEC, i.e. Birds Directive;
- Council Directive 92/43/EEC (as amended), i.e. Habitats Directive;
- Flora (Protection) Order, S.I. No. 356 of 2015;

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<sup>1</sup> Natura 2000 sites, referred to as European sites in Part XAB of the Planning and Development Act 2000 (as amended); these terms are synonymous

- Heritage Council (2011) Best Practice Guidance for Habitat Survey and Mapping;
- Fossitt (2000) A Guide to Habitats in Ireland;
- Transport Infrastructure Ireland (incorporating the National Roads Authority, Revision 1, December 2010). Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Road Schemes;
- National Parks and Wildlife Service, Department of Environment Heritage and Local Government (2006) Bat Mitigation Guidelines for Ireland;
- DoEHLG, (2010). Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities – February 2010 edition;
- Department of Arts, Heritage and the Gaeltacht (2014)<sup>2</sup> Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters;
- EC (2002) Assessment of plans and projects significantly affecting Natura 2000 sites;
- EC (2007) Managing Natura 2000 Sites: Guidance document on Article 6(4) of the Habitats Directive 92/43/EEC;
- EU (2013) Guidelines on Climate Change and Natura 2000: Dealing with the impact of climate change on the management of the Natura 2000 Network of areas of high biodiversity value;
- CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal;
- Inland Fisheries Ireland (2016) Guidelines on Protection of Fisheries during Construction Works in and adjacent to Waters
- EPA (2017) Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports; and
- EU (2017) Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU);

### 11.2.3 Study Area

#### 11.2.3.1 Study area for Terrestrial Biodiversity and Bird Surveys

The study area for desk studies is detailed in **Section 11.2.6.1** and illustrated in **Figure 11.1 in Volume 3**.

The study area for terrestrial biodiversity surveys was defined to include all areas associated with the proposed development, including interceptor sewer route options considered during the development of the design, working areas and construction compounds.

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<sup>2</sup> issued as an official guideline and code of practice under Regulation 71 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011)

Some adjoining lands, including lands around Arklow Pond, were included in the study area in order to provide context and baseline information on ecological corridors in the vicinity of the proposed development.

Waterbird surveys were carried out at Arklow Ponds as well as in the Avoca River and Estuary, because some waterbird species were observed to be moving between these areas. Marine inshore waters were also covered in bird surveys. These study areas are illustrated in **Figure 11.3 in Volume 3**.

Bat surveys included some additional areas outside the main study area, in order to facilitate assessment of potential cumulative effects of the proposed development with the proposed Arklow Flood Relief Scheme: Brigg's Lane behind Ferrybank and along the eastern margin of Arklow Town Marsh pNHA, and along the Avoca River immediately downstream of the M11 flyover (Refer to **Figure 11.1 in Volume 3**).

### 11.2.3.2 Study Area for Aquatic Biodiversity Surveys

The study area for desk studies is detailed in **Section 11.2.6.1**. The study area for aquatic biodiversity surveys was within the Avoca River from just upstream of the M11 flyover down to its point of discharge into the Irish Sea (i.e. the harbour mouth), with benthic sampling extending out into the Irish Sea. The locations of the freshwater sample stations are illustrated in **Figure 11.2 in Volume 3**, while the estuarine and marine sample stations are illustrated in **Figure 11.3 in Volume 3**.

Marine mammals are vulnerable to man-made sound sources, thus the distribution of cetaceans (whales, dolphins and porpoises<sup>3</sup>) within Irish territorial waters, the Irish Sea, and in waters off Arklow are all potentially relevant to identifying the main areas of distribution of recorded species in the context of the proposed development. The catchment of the Avoca River is relevant to the consideration of migratory fish species, including Habitats Directive Annex II listed species, that move between marine and fresh waters through the Avoca Estuary.

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<sup>3</sup> All cetacean species are listed as species of community interest in need of strict protection in Annex IV of the Habitats Directive

## 11.2.4 Site Visits

Field survey dates for the different baseline biodiversity elements are given in Table 11.1.

Table 11.1: Biodiversity field survey dates

Biodiversity Survey Element	Survey dates
Flora and habitat and breeding bird surveys	27 June 2016, 10 August 2016, 26 April 2017, 22 August 2017, 12 April 2018, 16 May 2018
Invasive plant species surveys	10 August 2016, 26 April 2017, 22 August 2017, 12 April 2018, 16 May 2018
Waterbird surveys	16 September 2016, 25 October 2016, 24 November 2016, 8 December 2016, 28 January 2017, 24 February 2017, 29 November 2017, 13 February 2018
Bat survey WwTP site	27 June 2016, 22-23 August 2017
Bat survey River Walk, Arklow Castle, The Alps, Arklow Bridge, and the northern bank of the Avoca River at Ferrybank including Brigg's Lane	17 and 19 October 2016, 22 to 29 August 2017
Estuarine and marine benthic survey	24 April 2017
Estuarine walk over survey	25 April 2017
Freshwater macroinvertebrate survey	26 September 2017

## 11.2.5 Consultation

In its response to the Scoping Report, the EPA indicated that this biodiversity assessment should identify the direct and indirect significant effects of the proposed development on biodiversity, with particular attention to species and habitats protected under the Habitats Directive and the Birds Directive.

Consultation meetings were held with Inland Fisheries Ireland, on 16 March 2018, and with National Parks and Wildlife Service (NPWS) on 27 June 2018, in respect of the proposed development and the proposed Arklow Flood Relief Scheme. Issues discussed related to the Arklow Wastewater Treatment Plant Project included the following:

- An overview of the project was provided;
- Discussion on the design development and baseline biodiversity studies undertaken;
- Habitats Directive Annex II listed fish species that migrate through the Avoca Estuary, potential for River Lamprey adults and larvae to be present in works areas, protocols to remove/protect fish during construction, and seasonal restrictions of in-stream works;
- Water quality protection during construction;
- Habitats Directive Annex IV listed bat species, roost locations including Arklow Bridge, requirements for bat derogation licence and mitigation; and

- Relative proximity to coastal European sites, advice that coastal processes including longshore drift be studied and documented, to facilitate the assessment of potential ex situ effects on these sites to arise from the marine outfalls and revetment upgrade.

Inland Fisheries Ireland provided Avoca River Estuary fish data from monitoring carried out under the Water Framework Directive in 2015.

The NPWS provided information on bat roosts in Arklow, and data on the distribution of the protected plant species<sup>4</sup> *Equisetum x moorei* in the Arklow area outside the planning boundary of the proposed development.

## 11.2.6 Categorisation of the Baseline Environment

### 11.2.6.1 Desk Study

The desk studies carried out accessed information held by the following:

- NPWS metadata website, and NPWS protected plant species data;
- National Biodiversity Data Centre (NBDC) database;
- EPA;
- Inland Fisheries Ireland reports and data;
- Bat Conservation Ireland database;
- Wetland Surveys Ireland database; and
- I-WeBS data held by BirdWatch Ireland. The Irish Wetland Bird Survey (I-WeBS) is a joint scheme of BirdWatch Ireland and the National Parks and Wildlife Service (NPWS).

A literature review of published information on flora and fauna occurring on site and in the surrounding terrestrial, marine, estuarine and riverine environment was also carried out. The geographical extent of the biodiversity desk study varies with the species being considered as outlined in **Section 11.2.3**.

### 11.2.6.2 Terrestrial Flora and Habitat Survey

Walkover flora and habitat surveys were carried out to determine species composition and distribution in the study area (Refer to **Figure 11.1 in Volume 3**).

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<sup>4</sup> Flora (Protection) Order, S.I. No. 356 of 2015

Habitats present were classified in accordance with Fossitt<sup>5</sup>, and also having regard to Heritage Council<sup>6</sup>, in order to provide a basis for habitat evaluation. Plant species scientific nomenclature follows Parnell and Curtis<sup>7</sup>, common names follow Scannell and Synnott<sup>8</sup> when common names are not given in Parnell and Curtis.

Habitats are small scale within the urban landscape of the proposed development, and have been subject to change during the course of the baseline studies, so they are described in the text provided, and illustrated by photographs rather than by habitat mapping.

Birds and mammals or mammal signs were also recorded during walk-over surveys.

### 11.2.6.3 Invasive non-native Plant Survey

Walk over surveys were carried out within the study area (Refer to **Figure 11.1 in Volume 3**), in order to check for the presence of invasive non-native plant species listed in Part 1 of the Third Schedule<sup>9</sup>.

Additional species listed as invasive non-native plant species in the NRA Guidelines<sup>10</sup> were also recorded, together with non-native species encountered that can be spread through distribution of plant material.

A handheld mobile mapper was used during field survey to record the location and extent of any invasive species encountered, together with notes on the characteristics of each stand encountered and the associated plant species, as appropriate.

### 11.2.6.4 Bird Surveys

Breeding and non-breeding birds, including wintering waterbird surveys were carried out on the dates listed in Table 11.1. The following areas were surveyed:

- Avoca River upstream of Arklow Bridge
- Avoca Estuary east of Arklow Bridge, including the harbour on the South Quay
- Coastal waters within 1.5 km of the shoreline, and shorelines to the north and south of Arklow Harbour (**Figure 11.3 in Volume 3**)
- Arklow Pond, accessed from Seaview Avenue (**Figure 11.1 in Volume 3**)

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5 Fossitt, Julie A (2000). A Guide to Habitats in Ireland. The Heritage Council.

6 Best Practice Guidance for Habitat Survey and Mapping (Heritage Council, 2011)

7 Parnell, John, and Tom Curtis (2012). Webb's An Irish Flora. Cork University Press

8 Scannell, Mary J.P., and Donal M. Synnott (1987). Census catalogue of the Flora of Ireland. Stationery Office, Dublin.

9 Part 1 of the Third Schedule, European Communities (EC) (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011)

10 Transport Infrastructure Ireland (incorporating the National Roads Authority) Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Road Schemes (Revision 1, December 2010)

Counts were carried out using binoculars and a telescope fitted with a 32X wide angle lens or a 25-60X zoom lens, during a range of tidal conditions including spring tides and neap tides, at high and low water. Waterbirds and sea birds present were identified and counted, and their activity noted (feeding, roosting, bathing and preening).

All bird species observed during flora and habitat surveys (within the study area shown in **Figure 11.1 in Volume 3**) were recorded, together with bird activities indicative of possible, probable, or confirmed breeding.

### 11.2.6.5 Bat Surveys

There are a number of specific areas that were targeted for detailed examination, in addition to a general evaluation of bat activity and presence within the planning boundary and adjacent lands:

- WwTP site: the derelict wallboard factory buildings and site;
- Interceptor sewer working areas on the northern bank upstream of Arklow Bridge (that overlap with the proposed Arklow Flood Relief Scheme);
- The Alps area (below the ruined remains of Arklow Castle, confirmed by NPWS as a pipistrelle roost several years previously), and Avoca River corridor immediately upstream (that also overlap with the proposed Arklow Flood Relief Scheme);
- Trees and existing bat boxes on River Walk upstream of Arklow Bridge;
- Arklow Bridge (overlap with proposed the Arklow Flood Relief Scheme);
- The footprint of the embankment area at the eastern margin of Arklow Town Marsh pNHA included as part of the proposed Arklow Flood Relief Scheme; in order to facilitate assessment of cumulative effects of the proposed development with the proposed Arklow Flood Relief Scheme;
- Avoca River corridor immediately upstream of ‘the Alps’ site (included as part of the footprint for the proposed Arklow Flood Relief Scheme) in order to facilitate assessment of cumulative effects of the proposed development with the proposed Arklow Flood Relief Scheme;
- Avoca River corridor downstream of M11 flyover (included as part of the footprint for the proposed Arklow Flood Relief Scheme) in order to facilitate assessment of cumulative effects of the proposed development with the proposed Arklow Flood Relief Scheme

#### WwTP

The Old Wallboard site at Ferrybank was examined over two consecutive years in 2016 and 2017 for evidence of roosting bats. Surveys were undertaken in daylight for evidence of roosting bats and from prior to sunset for two hours. The site was visually inspected for the presence of bat roost evidence in the buildings on site prior to sunset with the aid of a high-powered beam.

The bat detector assessment commenced prior to dusk (21.30 hours with sunset at 21.53 hours in June 2016 and in 2017, sunset was at 20.33 hours on 23rd August).

Surveying continued for two hours before a pause in surveying and recommencement over one and a half hours before dawn (03.30 hours, sunrise 05.03 hours in 2016 and sunrise at 06.22 hours on 24th August in 2017).

A Song Meter 2 BAT+ (SM2 bat detector) was placed within the site along the edge of the main building for a period of two hours and was then moved at 23.44 hours to the second smaller building closer to the river from this time up to dawn in 2016. In 2017, the SM2 bat detector was again placed on the perimeter of the main building within the site and remained here throughout the survey period. An EM3 and Pettersson D240X were carried for the entire survey and bat activity and species present were noted throughout the site. Additionally, bat activity along the roadway leading to the site was observed and noted.

### **Interceptor sewer routes and other infrastructure**

Bat activity at a number of points along and adjoining the proposed route of the interceptor sewers including Arklow Castle, the Alps, River Walk and the northern bank of the Avoca River close to the Ferrybank roundabout were all assessed in 2016. A further survey period was undertaken on 17 and 19 October 2016. This involved 2 post dusk assessments and 1 pre-dawn survey. On 17 October, there were two areas of assessment; a Cypress treeline at Ferrybank near the northern bank of the Avoca River upstream of Arklow Bridge (this treeline was subsequently felled to facilitate a separate development), and the ruins of Arklow Castle.

The 2016 survey involved the placing of a bat monitor at the side of the ruined castle within the grounds of the Courthouse prior to dusk and monitoring at this location until one hour after sunset (18.24 hours). The trees at Ferrybank were examined from sunset and for 1 hour and 20 minutes for any evidence of bat emergence from these trees. The trees were also examined in daylight for any potential roost cavities or crevices.

Prior to dawn, the area to the rear of Arklow Castle at the Alps was assessed as well as an evaluation of the trees at Ferrybank. During the night, the river was also examined for bat activity between the approach to Arklow Castle and the Cypress trees at Ferrybank.

Surveying was also undertaken in August 2017, a period of the year when many maternity roosts are still intact prior to the autumn disbandment of these gatherings and the formation of lesser mating assemblages and non-breeding groups or individual roosting behaviour. These sites were re-assessed on a number of dates in August including 21, 22, 23, 24 and 28 August up to dawn of 29 August 2017. In addition, the trees and timber bat boxes along River Walk between Arklow the Alps, and Arklow Bridge, were examined in daylight on 22 August 2017 for any evidence of bat activity. A bat detector evaluation of Arklow Bridge was carried out from 21 August to 22 August 2017 (sunset at 20.38 and sunrise at 06.18).

A Schwegler woodcrete bat box at the Arklow Ponds was superficially examined on 23 August 2017 for evidence of bat usage.

Surveying of Arklow Castle was also undertaken in August 2017 and any bat activity around the Castle was sought at dusk and prior to dawn. The family in residence to the rear of the Castle was questioned regarding bat roosts within the Castle and any observations of bats here in recent years.

Surveying included an examination of all areas through which the proposed development passes, from Arklow Castle and the Alps to the WwTP site.

### **Bat survey conditions and constraints**

The survey in June 2016 was carried out on a mild dry night with no wind. There had been rain early in the day but there was no rain at any stage during the night. The Old Wallboard site at Ferrybank is coastal and there is a continuous breeze to the east of the buildings. The remainder of the buildings were sheltered from the breeze. These were ideal conditions for bat activity.

Surveying for bats in late June is a very suitable time to address the summer usage of a site for feeding and commuting and for assessing the use of trees as summer roosts.

The second survey period was a period of mild weather in October 2016 and there was a dry, calm spell that commenced with moderate temperatures and dropping two to three hours after sunset. Bat activity was relatively high especially on 17 October and this is a good representation of the bat fauna in autumn in the survey area. Sunset on 17 October was at 18.24 hours with a temperature of 13 degrees Celsius (°C) and a moderate breeze and dry conditions. Sunset on 19 October 2016 was at 18.20 hours and the temperature at that time was 11 degrees Celsius and cloudy.

The survey in August 2017 was during mild dry weather and bat activity was noted at all periods of the survey. Pre-dawn conditions were cool and dry and bat activity was typically lower during this period. This was a representative survey of the site.

## **11.2.6.6 Aquatic Ecology Surveys**

A desk study was carried out to gather existing information on the aquatic ecology of the study area. This desk study included a review of the NPWS online mapping tool, a review of reports and data held by the NPWS, and a general literature search including Inland Fisheries Ireland reports and publications as described in **Section 11.2.6.1**.

### **Freshwater macroinvertebrate survey**

The macroinvertebrate community of the Avoca River was sampled at six locations on the main channel and at one location on the channel that runs in a south-easterly direction through Arklow Town Marsh (Refer to **Figure 11.2 in Volume 3**) on 26 September 2017. Sweep-samples were taken using a standard pond-net (25cm x 25cm, with 1 mm mesh bag), transferred to a labelled container and preserved in 70% Industrial Methylated Spirits for return to the laboratory for analysis. Basic physico-chemical parameters were recorded at each sample location:

- dissolved oxygen (mg/l and % saturation);
- pH;
- temperature (°C); and
- conductivity (mS/cm).

Also recorded at each sample location were details of the channel morphology and context:

- channel width (m);
- water depth (m);
- discharge;
- siltation;
- water clarity;
- shading;
- filamentous algae;
- slime;
- sewage fungus;
- surrounding land;
- bankside vegetation;
- instream vegetation;
- substratum; and
- other information.

### **Estuarine and marine benthic survey**

#### **Estuarine walkover survey**

A walkover survey was carried out on 25 April 2017 in order to identify the intertidal habitats within the relevant sections of the study area. The survey was carried out at low water spring tide in order to be able to view the greatest expanse of intertidal habitat. The study area included the Avoca River estuary and the coast to the north of the river in the vicinity of the alignment of the proposed outfall (see **Figure 11.2 in Volume 3**).

#### **Otter survey**

The study area was walked and signs of Otter (*Lutra lutra*) activity noted. Such signs included spraints, slides, and footprints. Where notable otter signs were recorded, a location was recorded using a hand-held global positioning system (GPS) receiver to allow mapping.

#### **Benthic survey**

A benthic field survey was carried out on 24 April 2017 using a 0.1m<sup>2</sup> Day grab deployed from the boat M.V. Sharpshooter.

A total of 13 stations were sampled for macroinvertebrate and sediment analysis (granulometry and total organic carbon (TOC)). As outlined in **Figure 11.3 in Volume 3**, three sample stations were situated within the Avoca River Estuary, while the remaining ten were located outside the breakwaters of Arklow Port. Sample stations were located using the Sharpshooter's on-board GPS system, onto which pre-selected sample station locations were loaded.

The 0.1 m<sup>2</sup> Day grab was deployed from an A-frame on the survey boat. Sediment samples were taken as a core into the retrieved sediment, labelled and placed in a cooler box. These were subsequently frozen on return to shore. Macroinvertebrate samples were washed through a 1 mm mesh sieve. The residue was transferred to labelled sample containers and fixed with 10% Formalin before being transported back to the laboratory for processing.

#### *Macroinvertebrate sample analysis*

In the laboratory, macroinvertebrate samples were logged to track the processing. Each freshwater macroinvertebrate sample was washed through a 1mm sieve and the residue transferred to a white tray for sorting. Macroinvertebrates present were removed and separated by major group for identification and enumeration.

Rose Bengal was added to the marine and estuarine macroinvertebrate samples on arrival in the laboratory in order to aid sorting. After 72 hours, samples were transferred to 70% Industrial Methylated Spirits as preservative prior to sorting and identification. Samples were sorted in a white tray, with animals being transferred to labelled containers and preserved with 70% Industrial Methylated Spirits prior to identification.

The species lists produced were checked against the Pan-European Species directory Infrastructure<sup>11</sup>. Identification was carried out using stereoscopic and compound microscopes and appropriate keys.

#### *Sediment sample analysis*

Sediment analysis for granulometry and TOC was carried out by Nautilus, Dublin.

#### *Data analysis*

On completion of estuarine and marine macroinvertebrate and sediment sample analysis, the data were used to describe the benthic environment. R-Statistic was used to carry out data analysis on the macroinvertebrate and sediment data. The following statistical analyses were undertaken:

- **Univariate ecological indices:** On completion of sorting and identification, several ecological univariate ecological indices were calculated to characterise the invertebrate community within the study area. These included Species Richness (number of species), Shannon-Wiener diversity index and Pielou's evenness index.

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<sup>11</sup> PESI (2017) Pan-European Species directories Infrastructure. Accessed through [www.eu-nomen.eu/portal](http://www.eu-nomen.eu/portal) on 2017-05-31.

- **Community structure:** Abundance data were fourth-root transformed to down-weight the importance of the highly abundant species and to give rarer species more importance (Clarke, 1993<sup>12</sup>) and used to calculate a Bray-Curtis similarity matrix. The similarity matrix was then used in cluster analysis to find sample groupings, i.e. samples within a group that are more similar to each other, than they are similar to samples in different groups. Similarity profile routine (SIMPROF) was used to identify significant ( $P < 0.05$ ) groupings and the results were represented graphically on a dendrogram.
- **Sediment:** Sediment data were fourth-root transformed and normalised to equalise variance and standardise contributory importance of each variable. Cluster analysis based on Euclidian distances was used to find sample groupings, i.e. samples within a group that are more similar to each other, than they are similar to samples in different groups. Similarity profile routine (SIMPROF) was used to identify significant ( $P < 0.05$ ) groupings and the results were represented graphically on a dendrogram.

## 11.2.7 Impact Assessment Methodology

Likely significant direct and indirect effects are assessed during both the construction and operation of the proposed development.

Consideration has been given to the presence of European sites, habitats and species protected under the Habitats Directive, species listed in Annex IV of the Habitats Directive, and sites and species protected under the Birds Directive. The occurrence of mobile species listed as Qualifying Interests for European sites protected under the Habitats Directive ex situ in the zone of influence of the proposed development, has been considered. The sensitivity of individual species to individual construction and operational phase activities has been considered.

Individual assessments of direct and indirect effects on biodiversity, plants, animals, and habitats include reference to the qualitative and quantitative methodologies and guidance listed in **Section 11.2.2**. The description of likely significant effects follows Table 3.3 of the draft EPA guidance<sup>13</sup>.

## 11.3 Baseline Conditions

### 11.3.1 Overview of the Area

The Avoca River drains a primarily upland catchment of some 650km<sup>2</sup>, and enters the Irish Sea at Arklow via a short riverine estuary that is largely contained by existing sea and harbour walls. The Avoca River is formed by the joining of the Avonmore and Avonbeg rivers.

The Avonmore River flows from Lough Dan, just west of Roundwood, and flows in a generally south-easterly direction for approximately 30 km before meeting the Avonbeg River (which rises near Table Mountain at the top of Glenmalure valley), just north of the village of Avoca, and becomes the Avoca River.

<sup>12</sup> Clarke, K.R. (1993) Non-parametric multivariate analyses of changes in community structure. *Australian Journal of Ecology* 18: 117-143.

<sup>13</sup> EPA (2017) Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports

Closer to Arklow, the Aughrim River and the Avoca River flow through steeply sloping wooded valleys, and join at Woodenbridge.

The Avoca River flows through lower ground from Shelton Abbey towards Arklow, and forms a west - east corridor through the town. Tidal influence in the Avoca River extends upstream of Arklow Bridge and to the west of 'the Alps'. Gravel banks in the Avoca River channel and estuary, both upstream and immediately downstream of Arklow Bridge, become exposed at low tide.

The largest area of exposure of gravel banks occurs during low water spring tides. Waterbirds use these areas, and are discussed further in **Section 11.3.4**.

There is a coastal north - south corridor of sand dunes habitats, interspersed with rocky headlands, along the coast of Wicklow and Wexford (Refer to **Figures 11.4 in Volume 3**). In the Arklow area, this coastal corridor is modified by recreational, commercial and industrial land uses on both sides of the Avoca estuary and Arklow Harbour. To the south of Arklow, there is a narrow strip of modified sand dune habitat, including a golf course, between Arklow Head and the south harbour wall. To the north of Arklow Harbour, part of an area of sandhills was reclaimed in the Ferrybank area during the 19<sup>th</sup> Century for commercial and industrial uses, while lands in the vicinity of Arklow Pond and to the north remain relatively natural although modified by residential, commercial and recreational land uses.

### 11.3.1.1 Protected areas: European Sites

The proposed development does not lie within or adjoining any European sites.

European sites located along the Wicklow and Wexford coasts within 15km of the proposed development, and more distant hydrologically linked European sites, are shown in **Figure 11.4 in Volume 3** and summarised in Table 11.2.

Screening for Appropriate Assessment has identified that part of the European site Buckronev – Brittas Dunes and Fen SAC (Site Code 000729) lies within the Zone of Influence of the proposed development. Since mitigation is provided under the precautionary principle to ensure that no adverse effects (slight, moderate or significant) arise to the European site Buckronev – Brittas Dunes and Fen SAC (Site Code 000729), A Natura Impact Statement (NIS) has been prepared in respect of the proposed development.

Table 11.2: Qualifying Interests of SACs and Special Conservation Interests of SPAs located within 15km, and more distant hydrologically linked sites

European site	Distance from proposed development	Qualifying Interests * indicates a priority habitat under the Habitats Directive
Buckronev – Brittas Dunes and Fen SAC (Site Code 000729)	Coastal site 4.5km to the north at its closest point	Annual vegetation of drift lines [1210]
		Perennial vegetation of stony banks [1220]
		Mediterranean salt meadows ( <i>Juncetalia maritimi</i> ) [1410]
		Embryonic shifting dunes [2110]
		Shifting dunes along the shoreline with <i>Ammophila arenaria</i> (white dunes) [2120]
		Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]*
		Atlantic decalcified fixed dunes ( <i>Calluno-Ulicetea</i> ) [2150]*
		Dunes with <i>Salix repens</i> ssp. <i>argentea</i> ( <i>Salicion arenariae</i> ) [2170]
		Humid dune slacks [2190]
Alkaline fens [7230]		
Kilpatrick Sandhills SAC (Site Code 001742)	Coastal site 6.5km to the south at its closest point	Annual vegetation of drift lines [1210]
		Embryonic shifting dunes [2110]
		Shifting dunes along the shoreline with <i>Ammophila arenaria</i> (white dunes) [2120]
		Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]*
		Atlantic decalcified fixed dunes ( <i>Calluno-Ulicetea</i> ) [2150]*
Magharabeg Dunes SAC (Site Code 001766)	Coastal site partly within 15km of the proposed development	Annual vegetation of drift lines [1210]
		Embryonic shifting dunes [2110]
		Shifting dunes along the shoreline with <i>Ammophila arenaria</i> (white dunes) [2120]
		Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]*
		Atlantic decalcified fixed dunes ( <i>Calluno-Ulicetea</i> ) [2150]*
		Petrifying springs with tufa formation ( <i>Cratoneurion</i> ) [7220]*
Wicklow Reef SAC (Site Code 002274)	Marine site located c. 20km to the north	Reefs [1170]
Blackwater Bank SAC (Site Code 002953)	Marine site located c. 30km to the south	Sandbanks which are slightly covered by sea water all the time [1110]

European site	Distance from proposed development	Qualifying Interests * indicates a priority habitat under the Habitats Directive
Wicklow Mountains SAC (Site Code 002122)	Upland site located some 25 to 30km upstream, including some of the headwaters of the Avoca River	Oligotrophic waters containing very few minerals of sandy plains ( <i>Littorelletalia uniflorae</i> ) [3110]
		Natural dystrophic lakes and ponds [3160]
		Northern Atlantic wet heaths with <i>Erica tetralix</i> [4010]
		European dry heaths [4030]
		Alpine and Boreal heaths [4060]
		Calaminarian grasslands of the <i>Violetalia calaminariae</i> [6130]
		Species-rich <i>Nardus</i> grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [6230]*
		Blanket bogs (* if active bog) [7130]
		Siliceous scree of the montane to snow levels ( <i>Androsacetalia alpinae</i> and <i>Galeopsietalia ladani</i> ) [8110]
		Calcareous rocky slopes with chasmophytic vegetation [8210]
		Siliceous rocky slopes with chasmophytic vegetation [8220]
		Old sessile oak woods with <i>Ilex</i> and <i>Blechnum</i> in the British Isles [91A0]
Lutra lutra (Otter) [1355]		
Vale of Clara (Rathdrum Wood) SAC (Site Code 000733)	Located 15km or more upstream of Arklow	Old sessile oak woods with <i>Ilex</i> and <i>Blechnum</i> in the British Isles [91A0]
		Special Conservation Interest
Wicklow Mountains SPA (Site Code 004040)	Upland site located some 25 to 30km upstream	Merlin ( <i>Falco columbarius</i> ) [A098]
		Peregrine ( <i>Falco peregrinus</i> ) [A103]

### 11.3.1.2 Protected Areas: Proposed Natural Heritage Areas

Upstream of Arklow, the Aughrim River and the Avoca River flow through steeply sloping wooded valleys, and join at Woodenbridge. The valley sides, with both coniferous and deciduous woodlands, are included within Avoca River Valley pNHA (Site Code 001748). The best examples of deciduous woodland occur in the Shelton Abbey area, and are dominated by Oak *Quercus petraea*. Parts of the river corridors are included in the pNHA area (Refer to **Figure 11.5 in Volume 3**).

The proposed development does encroach on parts of Arklow Town Marsh pNHA (Site Code 001931), along the south and north banks of the Avoca River upstream of Arklow Bridge (Refer to **Figure 11.6 in Volume 3**). Arklow Town Marsh pNHA includes the Avoca River channel upstream of Arklow Bridge, and the wetland habitats that extend northwards from the bank of the river (Refer to **Figure 11.6 in Volume 3**). Arklow Town Marsh pNHA covers an area of approximately 0.84 km<sup>2</sup>, including the adjoining river channel. Arklow Town Marsh was included in the Wicklow Wetlands Survey in 2012<sup>14</sup>, and assigned the evaluation National Conservation Value.

Arklow Town Marsh has been surveyed more recently as part of the baseline studies for the proposed Arklow Flood Relief Scheme in June 2017 by the lead ecologist for that project (Richard Nairn - Natura Consultants). Habitats recorded in the two surveys referenced are as follows:

- Reed and large sedge swamp FS1;
- Tall herb swamp FS2;
- Marsh GM1;
- Depositing/lowland rivers FW2;
- Drainage Ditches FW4;
- Wet willow-alder-ash woodland WN6;
- Treelines WL1;
- Scrub WS1;
- Oak-Birch-Holly woodland WN1;
- Wet grassland GS4; and
- Dry meadow and grassy verges GS2.

The NPWS site synopses for Avoca River Valley and Arklow Town Marsh pNHAs are reproduced in **Appendix 11.1**. It should be noted that these site descriptions were drafted in 1995, at which time industrial air pollution was problematic in the Arklow area.

Arklow Sand Dunes pNHA (Site Code 001746) lies along the coast to the north of the proposed development (Refer to **Figure 11.5 in Volume 3**), the site synopsis is reproduced in **Appendix 11.1**. Arklow Rock-Askintinny pNHA (Site Code 001745) lies to the south of Arklow at Arklow Head.

### 11.3.1.3 Natural Heritage and Biodiversity Objectives

The proposed development lies within the boundary of the Arklow and Environs Local Area Plan 2018 – 2024 (Arklow LAP). The plan includes the following natural heritage objectives:

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14 Wilson, F., Crushell, P. Curtis, T. & Foss, P.J. (2012). The County Wicklow Wetland Survey II. Report prepared for Wicklow County Council and The Heritage Council.