September 2018

UISCE ÉIREANN : IRISH WATER

Arklow Wastewater Treatment Plant Project

Environmental Impact Assessment Report

Volume 2: Main text (Book 3 of 3)

Contents

Book 1 of 3

Book 2 of 3

Book 3 of 3

Glossary and Abbreviations

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	'Cultural Heritage' where used generically, is an over-arching term applied to describe any combination of archaeological, architectural and cultural heritage features. 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.
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
GDSDS	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_2	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.

14 Land and Soils

14.1 Introduction

This chapter describes the likely significant effects of the proposed development on land and soils (i.e. soils, geology and hydrogeology).

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 land and soils assessment:

- Design:
  - Design features of the Alps SWO and stormwater storage, interceptor sewers, WwTP, revetment and outfalls (long sea outfall and SWO at the WwTP site) will all have to take into account the particular ground conditions, groundwater regimes and the properties of the underlying soils and groundwaters to ensure that these do not have any deleterious effects.
- Operation:
  - Subsoils, bedrock and groundwater will not have any impact upon the proposed development once operational.
- Construction:
  - Excavations both above and below the water table will require special consideration in terms of both the stability of the excavations and the logistics behind facilitating the works, i.e. dewatering. Additionally, the presence of contaminated soils and groundwater add further complexity to the construction of the proposed development. Finally, the construction of the revetment upgrade, long sea outfall and SWO at the WwTP will need to take into account the surrounding environment in terms of works along the coast and upon the seabed.

14.2 Assessment Methodology

14.2.1 General

The following section outlines the legislation and guidelines considered, and the adopted methodology for preparing this chapter and undertaking the land and soils assessment.

14.2.2 Guidance and Legislation

This assessment has been undertaken with due regard to the overarching EIA guidance (described in **Section 1.4.3 of Chapter 1**) and Institute of Geologists Ireland (IGI) guidance[1].

The following legislation is particularly relevant to the management of groundwater:

- The EU Water Framework Directive (WFD), 2000/60/EC;
- The Groundwater Directive, 2006/118/EC;
- European Communities (Water Policy) Regulations 2014 (S.I. No. 350 of 2014);
- European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010), as amended by the European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2011 (S.I. No. 389 of 2011) and the European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2012 (S.I. No. 149 of 2012) and the European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (S.I. NO. 366 of 2016);
- European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009) as amended by the European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2012 (S.I. No. 327 of 2012);
- European Communities Environmental Objectives (Surface Water) (Amendment) Regulations 2015 (SI No. 386 of 2015);
- European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003) as amended by the European Communities (Water Policy) (Amendment) Regulations, 2005 (S.I. No. 413 of 2005);
- European Communities (Water Policy) (Amendment) Regulations, 2008 (S.I. No. 219 of 2008);
- European Communities (Water Policy) (Amendment) Regulations, 2010 (S.I. No. 93 of 2010);
- European Communities (Drinking Water) Regulations 2014 (S.I. No 350 of 2014);
- European Communities (Quality of Salmonid Waters) Regulations 1988 (SI no. 293 of 1988); and
- Water Services Acts (2007 – 2017).

[1] Institute of Geologists of Ireland (IGI 2013). Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impact Statements.

14.2.3 Study Area

The study area for the land and soils assessment extends to areas within 2km of the planning boundary. For this assessment, the project is divided into four sections:

- Alps Storm Water Overflow (SWO) and stormwater storage tank;
- Interceptor sewers (including northern, southern and river crossing);
- WwTP and revetment; and
- Long sea outfall and SWO at WwTP.

14.2.4 Site Visits

A number of site visits to the study area were conducted in 2016 during the development of the Conceptual Site Model (CSM). Site walkovers and intrusive site investigation surveys were conducted where access was possible at this time. Site specific details were recorded and included logging of subsoil types, vegetation indicators, springs, drainage details and general trafficability of soils.

Where access was granted to proposed feature locations, subsoil deposits and selected exposures / sections were logged according to the standard[2].

The site was visited on 11 August 2017 in advance of the offshore site investigation. During this site visit, a walkover of the WwTP site and the revetment was carried out.

Arup carried out a site walkover of the WwTP site on 18 October 2017 to:

- Identify potential sources of contamination; and
- Inform the design of a geo-environmental site investigation.

In addition, between January and March 2018 the site was visited regularly to monitor the progress of the ground investigation at the WwTP site. Site walkovers were carried out at various stages, particularly during the site investigation works.

14.2.5 Consultation

Arup consulted with Wicklow County Council on 9 October 2017 in relation to information they may hold on their public register. In addition, Arup met with Wicklow County Council on the WwTP site on 18 October 2018 to carry out the site walkover and discuss any information that they may have in relation to the site history.

On 28 May 2018 Arup held a telephone conversation with the Environmental Protection Agency (EPA) in relation to the assessment of the radiological materials on the site.

[2] British Standard Institute (2015) BS 5930: 2015 - Code of Practice for Ground Investigations

On 19 June 2018 Arup held a telephone conversation with Wicklow County Council in relation to general queries on the need for a Discharge Licence under Section 4 of the Local Government (Water Pollution) Act 1977 during the construction of the proposed development.

14.2.6 Categorisation of the Baseline Environment

As part of the desk study that was undertaken to establish the baseline conditions (i.e. soils, geological and hydrogeological environment), the following sources of information were reviewed:

- An Foras Talúntais (1978). Ireland: Peatland Map. An Foras Talúntais, Dublin;
- Bing Maps (2018). Aerial photography[3];
- British Geological Survey (BGS) (2018). Offshore Bedrock Map, 1:250,000[4];
- Department of Communications, Climate Action and the Environment (2018). INFOMAR Seabed Mapping[5];
- Department of Communications, Energy and Natural Resources (2011). State Mining and Prospecting Facilities[6];
- Environment Protection Agency (EPA) (2018). EPA Maps, Corine Land Cover 2012[7];
- EPA (2018). EPA Maps, Water, Water Framework Directive[8];
- EPA (2018). EPA Maps, Environment and Wellbeing, Clean Water and Health[9];
- EPA (2018). Office of Licencing and Permitting[10].
- Google Maps (2018). Aerial photography[11];
- Geological Survey of Ireland (GSI) (2018). Geological maps of the site area produced by the Geological Survey of Ireland[12] including;
    - Quaternary Maps (GSI);
    - Bedrock Mapping;
    - National Landslide Database (GSI);
    - Karst Database (GSI);

[3] Available at: https://www.bing.com/maps, Accessed 18-07-2018
[4] Available at: http://www.maremap.ac.uk/view/search/searchMaps.html, Accessed 18-07-18.
[5] Available at: https://jetstream.gsi.ie/iwdds/delivery/INFOMAR_VIEWER/index.html, Accessed 18-07-18
[6] Available at: http://www.mineralsireland.ie/files/Competition_Booklet_May2011_web.pdf, Accessed 18-07-18
[7] Available at: https://gis.epa.ie/EPAMaps, Accessed 18-07-18
[8] Available from: https://gis.epa.ie/EPAMaps/, Accessed 18-07-18
[9] Available from: https://gis.epa.ie/EPAMaps/, Accessed 18-07-18
[10] Available at: http://www.epa.ie/licensing/, Accessed 18-07-18
[11] Available at: https://www.google.ie/maps, Accessed 18-07-2018
[12] Available at: http://map.geohive.ie/mapviewer.html, Accessed 18-07-2018

- Historic Mine Sites - Inventory and Risk Classification;
- GSI (2014). Directory of Active Quarries, Pits and Mines in Ireland. 4th Ed[12];
- GSI (2003). Wicklow GWB: Summary of Initial Characterisation. Groundwater Bodies[13];
- National Parks and Wildlife Service (2018). Proposed / Designated NHA, SPA, SAC Sites[14];
- Ordnance Survey of Ireland (OSI) (2017). Current and historical Ordnance Survey (OS) maps (1837-1842 and 1888-1913) available for the study area at 1:2,500 and 1: 10,560 scales[15];
- OSI (2017). Aerial photography (1995, 2000, 2005)[15];
- Tietzsch-Tyler, D. & Sleeman, A. G. (1994). Geology of Carlow-Wexford 1: 100,000 scale Bedrock Geology Map Series, Sheet 19: GSI.
- Teagasc and the Environmental Protection Agency (EPA) (2017). Irish Soil Information System[16];
- UK Hydrographic Office, Admiralty Chart, 1978, Arklow to the Skerries Islands, 1:100,000, Sheet 1468, Admiralty Charts, UK.
- Water Framework Directive (WFD) Ireland (2018). Water Maps[17];
- Wicklow County Council (2018). Planning Departments of Local Authorities, (Section 261, Pits and Quarries Planning and Development Act 2000)[18];

Historic Ground Investigations

Ground investigation data from previous projects within the study area including:

- Geotech Specialists Limited on behalf of Wicklow County Council (2009). Arklow Water Supply Scheme Contract 5 – Site Investigation for Lamberton Distribution Mains, Report No. KD8096;
- Geotech Specialists Limited on behalf of Wicklow County Council (2011). Arklow Water Supply Scheme Contract 5 – Ground Investigation for Bridgewater Section, Report No. KD8096B;
- Glover Site Investigations on behalf of Arklow Urban District Council (1996). Arklow Main Drainage Contract 2 – Marine Site Investigations - dated November 1996;

[13] Available at: https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/understanding-ireland-groundwater/Pages/Groundwater-bodies.aspx, Accessed 18-07-18
[14] Available at: http://webgis.npws.ie/npwsviewer/, Accessed 18-07-18
[15] Available at: http://map.geohive.ie/mapviewer.html, Accessed 18-07-2018
[16] Available at: http://gis.teagasc.ie/soils/index.php, Accessed September 2017
[17] Available at: http://watermaps.wfdireland.ie/NsShare_Web/Viewer.aspx?Site=NsShare&ReloadKey=True, Accessed 18-07-18
[18] Available at: https://www.wicklow.ie/Portals/0/Documents/Planning/Quarry-Registration/Quarry-Register/Registered%20Quarries%202004.pdf, Accessed 18-07-18

- Glover Site Investigations on behalf of Arklow Urban District Council (1997). Arklow Main Drainage Contract 2 – Marine Site Investigations Additional Works - dated May 1997;
- RPS Environmental (2005). Soil and Groundwater Investigation Report, Ferrybank, Arklow;
- RPS (2006). Geotechnical Interpretative Report, Ferrybank, Arklow.
- Tobin's Engineering (2005). SI Report, IFI Tank Farm Site, Arklow;
- Whiteford Geoservices Ltd on behalf of Arklow Town Council (2005). Arklow Main Drainage Scheme Southside Interceptor Sewers – Site Investigation Works, Report No. 454/05 - dated December 2005;
- Whiteford Geoservices Ltd on behalf of Arklow Town Council (2007) Additional Ground Investigation Works – North Quay, Arklow, Wicklow, Report No. 623/07 - dated May 2007;
- Geotech Specialists Limited on behalf of Wicklow County Council (2009) Arklow Water Supply Scheme Contract 5 – Site Investigation for Lamberton Distribution Mains, Report No. KD8096 - dated December 2009;
- Geotech Specialists Limited on behalf of Wicklow County Council (2011) Arklow Water Supply Scheme Contract 5 – Ground Investigation for Bridgewater Section, Report No. KD8096B - dated November 2011;
- Whiteford Geoservices Ltd on behalf of Arklow Town Council (2010) Arklow Main Drainage Scheme – Site Investigation Works, Report No. 775/08 - dated May 2010;
- Whiteford Geoservices Ltd on behalf of Wicklow County Council (2013) Arklow Sewerage Scheme Contract 6 Section 2", Report No. 1337-12 - dated September 2013.

A single ground investigation report held by the Geological Survey of Ireland (GSI) for the study area was sourced as follows:

- GSI (2006). Arklow Dock, Report No. 6924.

Project Specific Ground Investigations

As outlined in **Section 14.2.4**, three preliminary ground investigations were commissioned for the proposed development:

- A geotechnical ground investigation covering the area of the Alps SWO and stormwater storage tank and the interceptor sewers undertaken between August and November 2016 (Refer to **Appendix 14.8**);
- An offshore ground investigation within a 100m buffer of the footprint of the outfall that was undertaken between August and November 2017 (Refer to **Appendix 14.3**); and
- A geo-environmental investigation for the WwTP site that was undertaken in January and February 2018 which included a radiological survey of the site (Refer to **Appendix 14.5**).

14.2.7 Impact Assessment

The likely significant effects have been assessed by classifying the importance of the relevant attributes and quantifying the magnitude of any likely significant effects on these attributes. It should be noted that for the purpose of this assessment, likely significant effects and potential impacts are used interchangeably as this assessment has been undertaken drawn on the NRA guidelines[21].

This assessment has been undertaken in accordance with the EC Commission Guidance on the preparation of an EIAR[19] and the draft EPA guidelines on the preparation of an EIAR[20], along with the IGI guidance[1] which outlines a 13 step methodology that is divided across four distinct elements:

- Initial Assessment;
- Direct and Indirect Site Investigation;
- Mitigation Measures, Residual Impacts and Final Impact Assessment; and
- Completion of the Soils, Geological and Hydrogeological Sections of the EIAR.

Initial Assessment

The 'Initial Assessment' presents a description of the past and present uses of the land across the study area which may have a bearing on the proposed development. This includes a detailed description of the nature of the ground conditions within the planning boundary based on existing literature as well as site specific and neighbouring site investigation data.

Direct and Indirect Site Investigation

Sections 14.3.2 to 14.3.4 and **Section 14.3.9** provide discussion on the data available from the site-specific ground investigations (GI) carried out in relation to the proposed development. This, along with other sections from within **Sections 14.3.6 and 14.3.7** look at the regional setting. The information gathered on the baseline environment during ground investigations corresponds to the second element of the methodology, 'Direct and Indirect Site Investigation and Studies'.

Mitigation Measures, Residual Impacts and Final Impact Assessment

The outcome from examining this available data is a Conceptual Site Model (CSM). The CSM is a summary of geological conditions beneath the proposed development that considers the likely significant effects of the proposed development.

[19] European Commission (2017) Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report
[20] EPA (2017) Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft August 2017);

Based on the derived CSM the area across the study area is classified as generally a Type B environment (Naturally dynamic hydrogeological environments e.g. groundwater discharge areas, areas underlain by regionally important aquifers, nearby spring rises, areas underlain by permeable subsoils).

A 'Feature Importance ranking' is then assigned to each feature (likely to be affected by the proposed development based on guidance from the National Roads Authority (NRA)[21] and IGI[1].

This facilitates the assessment of likely significant effects which has been undertaken in accordance with the guidance outlined in **Section 14.2.2**.

Section 14.5 outlines the 'Mitigation Measures and Monitoring' associated with the works in accordance with the above methodology.

Completion of the Soils, Geological and Hydrogeological Sections of the EIAR

This section has been prepared iteratively whilst undertaking the first three elements. Upon finalisation of the preceding steps, this information has been documented accordingly (i.e. as part of this chapter) which corresponds to the final element of the methodology 'Completion of the Soils, Geological and Hydrogeological Sections of the EIAR'.

In parallel with the EIAR process, the site has been assessed following the EPA guidance[22]. While this document outlines the approach which should be adopted in order to assess contamination present on a licensed site, it is widely accepted as best practice for the assessment of contaminated sites in advance of redevelopment. The Preliminary Site Assessment (PSA)[23] and Detailed Site Assessment (DSA)[24] required under this methodology are all included in **Appendix 14.1 and 14.2**.

[21] Note- The NRA merged with the Railway Procurement Agency (RPA) to become Transport Infrastructure Ireland (TII) in 2015. The NRA tables presented in Tables C2 to C6 of the IGI (2013) document can be found in Box 4.1, Box 4.3, Box 5.1, Box 5.3 and Box 5.4 of the NRA (2008) document available on the TII website.
NRA (2008). Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes. Available at: http://www.tii.ie/technical-services/environment/planning/Guidelines-on-Procedures-for-Assessment-and-Treatment-of-Geology-Hydrology-and-Hydrogeology-for-National-Road-Schemes.pdf [Accessed 6 August 2018]

[22] EPA (2013). Guidance on the management of Contaminated Land and Groundwater at EPA licensed sites. ISBN: 978-1-84095-511-8. Available at: https://www.epa.ie/pubs/advice/waste/contaminatedland/contaminatedland/Guidance_on_the_Management_of_Contaminated_Land_and_Groundwater_at_EPA_Licensed_Sites_FINAL.pdf

[23] Arup (2018). Arklow Waste Water Treatment Plant, Preliminary Site Assessment. 247825_PSA_31-07-2017

[24] Arup (2018). Arklow Waste Water Treatment Plant, Detailed Site Assessment for the Wastewater Treatment Plant. 247825-00_13-03-2018-DSA

14.3 Baseline Conditions

14.3.1 Introduction

As noted in **Section 14.2.7**, the existing soils, geology and hydrogeology in the study area have been interpreted from both desk study information and from project-specific site investigations. The current baseline would represent the 'Do Nothing Scenario' as required under the EC Guidance[19]. A conservative approach would be to assume no major changes to the baseline condition of the site over time.

14.3.2 SWO, Stormwater Storage Tank and Interceptor Sewers

14.3.2.1 Non-intrusive Investigations

Non-intrusive investigations such as geophysics were not carried out for the Alps SWO and Stormwater Storage Tank, Interceptor Sewers (including the river crossing).

14.3.2.2 Intrusive Investigation

Following the completion of the route selection process (Refer to **Appendix 3.2)**, ground investigation works were undertaken in August to November 2017 in order to further refine the CSM. The findings of this investigation are included in **Appendix 14.3**.

These works comprised of 18 cable percussion boreholes, seven of which are north of the river mouth moving east into the Irish Sea and are dealt with in the next section. The remaining 11 boreholes were completed within the study area for the SWO and stormwater tank, interceptor sewers and river crossing. The following physical works were undertaken in relation to this study area:

- 9 cable percussion boreholes to depths of between 6.5 and 12.90m BGL
- 2 cable percussion boreholes with follow-on rotary boreholes to depths of 25m BGL
- Recovery of soil, rock and groundwater samples for laboratory and contamination testing

The findings of this report are consistent with the findings of the previous ground investigations cited in **Section 14.2.6**.

14.3.3 WwTP site and Revetment

14.3.3.1 Non-Intrusive Investigations

A geophysical investigation was initially carried out by Minerex Geophysics Limited in March 2016[25] with subsequent surveys carried out by Murphy Surveys in 2016[26] and 2018[27] across the WwTP site (Refer to **Appendix 14.4**). These surveys were carried out to direct the intrusive investigation that would follow, investigate the presence of any anomalies and investigate the nature of the subsoils beyond the site boundary. The detailed methodology for undertaking this geophysical investigation is provided in **Appendix 14.4**. The geophysical investigation included:

- 2D-Resistivity – 2 D Resistivity imaging uses an array of electrodes to measure the variation in resistivity in the soils both along the survey line and with depth;
- Seismic refraction (p-wave) – seismic refraction measures the variation of velocities within the ground due to differing densities of soils; and
- Multichannel analysis of surface wave (MASW) (s-wave) – which is a method of seismic surveys which measures the stiffness of soils.

The 2D-resistivity survey covered the full length of the eastern and western sections of the WwTP site to provide information on bulk resistivity to highlight any anomalies. Two smaller seismic refraction and MASW surveys were carried out in the north-west and south-east of the WwTP site to provide information on the depth and extent of the made ground.

The information gathered during the desk study highlighted areas where materials with low levels of naturally occurring radioactivity were located. This material originated from when Arklow Gypsum Ltd was operational on the WwTP site. This material is derived from apatite, a naturally occurring material which was processed to produce phosphogypsum, a by-product generated during the production of phosphate fertilizers, that is known to contain naturally occurring radioactive material. In order to confirm the presence of this material and the level of radioactivity across the site, a non-intrusive radiological survey was carried out.

14.3.3.2 Intrusive Investigation

An intrusive ground investigation was carried out by Causeway Geotech Ltd. (Causeway) in January and February 2018 (Refer to **Appendix 14.5**). The detailed methodology for undertaking this investigation is provided in **Appendix 14.5**.

[25] Minerex Geophysics Limited (2016). Geophysical Survey. Site at Ferrybank, Arklow, County Wicklow. MGX File Ref: 6049d-005.doc
[26] Murphy Surveys (2016). Arklow SS Topo Survey. Drawing Nos. MSL15547-T_0 scale 1:1000 @ A1 and MSL15547-T_1 to MSL15547-T_4 scale 1:250 @A1.
[27] Murphy Surveys (2018). Survey Old Wallboard Factory Site North Quay Arklow. Drawing No. MSL24433_T_Rev1_0 to MSL24433_T_Rev1_4, Scale 1:250 @A1 and Drawing No. MSL24433_KP, MSL24433_XS_01 to MSL24433_XS_03, Scale 1:500 @A1.

Prior to the commencement of the ground investigation, all trial pit and borehole locations were checked for the presence of underground services by using Cable Avoidance Tool (CAT).

23 boreholes were drilled using cable percussion to a minimum of 1m into the clay layer above the bedrock to prove the full thickness of the sand and gravel aquifer which was a depth of approximately 20m Below Ground Level (mBGL).

Three of the boreholes were progressed further by rotary coring methods. These boreholes extended up to 26.5mBGL using rotary core follow-on to collect approximately 5m of bedrock core.

All boreholes were completed with groundwater monitoring installations monitoring the sand and gravel aquifer beneath the site. The boreholes that were drilled into bedrock were backfilled with bentonite clay to a point above the base of the sands and gravels. This bentonite clay prevented the formation of a pathway between the made ground and the aquifers beneath the WwTP site.

Three of the boreholes were completed with an additional narrow monitoring pipe installed in the made ground alongside the standpipe monitoring groundwater in the sand and gravel. These were installed to monitor potential landfill gas migrating from a historical landfill to the north-west of the site.

29 trial pits were excavated with a tracked excavator as part of the investigation. Logging of material was carried out in accordance with the relevant standard[28]. The depth of the trial pits ranged from a minimum depth of 0.8mBGL to a maximum depth of 3.10mBGL.

As part of the investigation, small, disturbed soil samples were retrieved at every 1m depth interval and from every change of strata during trial pitting and borehole drilling.

All soil samples from trial pits and boreholes were screened using a photo ionisation detector (PID) which tests on site for volatile organic carbons. A subset of the samples was sent to an accredited analytical laboratory and further tested for the analytical suites of contaminants highlighted in Table 2 of the Arklow Waste Water Treatment Plant Preliminary Site Assessment (PSA)[23] presented in **Appendix 14.1**. The subset of samples selected for further testing was based on the PID readings and visual and olfactory observations. Only those samples that were considered to be the most contaminated from each trial pit were sent for testing, along with the top samples recovered from the natural ground.

Following the completion of the site investigation, monitoring was carried out comprising:

- Continuous monitoring of water levels in all groundwater boreholes for three months using level loggers;
- Three occasions of groundwater level monitoring in all boreholes;

[28] British Standards (2015). Code of practice for ground investigations. BS5930:2015. 4th Ed. ISBN: 978 0 580 80062 7

- Three occasions of groundwater quality sampling and surface water quality sampling in a subset of the boreholes at high tide and low tide;
- Three occasions of gas monitoring to obtain data over a range of climatic conditions; and
- Laboratory analysis of water samples.

The groundwater, surface water and ground gas monitoring locations are presented on **Figure 14.10 in Volume 3**.

Following the intrusive investigations, all locations were surveyed relative to Ordnance Datum.

Following development of all wells, falling and rising head tests were carried out in five boreholes across the site to assess the permeability of the aquifer.

14.3.4 Long Sea Outfall and SWO at the WwTP

14.3.4.1 Non-Intrusive Investigations

An offshore geophysical survey was carried out by Apex Geoservices[29] between 6 and 16 March 2017 (Refer to **Appendix 14.6**). The detailed methodology for undertaking this investigation is provided in **Appendix 14.6**. This included the following investigation methods over an area of 75ha up to 1.5km offshore:

- Underwater Multichannel Analysis of Surface Waves (UMASW) to determine shear wave velocities in sediments which reflect the relative densities of the sediments;
- Sub bottom profiler single channel seismic reflection which can be used to identify the likely bedrock surface beneath the sea-bed; and
- Seismic Refraction surveys which allow an assessment of the condition of the bedrock.

The outfall study area is generally characterised by unconsolidated sediments over glacial till of variable thickness overlying undulating bedrock.

14.3.4.2 Intrusive Investigation

An offshore preliminary ground investigation was carried out by Causeway during 29 August - 11 November 2017 (Refer to **Appendix 14.3**). The works were affected by Storm Ophelia at this time resulting in the extended programme. The detailed methodology for undertaking this investigation is provided in **Appendix 14.3**.

[29] Apex Geoservices (2017). Report on the Geophysical Investigation for the Marine Outfall Pipeline, Arklow Waste Water Treatment Plant for Byrne Looby Arup. AGL16077_01

This investigation consisted of undertaking 18 boreholes, 11 of which were within the Avoca River and relate to the Alps SWO and stormwater storage tank and interceptor sewers. The remaining seven boreholes were completed within the study area for the long sea outfall.

These seven boreholes were completed using a combination of light cable percussive methods and rotary follow on drilling techniques to prove bedrock. Three of the boreholes (BH04, BH05 and BH06) were progressed to a depth of 25, 22.5 and 25.2m below seabed respectively without encountering bedrock. The remaining boreholes encountered bedrock between 9.5 to 11.6m below seabed except for BH08 which encountered rock at 23.5m below seabed.

14.3.5 Technical Limitations

The baseline data described and considered in this assessment includes existing data from earlier investigations within the study area and surrounds as well as dedicated field surveys commissioned specifically for the proposed development. The data collected provides a comprehensive dataset in relation to the soils, geology and hydrogeology within the study area.

The baseline data provides valuable information on the existing soils, geology and hydrogeological environment at point locations within the study area. Between each point the baseline data has been assessed by conservative interpretation. While soils, geology and hydrogeology can vary, the exploratory locations have been selected following the completion of the comprehensive baseline data collection. This review was completed by studying local geological maps, aerial photography, historic ground investigation and completing site walkovers to provide an understanding of the study area. The location and the spacing of the exploratory locations used as part of the intrusive investigation was chosen in order to gain an understanding of the soils, geology and hydrogeology beneath the site. The findings from the investigations for the majority of cases compared favourably with the desk study of existing information on the baseline conditions.

14.3.6 Regional Overview

The site of the proposed development, as illustrated in **Figure 1.1 of Volume 3** includes the footprint of terrestrial, riverine and marine lands within the planning boundary. The planning boundary of the proposed development is located in Arklow town, entirely within the administrative boundary of Wicklow County Council. Arklow town is a key hub of economic activity, shopping, education, recreation and administration for south-east Wicklow therefore the site of the proposed development is predominantly urban in character.

The proposed development is concentrated in the waterfront area of Arklow, with the proposed interceptor sewers located along the north and south quays (see **drawing W3136/802 and drawings W3136/700 to W3136/716 in Appendix 14.7** for more details). The proposed WwTP is located at the Old Wallboard site, at Ferrybank. The WwTP site is bounded to the east by Arklow Bay and to the south by the Arklow River, in a prominent location on the waterfront at the mouth of the estuary.

14.3.7 Regional Geomorphology and Topography

Arklow town is located in the catchment of the Avoca River which rises in the Wicklow mountains and flows down to the Irish Sea entering at the 'Harbour Mouth' in Arklow town that lies to the south-east of the proposed WwTP site[3,11].

The topography of the region is dominated by the Wicklow Mountains to the northwest. The topography varies between 800m Ordnance Datum (OD) at Tonelagee to an elevation of almost 0.0mOD in Arklow town. The existing ground level at the southern end of the WwTP site is at approximately 2.60mOD[30].

The landscape principally reflects the erosional and depositional legacy of the last period of glaciation. Glacial erosion of pre-existing topographic features and deposition of thick glacial drift deposits, mainly till (boulder clay) resulted in areas of rather subdued post-glacial topography away from the topographic highs of the Wicklow mountains.

The post-glacial landscape also reflects the effects of fluvial (river) processes that have altered the topography, albeit only to a small extent in this area, since the ice sheet retreat.

The geomorphology of the proposed development is predominantly that of a post glaciation, 'U-shaped' river valley. The ground levels fall along the river by approximately 5m. Ground levels in the bottom of the river valley are generally relatively flat, but can slope up relatively steeply at the valley extents. In addition, the proposed development is crossed locally in places by surrounding roads which appear to have been constructed generally on embankment, presumably to lift them out of the flood plain of the river. On either side of the river, alluvial floodplains are present, which are tens of metres wide in places. As would be expected, the watercourses have a tendency to meander within the flood plains, meaning that there is no consistent location of the watercourse within the valley bed.

A number of buried meltwater channels are located in this area and roughly follow the path of various streams and part of the Avoca River[30].

With reference to the GSI online mapping, the subsoils comprise primarily of made ground, with alluvium and rock outcrops at the western end of the pipeline[30].

The bathymetry of the seabed off the coast of Arklow was noted to vary from 0.0mOD (close to the shoreline) to -11.7mOD at a distance of 900m offshore at BH10. In general, the seabed gradually slopes downwards from the shoreline to the termination point of the proposed long sea outfall[29].

The coastline in the vicinity of the proposed development is characterised by sandy beaches[30].

[30] GSI Groundwater Data Viewer (2018). Available from: http://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 [Accessed 18 July 18]

A bathymetry survey[29] was carried out on the offshore section of the proposed development by Murphy Surveys Limited in August 2017 and compared to the admiralty chart from the UK Hydrographic Chart (sheet 1468)[31].

14.3.8 Regional Soils and Subsoils

The soils within the study area are described in the National Soil Survey (NSS)[32]. The general soil map of Ireland published by the NSS shows the study area to be underlain by urban soils or made ground. Further north and inland outside of the study area there are deposits of Irish Sea Till and Glacial Till derived from Lower Palaeozoic Sandstones and Shales.

The till of the study area principally reflects the depositional process of the last glaciation. Typically, during the ice advance, boulder clays were deposited subglacially as lodgement till over the eroded bedrock surface, whilst moraine granular deposits were laid down at the glacier margins. Subsequently, with the progressive retreat of the ice sheet from the region, granular fluvio-glacial deposits were laid down in places by melt waters discharging from the front of the glacier[30].

Boulder Clay is expected to be encountered across the footprint of the proposed development. Made ground is located extensively across the onshore parts of the study area.

River alluvium deposited from historic flooding events is mapped by the GSI along the banks of the Avoca River and along the Avoca River paleochannel. Beach sands and gravels are shown along the coast within 1km of the WwTP site[30],[33].

The offshore ground conditions are expected to be made up of marine sediments (sands and gravels) c. 4.5m to 12.5m thick, overlying till c. 3.1 to 13m thick on weathered bedrock (Sandstones and Shales), from c. 9.5 to greater than 25.2m below seabed[32].

14.3.9 Regional Bedrock Geology

The 1:100,000 GSI bedrock geology map (Sheet 19) indicates that the site is underlain predominately by the Ordovician Kilmacrea Formation with the exception of the south-east corner which is underlain by the Ordovician Maulin Formation[30]. The regional geology is presented **on Figure 14.3 in Volume 3.**

The Kilmacrea Formation is described by the GSI as buff-weathering, grey and black slates and shale with occasional sandstones. The Maulin Foundation is described as dark blue-grey slates and phyllites.

[31] UK Hydrographic Office (1999). Republic of Ireland – East Coast. Arklow to the Skerries Islands. Scale: 1:100000 at lat 15°30'. Sheet no. 1468. 3rd Ed.
[32] NSS of Ireland (1980) Soil Associations of Ireland and Their Land Use Potential.
[33] GSI Groundwater Data Viewer (2017). Available from: http://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 [Accessed 18-07-18]

The Kilmacrea Formation dips reported in the vicinity of the site vary from 44º east-north-east to 80º south east. In general, the area is shown to comprise the south eastern limb of a large anticline with a north east to south west trending axis approximately 3km to the north west of the site.

A fault is shown trending generally SSW-NNE running beneath the south-east section of the site, separating the two formations.

According to the GSI Groundwater Data Viewer[30], there are no karst features present in close proximity to the site or the surrounding area.

The BGS 1:250,000 offshore map indicates that the area between Ferrybank and the proposed long sea outfall is underlain by Ordovician Slates[4].

14.3.10 Surface Water Bodies

The closest water body is the Avoca River which discharges into the Irish Sea at Ferrybank as described in detail in **Chapter 15**.

14.3.11 Regional Hydrogeology

The GSI has devised a system for classifying the aquifers in Ireland based on the hydrogeological characteristics, size and productivity of the groundwater resource into the National Draft Bedrock Aquifer Map[30],[34]. The three main classifications are: 'Regionally Important Aquifers', 'Locally Important Aquifers' and 'Poor Aquifers'. Each of these three types of aquifer is further subdivided and has a specific range of criteria associated with it such as the transmissivity (m²/day), productivity, yield and the potential for springs. The aquifer designations in the vicinity of the study area are shown on **Figure 14.4 in Volume 3** and a summary is provided below:

- The Kilmacrea and Maulin Formations have been designated by the GSI as a 'Locally Important Aquifer' - Bedrock which is moderately productive only in Local Zones (LI). Locally Important aquifers are dominated by poor yielding boreholes with yields less than 40m^3/d.
- A gravel aquifer which partly underlies the west of the WwTP site and extends west-north-west away from the site is designated by the GSI as a Local sand and gravel (Lg) aquifer. This is described by the GSI as an aquifer with a surface area between 1km^2 and 10km^2 which may supply excellent yields but due to its smaller size the amount of recharge available to meet abstractions can be limited.
- The Kilmacrea and Maulin formations are part of the Ordovician Metasediments within the Wicklow Groundwater Body. The GSI describe the Ordovician Metasediments as one of the better bedrock aquifers within the groundwater body.

[34] GSI Groundwater Data Viewer (2017). Available from: http://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 [Accessed 18-07-18]

- The majority of groundwater flow in the Kilmacrea and Maulin formations takes place mainly in the weathered zone in the upper 3m of the bedrock. The GSI states that deeper groundwater flow can take place in isolated fractures. Pumping tests have been undertaken by the GSI for the Maulin Formation and the Kilmacrea Formation which provided transmissivity values of 30m^2/d to 32m^2/d in these formations. Regional groundwater flow is dominated by the presence of the Avoca River with flow towards this surface water body. To the north of the WwTP site, the groundwater flow is likely to be characterised by the tidal influence of the Irish Sea.

14.3.11.1 Recharge

The average rainfall between 1984 and 2016 in the study area is approximately 79.26mm/yr. The average monthly rainfall values for Arklow that have been measured at Ballyrichard House during 1984 to 2016[35] are summarised in Table 14.1.

Table 14.1: Average Monthly Rainfall (mm) measured at Arklow town during 1984 – 2016[35].

Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1984 - 2016	98	72	62	69	63	68	60	80	68	105	104	101

Recharge is the amount of rainfall that replenishes the aquifer. It is a function of the effective rainfall, the permeability and thickness of the subsoil and the aquifer characteristics. The GSI recharge map for the study area shows that recharge is approximately between 201mm/annum to 250mm/annum[30]. The approximate recharge in the study area is presented on **Figure 14.5 in Volume 3**.

14.3.11.2 Aquifer Vulnerability

Aquifer vulnerability is a measure of the likelihood with which the groundwater could be contaminated by human activity. Aquifer vulnerability depends on the intrinsic geological and hydrogeological characteristics of the aquifer.

Aquifer vulnerability is determined by the thickness and permeability of any overlying deposits. For example, bedrock with a thick, low permeability, clay-rich overburden is less vulnerable than bedrock with a thin, high permeability, gravelly overburden.

Aquifer vulnerability under the site has been classified by the GSI as low (Refer to **Figure 14.6 in Volume 3**). Aquifer vulnerability is relevant to the LI bedrock aquifer. The vulnerability of the Lg gravel aquifer is likely to be highly dependent on the thickness of the overlying soil and the depth to groundwater[30].

[35] Met Éireann, (2018). Climate, Available Data, Historical Data. Available at: https://www.met.ie/climate/available-data/historical-data, Accessed 18-07-18

14.3.11.3 Groundwater Hydrochemistry

Groundwater in the Ordovician bedrock of the Wicklow Groundwater Body that underlies the study area is generally soft to moderately soft (20–80 mg/l $CaCO_3$) and has low electrical conductivity (ranging from 130 to 220 µS/cm)[13].

Within the local area, the quality of the groundwater in the LI bedrock aquifer and the Lg gravel aquifer are considered to be heavily influenced by the Irish Sea, creating a brackish environment that is not potable.

According to the EPA, the Wicklow Groundwater Body was classified as having 'Good' status in conjunction with the WFD between 2010 – 2015 (refer to **Section 15.3 of Chapter 15** for further detail)[8]. The current status of the groundwater body is under review but the Wicklow Groundwater Body is 'at risk of not achieving good status'[17].

14.3.11.4 Sensitive Features

A small number of sensitive features have been identified as they may be dependent on the geology and hydrogeology characteristics including:

- Groundwater abstractions; and
- Groundwater dependent terrestrial ecosystems.

Groundwater abstractions

Based on GSI records[30], nine domestic, agricultural and industrial use groundwater wells are located within the study area. The abstractions identified (refer to Table 14.2) include 14 boreholes drilled to depths between 5.9 - 53.3m below ground level and have yields varying from 0 to 160m^3 per day. The closest abstraction to the WwTP site is used for domestic use only, however the approximate location of this borehole is only known to within 1km. The exact location of this borehole is unknown. The closest borehole with a high level of location accuracy is located approximately 850m south-west of the WwTP site and is used for industrial use.

The source that the groundwater is abstracted from is not stated but it is likely that it abstracts from the sands and gravels (Lg aquifer) and/or bedrock (LI Aquifer) beneath.

Consultation with Wicklow County Council has confirmed that they do not have records of any private groundwater abstractions within the study area.

Table 14.2: Summary of groundwater abstractions within 2km of the site.

Abstraction ID	Depth (mBGL)	Depth to Bedrock (mBGL)	Location Accuracy (m)	Townland	Use	Yield m3/d
3217SWW061	23.8	15.2	20	Ticknock	Unknown	22
3217SWW062	9	7.5	20	Abbeylands	Industrial use	60
3217SWW063	7.4	7.4	20	Abbeylands	Other	10

Abstraction ID	Depth (mBGL)	Depth to Bedrock (mBGL)	Location Accuracy (m)	Townland	Use	Yield m3/d
3217SWW064	5.9	3.5	20	Tinahask Upper	Other	12
3217SWW079	17.9	14.8	20	Seabank	Unknown	0
3217SWW098	36.6	27.4	20	Coolboy	Agri & domestic use	43.6
3217SWW043	61	0	100	Kilbride	Domestic use only	22
3217SWW070	6.1	0	100	Rock Big	Unknown	0
3217SWW006	31.7	9.1	1000	Killiniskyduff	Domestic use only	21.8
3217SWW007	27.4	3.1	1000	Tinahask Lower	Domestic use only	22
3217SWW011	25.9	0	1000	Seabank	Domestic use only	33
3217SWW048	48.7	21.3	1000	Arklow	Industrial use	55
3217SWW052	53.3	12	1000	Arklow	Domestic use only	160
3217SWW053	45.7	3.6	1000	Arklow	Domestic use only	55

The GSI and EPA have delineated certain areas nationwide as Source Protection Areas in order to provide protection for groundwater abstractions and public water supplies. There are no Source Protection Areas located beneath the site or within 2km of the site boundary[10,30] (Refer to **Figure 14.7 in Volume 3**).

In addition, there are no National Federation of Group Water Schemes Zones of Influence within the study area[30].

Groundwater dependent terrestrial ecosystems

The NPWS online database has been consulted to establish whether areas with national or international important ecological sites are located within the vicinity of the study area[14]. **Figure 11.4 in Volume 3** outlines the locations of the nearest Natura 2000 sites.

There are two proposed National Heritage Are (pNHA) sites within 2km of the study area. These are the Arklow Sand Dunes (Ref: 001746) located 1.9km to the north of the site and the Arklow Town Marsh (Ref: 001931) adjacent to the north west of the site.

The Arklow Town Marsh is a wetland area located north of the Avoca estuary north-west of the site. The wetland is noted to have been impacted by its close proximity to Arklow town and the nearby industry.

The Arklow Sand Dunes are a dune system connected to wet woodland located along the coast. Any activities associated with the construction or operation of the proposed development would be too distant to affect this site.

14.3.12 Site Specific Environmental Setting

14.3.12.1 Introduction

This section outlines the site-specific information available for the proposed development. This section describes the findings of the site-specific surveys commissioned for the proposed development as described in **Chapter 4**.

14.3.12.2 Site Walkover Surveys

Storm Water Overflow (SWO) and Stormwater Storage Tank and Interceptor Sewers

A number of site visits of the study area were conducted during the refinement of the Conceptual Site Model (CSM) in 2016.

Site specific details were recorded and included logging of subsoil types, vegetation indicators, springs, drainage details and general trafficability of soils.

Where access was granted to proposed specific scheme feature locations, subsoil deposits and selected exposures / sections were logged according to the British Standard Institute (BSI) BS 5930: 2015 - Code of Practice for Ground Investigations[28].

WwTP and Revetment

Arup carried out a site walkover of the WwTP and revetment site on 18 October 2017. They were assisted by representatives from Wicklow County Council who had useful local knowledge on the history of the site. A visual inspection was undertaken in addition to field notes and a detailed photographic record. The site walkover identified a number of features on the WwTP site of relevance (Refer to **Table 4 and Figure 2 in Appendix 14.1**). Photographs taken during the site walkover are presented in Appendix G of the PSA (Refer to **Appendix 14.1**) which show some of the features of concern that have been highlighted. Further detail on the site walkover is provided in **Section 2.2.9 of Appendix 14.1**).

Outfalls (Long Sea Outfall and SWO at WwTP)

A walkover of the WwTP site and the revetment was carried out in advance of the offshore GI in August 2017. Refer to **Chapter 15** for further information.

14.3.12.3 Topography/Bathymetry

Storm Water Overflow (SWO) and Stormwater Storage Tank

The ground level at the northern end of the site at the Alps (MHS1) rises from +2.166 m AOD to +4.6m AOD at the southern edge of the site.

Interceptor Sewers

Southern section of alignment from MHS1 to TSS3 (Coomie Lane to Harbour Road)

Ground levels through this section are generally level, with a slight fall at a shallow gradient from approximately +2.17m above Ordnance Datum (AOD) to +1.75m AOD, over a length of approximately 1.04km. This section can be broken into the following parts:

- Between MHS1 and MHS9, the ground levels drop from +2.17m AOD to +1.05m AOD over a length of approximately 420m;
- Between MHS9 and TSS1, the pipeline is within the river channel. The river bed levels drop from -0.30m AOD to -0.62m AOD over a length of approximately 260m, before rising again to +0.50m at manhole TSS1; and
- Between TSS1 and MHS16, the ground levels rise from +1.30m AOD to +1.75m AOD over a length of approximately 320m.

Central section of alignment from TSS3 to TSN8 (Harbour Road to Mill Road)

- The pipeline runs under the Avoca River from TSS3 to TSN6, with a channel bed level of approximately -4.5m AOD. Channel depth ~ 4.5m
- Ground level varies from c. 2.00m AOD to 1.80m AOD between TSN6 and TSN8, over a length of approximately 160m.

Northern section of the alignment from MHN1 to TSN7 (west of Bridge Street, Ferrybank to Mill Road):

As described above this section passes from west of Bridge Street, runs down the eastern bank of the Avoca River to the Marina at Mill Road. Levels through this section are as follows:

- MHN1 to TSN1 (~45m length in marsh land): rising from approximately +0.89AOD m to +1.60m AOD;
- TSN1 (Bridge Street) to MHN2A (Bridgewater Section) (~30m length): approximately +1.60m AOD to +3.06m AOD;
- MHN2A (Bridgewater) to TSN4 (end of North Quay) (~445m length): approximately +3.06m to +2.12m AOD; and
- TSN4 to TSN7 (Marina section (~200m length)) varies between +2.12 and +1.62 AOD.

WwTP and Revetment

According to the topographic survey carried out by Minerex[25] (Refer to **Appendix 14.4**), the WwTP site is predominately flat and largely covered with asphalt /concrete or derelict buildings. The ground level generally varies between approximately +1.5mOD to +2.5mOD apart from the area in the northern part of the WwTP site where the ground level is up to approximately +3.7mOD.

The topographic survey carried out by Murphy's Surveys (Refer to **Appendix 14.3**) shows that the top of the existing revetment varied between c. 4.42mOD in the south of the WwTP site to c. 6.25mOD in the north of the WwTP site. The revetment is steeper on its eastern side.

Outfalls

Long Sea Outfall

According to the bathymetry survey[29] (Refer to **Appendix 14.3**), the existing ground level at the landside end of the outfall is at approximately 2.60mOD. The seabed level varies from 0mOD (close to the shore) to -11.7mOD at the seaward end of the outfall. Generally, the ground is consistently and gradually sloping away from the shore as previously noted in **Section 14.3.7**.

SWO at WwTP

According to the bathymetry survey[29] (Refer to **Appendix 14.3**), the existing ground level on the landward side of the outfall is approximately 2.60mOD. The seabed level was noted as being -2.73mOD at the toe of the revetment (discharge point for SWO).

14.3.12.4 Site History/Man Made Features

Storm Water Overflow (SWO) and Stormwater Storage Tank

A summary of the site history is outlined in Table 14.3. From the historical maps[15], this land has remained vacant from 1837 until the present day.

Table 14.3: Summary of the relevant information presented on historical maps from 1837 - 2005[15]

Source	Date	Land use at the site	Land use in the vicinity of the site
Map from OSI Web Viewer	1837-1842	Open land adjacent to minor road	North: Avoca River East: Post Office on Main Street South: Castle (In ruins) West: Lane
Map from OSI Web Viewer	1888-1913	No Change	North: Avoca River East: Court House South: Castle (In ruins) West: Lane
Map from OSI Web Viewer	1995	No Change	North: Avoca River East: Court House South: Residential/Commercial Units West: Lane
Map from OSI Web Viewer	2000	No change	North: Avoca River East: Court House South: Castle (In ruins) West: Lane

Source	Date	Land use at the site	Land use in the vicinity of the site
Map from OSI Web Viewer	2005	No change	North: Avoca River East: Court House South: Residential/Commercial Units West: Lane

Interceptor Sewers

A summary of the sewer alignment history on the southern side of the Avoca River is outlined in Table 14.4.

Table 14.4: Summary of the relevant information presented on historical maps from 1838-2005 for the southern Interceptor Sewer

Source	Date	Land use at the site	Land use in the vicinity of the site
Between MHS1 and MHS9			
Map from OSI Web Viewer (Appendix A)	1837-1842	Open Land adjacent to river	North: Avoca River East: Avoca River/Arklow Bridge South: Residential/ commercial Units/ Grave Yard West: Open land
Map from OSI Web Viewer (Appendix A)	1888-1913	Open Land adjacent to river	North: Avoca River East: Avoca River/Arklow Bridge South: Residential/commercial Units/ Grave Yard (disused)/Gas Works West: Open land
Maps from OSI Web Viewer (Appendix A)	1995-2005	River Lane/River Walk	North: Avoca River East: Avoca River/Arklow Bridge South: Residential/commercial West: Open land
Between MHS9 and TSS1			
Map from OSI Web Viewer (Appendix A)	1837-1913	In river channel	North: Avoca River East: Avoca River South: Residential/commercial West: Residential/commercial
Map from OSI Web Viewer (Appendix A)	1995-2005	In river channel adjacent to Sourth Quay Wall	North: Avoca River East: Avoca River South: Residential/Commercial West: Residential/commercial
Between TSS1 and TSS3			
Map from OSI Web Viewer (Appendix A)	1837-1842	Open Land adjacent to river	North: Avoca River East: Avoca River South: Open Land West: Open Land

Source	Date	Land use at the site	Land use in the vicinity of the site
Map from OSI Web Viewer (Appendix A)	1888-1913	No Change	North: Avoca River East: Avoca River South: Boatbuilding Yard West: Open Land
Map from OSI Web Viewer (Appendix A)	1995-2005	South Quay Wall	North: Avoca River East: Avoca River South: Residential/Commercial/Industrial West: Open Land

Northern Interceptor Sewer

A summary of the site history along the route of the northern interceptor sewer is outlined in Table 14.5.

Table 14.5: Summary of the relevant information presented on historical maps from 1838-2005 for the northern Interceptor Sewer

Source	Date	Land use at the site	Land use in the vicinity of the site
MHN1 to TSN1			
Map from OSI Web Viewer (Appendix A)	1837-1842	Marsh Land	North: Grave Yard East: Open Land South: Avoca River West: Marsh
Map from OSI Web Viewer (Appendix A)	1888-1913	Marsh Land	North: Marsh Land/Residential Properties East: Masonic Hall South: Avoca River West: Marsh
Maps from OSI Web Viewer (Appendix A)	1995-2000	No change	North: Marsh/Residential Properties East: Residential South: Avoca River West: Marsh
Maps from OSI Web Viewer (Appendix A)	2005	No change	North: Marsh/Residential Properties East: Bridgewater Shopping Centre South: Avoca River West: Marsh
MHN2A to TSN4 (end of North Quay) (~445m length)			
Map from OSI Web Viewer (Appendix A)	1837-1842	Islands/Land at the edge of the Avoca River	North: Grave Yard East: Open Land South: Avoca River West: Marsh
Map from OSI Web Viewer (Appendix A)	1888-1913	Reclaimed Land at the edge of Avoca River	North: Open Land East: Open Land/Inlet South: Avoca River West: Avoca River

Source	Date	Land use at the site	Land use in the vicinity of the site
Maps from OSI Web Viewer (Appendix A)	1995-2000	North Quay	North: Residential/ Commercial Units/ Sports Field East: Marina/Industrial Land South: Avoca River West: Avoca River
Maps from OSI Web Viewer (Appendix A)	2005	No change	North: Bridgewater Shopping Centre/ Sports Field East: Marina/Industrial Land South: Avoca River West: Avoca River
TSN4 to TSN7 (Marina section) (~200m length))			
Map from OSI Web Viewer (Appendix A)	1837-1842	Islands/Land at the edge of the Avoca River	North and East: Open Land South and West: Avoca River
Map from OSI Web Viewer (Appendix A)	1888-1913	Dam/Reclaimed Land at the edge of the Avoca River	North: Open Land East: Kynock Factory and Chemical Works South: Avoca River West: Inlet and Avoca River
Maps from OSI Web Viewer (Appendix A)	1995-2005	Marina	North: Sports Field/Industrial East: Several long buildings which fit within the foot print of the site belonging to the Wallboard Factory South: Avoca River West: Avoca River

River Crossing

The central section of alignment, i.e. the river crossing runs from TSS3 to TSN8 (Harbour Road to Mill Road). A summary of the site history from TSN6 to TSN8 is outlined in Table 14.6 as there is no historic data from TSS3 to TSN6.

Table 14.6: Summary of the relevant information presented on historical maps from 1838-2005 for the river crossing[15]

Source	Date	Land use at the site	Land use in the vicinity of the site
Map from OSI Web Viewer (Appendix A)	1837-1842	Islands at the Estuary of the Avoca River	North: Open land East: Irish Sea South: Avoca River West: Avoca River
Map from OSI Web Viewer (Appendix A)	1888-1913	Open land which appears to have been reclaimed	North: Open land East: Kynock Factory and Chemical Works South: Avoca River West: Salvage Store, 2 slips, dam

Source	Date	Land use at the site	Land use in the vicinity of the site
Maps from OSI Web Viewer (Appendix A)	1995-2005	Road	North: Sports field East: Several long buildings which fit within the foot print of the site belonging to the Wallboard Factory South: Avoca River West: Marina, Boatyard

WwTP and Revetment

The site history is discussed in detail in Section 2.2 of the PSA (**Appendix 14.1**) with historical maps and photographs shown in Appendix A and Appendix B respectively within **Appendix 14.1.**

The WwTP site is located on land reclaimed from the Avoca River estuary. Once this land was reclaimed, Arklow Chemical Works (Limited) founded by Wicklow Copper Mine Company were established on the WwTP site. The chemical factory was purchased by Kynoch in 1895 and the Kynoch Explosives Factory was established at this location. The Kynoch Explosives Factory was an ammunitions factory that produced explosives including nitroglycerine, guncotton, picric acid and cordite. During this time, the operations associated with the chemical works continued to produce sulphuric acid required to produce cordite by pyrite burning.

The Kynoch Explosives Factory was subsequently sold in 1919 and most of the buildings were demolished at that time. The sea has reclaimed some of the site.

The site remained derelict until Arklow Gypsum Ltd plant was established in 1971. Arklow Gypsum Ltd plant was a subsidiary of NET, later known as Irish Fertilizer Industry (IFI). One of the by-products of phosphoric acid production in NET was the production of gypsum and Arklow Gypsum Ltd. was set up to use the gypsum produced in the manufacture of fertilizer to make plasterboard. IFI also stored Heavy Fuel Oil, Sodium Hydroxide and Nitric acid in tanks west of the Arklow Gypsum Ltd. site on the site known as the Foudi Site.

Anecdotal evidence from local residents suggests the following:

- All unwanted material from the Arklow Gypsum Ltd plant was dumped in the northern part of the WwTP site which is currently fenced off. There is a risk that this material is slightly radioactive;
- Guncotton is present in the ground throughout the WwTP site;
- A low-lying area in the north-western part of the WwTP site was likely to have been used as a dump for various types of materials from the Kynoch Explosives Factory. A diversion from the train tracks accessing this area can be seen on the historical map from 1910.

Long Sea Outfall and SWO at WwTP

From review of the aerial imagery[3,11],, rock armour was noted along the interface of the land and marine environment. Refer to **Chapter 15** for further details.

There is an underwater cable associated with Arklow Bank Wind Park within the vicinity of the offshore section of the proposed development.

The wayleave of the cable from the Wind Park and the offshore section of the proposed development do not intersect (Refer to **Figure 14.8 in Volume 3**).

14.3.12.5 Potential Sources of Contamination

Alps SWO and Stormwater Tank and Interceptor Sewers

At the Alps SWO and Stormwater Tank site and along the alignment of the interceptor sewers, no contaminated ground was found by previous site investigations. Contaminated ground was, however, found at a site to the east of Manholes TSN6 and TSN7.

At the request of Foudi Limited, an environmental assessment was completed by Tobin Consulting Engineers in December 2005[36] in relation to a planning application for a proposed residential development site on the North Quay of Arklow Harbour (See Appendix D in **Appendix 14.1**).

The site had an industrial use previously as the IFI Tank Farm, storing heavy fuel oil, nitric acid and sodium hydroxide.

Site works were completed on 14 October 2004. The works comprised 10 window sampler holes to depths of 2.0m – 3.0mBGL, with piezometers installed in 3 No. of these holes.

An asbestos survey was undertaken on the same day due to the uncertain nature of lagging around tanks and pipework within the site. The lagging was determined to be rockwool. However, it was noted that the buildings were predominately roofed with single skin asbestos cement sheeting with gutters and down-pipes made of asbestos cement, as well as asbestos vinyl floor tiles in one building.

Made Ground comprising gravels with red brick, glass and slag was encountered in 7 No. of these holes to depths of up to 2.5m.

Laboratory testing was carried out to determine the contaminant potential due to previous land use. This analysis does not suggest the natural soil has been impacted by this use. However, the Made Ground does have contaminant potential due to elevated levels of heavy metals and polycyclic aromatic hydrocarbons. The report concluded the most appropriate manner for dealing with this is to allow the Made Ground to remain in situ as no basement was proposed as part of the development.

WwTP and Revetment

According to Wicklow County Council, a former unlicensed town landfill is present (approximately 300m north-west of the WwTP site) that closed before 1977. The former landfill extended from the Bridgewater Shopping Centre in the west to the running track (located to the north of Mill Road) to the east.

[36] Tobin Consulting Engineers (2005). Site Investigation Programme for Foundi Limited, c/o ID Partnership Ireland Ltd. At IFI Tank Farm, Arklow, County Wicklow.

Much of the former landfill was removed during the construction of the commercial properties on North Quay. However, the running track area is understood to be still underlain by the former landfill.

Based on a site investigation of the neighbouring site the landfill extends beneath Mill Road and under the western extent of the Eirgas site next to Mill Road.

Other sources of historic contamination in the immediate vicinity of the WwTP site include the following:

- An incident in one of the tanks on the adjacent Foudi site, a former IFI tank farm, which allegedly led to hydrocarbon spillage into the ground;
- An explosion on the tank farm which led to the release of various contaminants.

Long Sea Outfall and SWO at WwTP

Three locations within Arklow Bay were identified as Dumping at Sea (DaS) sites (Refer to **Figure 14.7 in Volume 3**). These DaS sites have been used for the disposal of local dredge material.

The Clean Water and Health database available from the EPA[9] states that there is no WwTP for Arklow town and at present, there is untreated wastewater being discharged into the Avoca River. As discussed in detail in **Section 15.3 of Chapter 15**, the most recent water quality status report[37] showed the following:

- The overall WFD status of the Avoca River within the study area was 'Moderate';
- The Avoca Estuary was given 'At risk' status;
- Ecological status for Avoca Estuary was 'Unassigned';
- Chemical surface water status was classed as 'Failing to achieve good status';
- Hydro-morphological status was specified as 'Moderate'; and
- A stretch of the Avoca River within the study area fails the Specific Pollutant Conditions.

The EPA introduced the system of Integrated Pollution and Prevention Control (IPPC) licencing in 1994 to control the emissions, including air, water, waste and noise, from various industrial activities in accordance with the requirement of the Environmental Protection Agency Act 1992, as amended[38]. There are two businesses within Arklow which are subject to Industrial Emissions Directive ('IE') Licences from the EPA (Refer to **Chapter 19** for more information):

- Avoca River Park Limited – located upstream of the proposed development adjacent to the Avoca River; and

[37] EPA (2012). Water Quality in Ireland 2010 – 2012. Available from: http://www.epa.ie/pubs/reports/water/waterqua/wqr20102012/WaterQualityReport.pdf, Accessed: 16/08/2018

[38] Environmental Protection Agency Act (1992). No. 7 of 1992. Available from: http://www.irishstatutebook.ie/eli/1992/act/7/enacted/en/print#sec2, Accessed 16/08/2018

- Sigma-Aldrich Ireland Limited – located on Vale Road adjacent to the M11 flyover and close to the Avoca River.

The Sigma Aldrich facility is also designated as a 'Seveso site', in accordance with Council Directive 2012/18/EU on the control of major-accident hazards involving dangerous substances. This classification as a 'Seveso site' identifies the facility as an industrial establishment where dangerous substances are used or stored in large quantities.

14.3.12.6 Soils

Storm Water Overflow (SWO) and Stormwater Storage Tank

The ground conditions in the study area are available from the Geological Survey of Ireland (GSI) Data Viewer – Teagasc Soils layer[30]. The ground conditions at the Alps SWO and stormwater storage tank vary in terms of its soil, sub-soil and bedrock geology. The following subsoil groups occur along the SWO and stormwater storage tank site:

- AlluvMIN – Alluvial (mineral); and
- Made – Made Ground.

Results of site investigations at the SWO and Stormwater Storage Tank site are summarised in Table 14.7. From the site investigation, it is evident that bedrock is at the surface or near the surface. This is in line with the GSI maps. The main subsoils include Made Ground and Alluvium.

Table 14.7: Summary of SWO and Stormwater Storage Tank Site Investigation results

Lithology	Description	Depth (mBGL)	Thickness (m)
Topsoil		0 – 0.4	0.1 - 0.4
Made Ground (where present)	Soft, brown. Gravelly, sandy clay with fragments of red brick, timber, concrete, glass and ceramics.	0.3-3.2	0.4-2.8
Cohesive Alluvium (where present)	Very soft to soft sandy clay	1.6-2.2	0.6
Sand and gravels	Dense, dark greyish orange, silty, sandy gravel.	2.2->2.4 (base not proven)	>0.2
Shale/Sandstone	Weak dark brown grey, distinctly weathered, highly fractured Shale/sandstone which becomes weak to medium strong, dark grey, moderately to slightly fractured with depth.	0.1->20	1.2- >19.9

Interceptor Sewers

The following subsoil groups occur along the alignment of the proposed interceptor sewers:

- AlluvMIN – Alluvial (mineral);
- Made – Made ground; and
- Rck – Bedrock at or near surface.

Alluvial soils are evident along the course of the Avoca River and its tributaries. Made ground underlies the town of Arklow.

A summary of the length of the proposed development within each subsoil group is outlined in Table 14.8.

Table 14.8: Subsoil Classifications along alignment[30]

Subsoil Group	Length of proposed development within subsoil category (m)	% of proposed development within subsoil category
Alluvium	480	22.6%
Bedrock at or near surface	40	1.9%
Made ground	1,600	75.5%
TOTAL	2,120	100%

Southern Interceptor Sewer

Results of site investigation along the south interceptor sewers have been broken up into three sections and are summarised in Table 14.9. Between MHS1 and MHS9 the top of the bedrock is seen to increase in depth from at surface to undetected at a level of 15mBGL at MHS9. Underlying the made ground, the subsoils are mainly a mixture of medium dense sand and gravels, organic silts and clays and cohesive alluvium. The sands become more prominent towards MHS9 as the alignment gets closer to the Avoca River estuary.

From MHS9 -TSS1, the bedrock is only reached in a borehole near MHS9 at a depth of 17.6mBGL. Underlying the made ground, is mainly a mixture of medium dense sand and gravels and cohesive glacial till. A significant thickness of alluvium was found in a borehole dug in the river bed.

From TSS1 to TSS3, the bedrock was not reached in the site investigations carried out along this section of the alignment. Underlying the made ground, is mainly a mixture of medium dense sand and gravels, dense sand and gravels, and cohesive glacial till.

Table 14.9: Summary of southern Interceptor Sewer Site Investigation results

Lithology	Description	Depth (mBGL)	Thickness (m)
Between MHS1 and MHS9			
Topsoil (where present)		0 – 0.4	0.1 - 0.4
Made Ground (where present)	Made Ground – Varies	0.0-3.2	0.4-2.8
Cohesive Alluvium (where present)	Very soft to soft becoming stiff, gravelly very sandy clay	1.1-10	0.55-4.4
Soft Organic Silt and Clay (where present)	Very soft greyish brown sandy organic silty clay to soft organic clay	1.2-11.8	0.8-5
Sand and Gravels (where present)	Medium dense to dense sand and gravels	1.9->15	>0.2-5.4
Shale/Sandstone (where present)	Weak weathered, highly fractured Shale/sandstone which becomes weak to medium strong, dark grey, moderately to slightly fractured with depth.	0.1->27.8	>1.2- >19.9
Between MHS9 and TSS1			
Topsoil (where present)		0 – 0.2	0.1 - 0.2
Made Ground (where present)	Made Ground – Varies	0-5.8	0.1-5.8
Cohesive Alluvium (where present)	Soft sandy clay	3-10.3	0.4-3.7
Soft Organic Silt and Clay	Soft, dark brown, very peaty silt to soft black organic fine sandy clay	1.9-6.4	0.6-1.3
Sand and gravels (where present)	Medium dense sand and gravels	0.1-11.5	1.6-6.6
Cohesive Glacial Till (Boulder Clay)	Firm becoming stiff brown slightly gravelly, sandy, silty clay	2.3-15.8	1.9-8.2
Sand and Gravels (where present)	Dense sand and gravels	9.6-17.6	1.1-1.8
Sandstone (where present)	Large boulders	17.6-18.2	0.6
Between TSS1 and TSS3			
Topsoil (where present)		0-0.4	0.3-0.4
Made Ground (where present)	Made Ground – Varies	0-3.6	0.35-
Sand and Gravels (where present)	Medium dense sand and gravels	0.25-20.5	1.35-10
Cohesive Glacial Till (Boulder Clay)	Stiff, brown clay to stiff blue grey sandy silty clay	4.7-28	1-6
Sand and Gravels (where present)	Dense sand and gravels	2.7-25	0.2-5.3

Lithology	Description	Depth (mBGL)	Thickness (m)
Cohesive Alluvium (where present)	Soft sandy clay	7.2-10.5	0.4-0.9
Soft Organic Silt and Clay (where present)	Firm, greyish brown, sandy, peaty silt	1.6-2.2	0.8

River Crossing

Results of site investigation along the alignment of the river crossing (TSS3 to TSN8) which includes the river crossing are summarised in Table 14.10. The bedrock was not reached in any of the site investigations carried out in this section, although Amphibolite was found in one borehole at a depth of 18.00 mBGL. Underlying the made ground, both sides of the Avoca river, the subsoils are mainly a mixture of medium dense sand and gravels, dense sand and gravels and cohesive glacial till. Under the river bed, is cohesive glacial till and large depths of medium dense sands and gravels.

Table 14.10: Summary of the river crossing Site Investigation Results

Lithology	Description	Depth (mBGL)	Thickness (m)
Topsoil (where present)		0-0.3	0.3
Made Ground (where present)	Made Ground – Varies	0-3.2	0.35-2.9
Sand and Gravels (where present)	Medium dense sand and gravels	0-20.5	1-10
Cohesive Glacial Till (Boulder Clay)	Soft to very stiff, grey/brown sandy gravelly clay or silt	4.9-11.5	1.1-2.8
Sand and Gravels (where present)	Dense sand and gravels	1.6-25	2.4-5.1
Cohesive Alluvium (where present)	Soft grey slightly sandy silt	10.1-10.5	0.4
Soft Organic Silt and Clay	Soft black slightly gravelly very sandy silt with organic matter	1-2.3	1.3

Northern Interceptor Sewer

Results of site investigation along the northern interceptor sewer (MHN1 to TSN7) are summarised in Table 14.11. The bedrock was not reached in any of the site investigations carried out in this section. Underlying the made ground, the subsoils are mainly a 5m layer of medium dense sand and gravels overlying cohesive glacial tills and dense sand and gravels. A 5m layer of alluvium was found in a borehole adjacent to the river.

Table 14.11: Summary of northern Interceptor Sewer Site Investigation Results

Lithology	Description	Depth (mBGL)	Thickness (m)
Topsoil (where present)		0-0.55	0.1-0.55
Made Ground (where present)	Made Ground – Varies	0-2	0.1-2
Sand and Gravels (where present)	Medium dense sand and gravels	0.55-14.5	1.45-6.9
Cohesive Glacial Till (Boulder Clay)	Soft to firm, greyish brown, slightly sandy, silty clay or stiff brown clay	5.6-15.4	2.7-6.1
Sand and Gravels (where present)	Dense sand and gravels	2.5-23.5	0.9-10.8
Cohesive Alluvium (where present)	Soft sandy Clay	0.5-12.6	0.75-5
Soft Organic Silt and Clay	Soft to firm, brown, peaty silt /soft, brown, organic clay	7.1-10	2.4-2.9

WwTP and Revetment

The site investigations that have been undertaken (Refer to **Section 14.3**) are described in detail in the Detailed Site Assessment (DSA) that has been produced by Arup (Refer to **Appendix 14.2**). Specifically, Section 2.1 of the DSA details the soils identified underneath the WwTP site and revetment.

The soils under the WwTP site and revetment consist of made ground underlain by natural deposits. The made ground is present throughout the site from ground level. Typically, this layer of made ground is thicker (4.4mBGL in BH09) in the north and west where land was reclaimed from the old Avoca River, and thinner in the east and south of the site (0.5mBGL in TP15). The made ground consists of four subgroups:

- **Brown sand and gravel:** This soil group contains bricks and cement, with some occasional asbestos, gun cotton and brick lined chambers. In some locations green, orange and red staining of the soils was noted implying metal contamination.
- **Phosphogypsum deposits:** These deposits have been identified in the fenced area north of the site (TP24, TP25 and TP26) as a white silt. They are generated as a by-product of phosphate production and are mildly radioactive. The ground level in this location is approximately 0.5m to 1m higher than the ground level immediately to the south, indicating that phosphogypsum deposits may have been stockpiled here.
- **Infilled pond:** These deposits have been identified in BH08, BH09, BH11 and TP21 and are thickest in the north of the site in the area of a potential pond feature seen on the historic maps presented in the PSA.

These deposits are thinner towards the north-west and were not identified in the east of the WwTP site.

- **Black sand and gravel:** These deposits are located in the east (BH06A, BH08, TP02, TP06 – TP09, TP18) and west (BH05, BH17, TP05) of the WwTP site. It is anticipated that these deposits may extend across the site underneath the factory building currently in the centre of the WwTP site. This layer is associated with hydrocarbon and chemical odours identified in the trial pits.

The natural strata underlining the made ground consists of:

- **Sand and gravel:** These are likely to be estuarine deposits in the area of the old Avoca River channel to the north and beach deposits in the centre and south of the WwTP site
- **Clay:** This is described as soft to very stiff brownish-grey clay approximately 1m thick that is present across the north and centre of the WwTP site underlying the natural sand and gravel. A deeper clay layer (up to 6.8m thick), is also present across the WwTP site.
  This layer overlies the glacial sand and gravel deposits in the south and bedrock in the north and centre of the WwTP site may act as an aquiclude.
- **Glacial sand and gravel:** These deposits are more angular and less well sorted than the shallower sand and gravel deposits. These deposits are likely to be glacial deposits.

Long Sea Outfall and SWO at WwTP

The ground conditions beneath the offshore study area are summarised in Table 14.12.

Table 14.12: Offshore Ground Conditions

Lithology	Description	Depth (metre below ground level)	Thickness (m)
Sand and Gravel	Medium dense, yellowish-brown, slightly silty, gravelly, fine to coarse Sand. Or Medium dense, brown, sandy, slightly silty, fine to coarse Gravel. Note: Loose sand and gravel occasionally encountered within first 2m of seafloor.	0 – 14.7	4.5 – 14.7
Clay	Stiff, brown, slightly sandy, slightly gravelly, Clay.	4.5 – 14.7	1.9 – 13.0
Sand and Gravel	Dense, brown, slightly silty, gravelly, fine to coarse Sand. Or Dense, brown, sandy, slightly silty, fine to coarse Gravel.	8.3 – 17.5	1.6 – 3.4

Lithology	Description	Depth (metre below ground level)	Thickness (m)
Bedrock	1. Weathered to medium strong Amphibolite (BH05, BH07, BH09); 2. Very weak Breccia (BH07); and 3. Very weak to medium strong Slate (BH07, BH08, BH10)	11.6 – 23.5	Not proven

14.3.12.7 Bedrock Geology

Alps Storm Water Overflow (SWO) and Stormwater Storage Tank

The depth to bedrock will be a key component in determining the impact of the proposed development on the bedrock geology. As noted previously in **Sections 14.3.12.6** and **14.3.12.7**, rock is mapped close to the surface. On the basis of the site investigations, rock outcrops, or close to surface rock, occur at this area.

Interceptor Sewers

From the available SI along the southern alignment of the southern interceptor sewer, depth to bedrock along this alignment varies from rock being close or at the surface at MHS1 to depths increasing to undetectable from MHS10 onwards. Immediately south of MHS9 and Bridge Street, one hole encounters rock at 17.5mBGL. However, most of the holes do not extend to this level. Between Anchor Mews and South Green, a borehole extends to 28mBGL and does not encounter rock.

The bedrock was not reached in any of site investigations carried out along the central alignment (TSS3 to TSN8) and under the river crossing alignment, although the metaphoric rock Amphibolite was found in one borehole at a depth of 18.00 mBGL.

From the available SI for the northern interceptor sewer, none of the exploratory holes, which extended to 10m to 25mBGL, encountered rock.

WwTP and Revetment

The site investigations that have been undertaken (Refer to **Section 14.3**) are described in detail in the Detailed Site Assessment that has been produced by Arup (Refer to **Appendix 14.2**). Specifically, Section 2.1 of the DSA details the geology identified underneath the WwTP site.

Highly weathered sandstone and highly weathered dolerite have been identified in the rotary core follow on boreholes (BH04, BH05 and BH11) between 17.8 to 24m below ground level (-14.66mOD to -22.28mOD).

The weathered bedrock layer overlies medium strong to strong grey massive sandstone bedrock. This is present at 24m below ground level (-22.28mOD) in the north (BH11) and between 20 to 20.9m below ground level (-17.49mOD to -17.76mOD) in the south of the WwTP site (BH04 and BH05 respectively).

The regional geology is presented on **Figure 14.3 in Volume 3**.

Long Sea Outfall and SWO at WwTP

Three metamorphic rock types were identified during the offshore ground investigation;

- Weathered to medium strong Amphibolite (BH05, BH07, BH09);
- Very weak Breccia (BH07); and
- Very weak to medium strong Slate (BH07, BH08, BH10)

The bedrock was encountered between 10 - 28m below seabed.

The Amphibolite encountered was described as weak to medium strong, highly fractured, bluish grey Amphibolite. It was recorded as partially weathered with heavy, orangish-brown stains.

Breccia was encountered in BH07 only and was described as very weak, orange-brown Breccia. It was recorded as partially weathered with orange staining on the fracture surfaces.

The Slate was primarily described as very weak to weak, highly fractured orange-brown Slate that was partially weathered.

14.3.12.8 Karst Features

The karst database available on the GSI Groundwater Data Viewer – Karst Features layer was consulted. No limestone was noted in the area and therefore, no recorded karst features were identified within 1km of the study area[30].

14.3.12.9 Site Hydrogeology

Alps SWO and Stormwater Tank

As a result of the proximity of the proposed SWO and Stormwater tank to the river, the groundwater level will be similar to the river level. The Avoca River is in continuity with the groundwater in the sand and gravels throughout the study area and is likely to be at least partly dependent on water levels in the aquifer.

Interceptor Sewers

As a result of the proximity of the proposed interceptor sewer alignment to the river and sea, the groundwater level will be similar to the river level and sea level. The Avoca River is in continuity with the groundwater in the sand and gravels throughout the study area and is likely to be at least partly dependent on water levels in the aquifer. The sewer alignment closer to the sea is likely to be more influenced by the tidal cycle. During a tidal cycle, the water levels in Arklow Harbour range between 0.2m below groundwater level (in the sand and gravel aquifer at the low tide peak) to 0.3m above groundwater levels (in the aquifer at high tide peak).

WwTP and Revetment

The site investigations that have been undertaken (Refer to **Section 14.3**) are described in detail in the Detailed Site Assessment that has been produced by Arup (Refer to **Appendix 14.2**). Specifically, Section 2.2 of the DSA details the hydrogeology identified underneath the WwTP site.

The made ground and underlying sand and gravel deposits encountered were seen to be water bearing. All boreholes were installed with response zones in the sand and gravel aquifer under the made ground. The results of water level monitoring are summarised below:

- During a tidal cycle, the water levels in Arklow Harbour range between 0.2m below groundwater levels (in the sand and gravel aquifer at the low tide peak) to 0.3m above groundwater levels (in the aquifer at high tide peak).
- At low tide groundwater flows in a west to east-south-east direction toward the Irish Sea with a typical hydraulic gradient of 0.007.
- At high tide groundwater flow direction is changed and flows in a north-north-west to south-east direction with a typical hydraulic gradient of 0.004. This reflects the movement of the sea water into the aquifer as the water level along the coast rises above the water level in the aquifer.

Long Sea Outfall

Soils in relation to the long sea outfall are fully saturated.

14.3.12.10 Radiological Survey

The radiological survey that has been undertaken at the WwTP site (Refer to **Section 14.3**) is described in detail in the Detailed Site Assessment that has been produced by Arup (Refer to **Appendix 14.2**). Specifically, Section 2.3.2 of the DSA details the results of the radiological survey that has been undertaken.

The radiological survey consisted of a walkover survey and intrusive investigation that identified radiation slightly above background levels in the area containing phosphogypsum deposits, at two open pipes to the north of the main factory building and in a discrete location in the south of the WwTP site (TP27).

The survey has concluded that significant radiological contamination at the surface or immediate subsurface was not identified, however in regard to the phosphogypsum deposits in the north of the WwTP site:

"It should be noted that the non-intrusive survey reports on contamination in surface layers only, due to the shielding effect of soil overburden. The absence of contamination at deeper levels (>200mm) and across the whole site cannot be guaranteed."

14.3.12.11 Chemical Test Results

Alps SWO and Stormwater Tank

Given the previous site usage, no significant concerns were expected. Limited sulphate and pH testing was carried out in terms of determining the likely presence of aggressive soils at the locations of the SWO and stormwater tank. Nothing of note was observed.

Interceptor Sewers

Limited sulphate and pH testing was carried out in terms of determining the likely presence of aggressive soils at the locations of the interceptor sewers. Nothing of note was observed. As discussed in **Section 14.3.8.5**, the closest contaminated ground was found at a site to the east of Manholes TSN6 and TSN7.

WwTP and Revetment

The site investigations that have been undertaken are described in detail in the Detailed Site Assessment that has been produced by Arup (Refer to **Appendix 14.2).** Specifically, Section 2.3 of the DSA details the chemical tests results.

The following section presents a summary of the results of the assessment of the soil analysis, water quality and ground gas.

Soil Analysis from the Made Ground

The main findings of the soil analysis of the made ground are as follows:

- Asbestos was confirmed in four of the 87 samples analysed. Asbestos was detected at 0.09% to 4.5% by weight.
- Photo-Ionisation Detector (PID) readings carried out on-site generally recorded low levels of volatile organic carbons above the instrument detection limit which were scheduled for further lab testing; and
- Elevated concentrations of metals were recorded across the WwTP site in the brown sand and gravel. Hydrocarbon compounds were recorded in the black sand and gravel.

Water Quality

The main findings of the water quality analysis are as follows:

- Elevated levels of metal determinands were recorded in all groundwater samples from the sand and gravel aquifer;
- Elevated concentrations of copper were recorded in all groundwater and surface water samples; and
- Elevated concentrations of zinc were recorded in the majority of groundwater and surface water samples.

These elevated concentrations are likely to be associated with sediments from the Avoca mines which were washed down to the estuary of the Avoca River.

Ground Gas

The main findings of the ground gas analysis are as follows:

- There are low concentrations of methane and carbon dioxide present at the WwTP site; and
- Borehole gas flows recorded are low.

Long Sea Outfall

15 sediment samples from the offshore boreholes were compared to the limits defined in the EU Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Council Directive 1999/31/EC on the landfill of waste, referred to as the waste acceptance criteria (WAC). In addition, the samples were compared to the contents of the SEPA, NRW, NIEA and EA Hazardous Waste Classification Tool (version WM3 V1)[39] to determine if the materials were considered hazardous. This comparison was carried out using the HazWaste Online.

14 of the 15 samples were classified as suitable for disposal to a non-hazardous licensed landfill due to concentrations of chloride and Total Dissolved Solids. In 2 of those samples antimony was also detected at concentrations above the limits for an inert licensed landfill. Another sample also contained molybdenum and sulphates above the inert limits as well as elevated total organic carbon.

Soils results were compared to the "Guidelines for the Assessment of Dredge Material for Disposal in Irish Waters" published by the Marine Institute of Ireland. This document sets out two levels of concentrations for heavy metals and hydrocarbons which need to be considered when looking at dumping at sea. It should be noted that we are proposing to excavate these soils and side cast.

The Guidance document refers to the following categories:

- Class 1:
  - Contaminant concentrations less than level 1.
  - Uncontaminated: no biological effects likely.
- Class 2:
  - Contaminant concentrations between level 1 and Level 2.
  - Marginally contaminated;
  - Further sampling & analysis necessary to delineate problem area, if possible.
- Class 3:
  - Heavily contaminated;
  - Very likely to cause biological effects/toxicity to marine organisms.

[39] SEPA, NRW, NIEA and EA (2018). Waste Classification. Guidance on the classification and assessment of waste (1st Ed v1.1), Technical Guidance WM3.

- Alternative management options to be considered.

Table 14.13 summarises the exceedances of the Level 1 criteria from the ground investigation for the long sea outfall.

Table 14.13: Outfall Soil sample results

Location	Depth	Classification	Contaminant
BH04	0.5	Between Level 1 and 2	As (20.6mg/kg, Level 1 Limit 9mg/kg), Cu (88.9mg/kg, Level 1 Limit 40mg/kg)
BH05	0.5	Between Level 1 and 2	As (10.4mg/kg, Level 1 Limit 9mg/kg)
BH07	1.5	Between Level 1 and 2	As (15.9mg/kg, Level 1 Limit 9mg/kg)
BH08	0.5	Between Level 1 and 2	As (10.5mg/kg, Level 1 Limit 9mg/kg)
BH09	2.5	Between Level 1 and 2	As (16.2mg/kg, Level 1 Limit 9mg/kg)
BH10	0.5	Between Level 1 and 2	As (14.9mg/kg, Level 1 Limit 9mg/kg)
BH10	1.5	Between Level 1 and 2	As (14.6mg/kg, Level 1 Limit 9mg/kg), Cd (0.92mg/kg, Level 1 Limit 0.7mg/kg), Ni (38.8mg/kg, Level 1 Limit 21mg/kg)
BH10	2.5	Between Level 1 and 2	As (14.4mg/kg, Level 1 Limit 9mg/kg), Ni (30.5mg/kg, Level 1 Limit, 21mg/kg)

Note that all of the exceedances while above the Level 1 criteria are below the Level 2 criteria from the Marine Institute's Dumping at Sea criteria[40].

The sediments in this case fall within Class 1 (uncontaminated) (7 samples) with the remaining 8 no. samples falling within Class 2, marginally contaminated.

The lower limits for the criteria are defined based on a number of factors.

"Lower level guidance values represent concentrations that are either a) at the upper *end* of the no-effect range or *b) at* background concentrations. *Upper level guidance values are set at the lower end of the known range of effective concentrations i.e. lowest concentrations shown to have adverse effects on marine organisms."*

[40] Cronin, M., McGovern, E., McMahon, T. & R. Boelens (2006). Guidelines for the Assessment of Dredge Material for Disposal in Irish Waters. Marine Institute.

It should be noted that one factor which is relevant to Arsenic (As) only is that included as a footnote to Table 1.2 in the report:

"In some locations natural levels of arsenic will exceed this value (70mg/kg)and in such instances this guidance value will not be appropriate."

While none of our results exceed the upper limit, there is an acknowledgement that naturally occurring elevated arsenic (As) does occur in Irish Waters. Furthermore the lower limits for As and Nickel (Ni) are stated to be based on the "Effects Range Lower" (ERL). This is defined as the concentration that is rarely associated with toxicity for marine and estuarine sediments. This concentration is adopted based on the fact that there is insufficient Irish background data available for these metals.

Taking that into account and noting the consistently elevated concentrations of As, we would propose that these values represent naturally occurring elevated concentrations of As. Similarly Copper (Cu) and Cadmium (Cd) are each present in one location and represent isolated occurrences. Additionally the Cadmium concentration, while above the Level 1 limit (which is based on background concentrations) is still below the ERL (1.2mg/kg) as described above.

On this basis, and considering that only a limited volume of material is proposed for excavation, of which almost half would be classed as uncontaminated, the overall impact from these sediments, where the detected contaminants most likely represent elevated background concentrations, is negligible.

As stated, the environmental testing undertaken indicates that the marine sediments are very slightly contaminated at relatively low levels for some specific parameters.

14.3.13 Conceptual Site Model

14.3.13.1 Introduction

A CSM was developed based on the data obtained during the intrusive investigations i.e. borehole and trial pit logs, geophysical surveys and groundwater monitoring data.

The CSM (Refer to **Figures 14.11A to 14.11F in Volume 3 and Appendix 14.7**) summarises the important geological and hydrogeological features in the study area.

14.3.13.2 Importance of Features

A summary of the geological and hydrogeological features of relevance within the study area is presented in Table 14.14. In addition, the importance ranking of the highlighted feature is established based on the IGI guidance[1].

A proposed Natural Heritage Area is present covering the marsh area to the north-west of Bridge Street (Refer to **Chapter 11** for further information).

Table 14.14: Summary of the geological and hydrogeological features of importance

Feature		Importance ranking	Justification
Aquifer	Arklow gravel aquifer	Medium	This is a high-quality aquifer with a localised extent.
	Locally important bedrock aquifer	Medium	This is a medium quality attribute and is important on a local scale.
SAC's	None noted in the study area	Negligible	None noted in the study area
pNHA	Arklow Marsh	High	Site is a pNHA. See **Chapter 11** for details
Abstractions	None noted in the study area	Negligible	None noted in the study area.
Contaminated land	WwTP site, made ground	High	Extent of contaminated soil is significant on a local scale. The WwTP site has a previous heavy industrial usage.
	Marine sediments at the mouth of the old Avoca River channel.	High	Potentially contaminated river sediment deposited on the sea bed. Extent of contaminated soil is significant on a local scale.
Marine Sediments	Proposed long and outfall and SWO (marine section)	Low	Volume of soft soils underlying the outfalls are low on a local scale
	Mobilisation of sediments into the water column through the outfall construction process.	Low	Attribute has a low-quality significance due to naturally occurring contamination.

14.3.13.3 Environment Type

The geological and hydrogeological environment at and in the vicinity of the study area includes an area of groundwater discharge to surface water and highly permeable soils. Consequently, the geological and hydrogeological environment is considered to be naturally dynamic (type B) as per the IGI guidelines[1].

14.3.13.4 Activities/Environment Matrix

Table 14.15 outlines the required activities that would be undertaken during construction and operation, and the investigations, assessments and surveys that have been carried out to consider those activities.

Table 14.15: Details of proposed works as per the IGI Guidelines[1] and how they were undertaken to support this EIAR

Work Required under Activity and Type Class (based on IGI Guidelines)	Details of works completed to date
Earthworks	
Invasive site works to characterise nature, thickness, and stratification of soils and subsoils	Site specific site investigation carried out across the study area.
Works to determine groundwater level, flow direction and gradient.	Manual and electronic groundwater monitoring and comparison with sea tide levels within the WwTP.
Works to determine groundwater-surface water interaction.	Collection of groundwater and surface water samples for water quality analysis within the WwTP.
Storage/ transmission of leachable and/or hazardous materials	
Establish nature and quantity of leachable materials.	Collection of soil samples. Analysis for quality, including WAC and waste classification screening.
Site works to characterise nature, thickness, permeability and stratification of soils, subsoils, bedrock geology.	Site specific site investigation carried out across the study area.
Works to determine groundwater level, flow direction and gradient.	Manual and electronic groundwater monitoring and comparison with sea tide levels within the WwTP.
Works to determine groundwater-surface water interaction.	Collection of groundwater and surface water samples for water quality analysis within the WwTP.
Lowering of groundwater levels by pumping or drainage	
Establish sustainable yield and proposed daily abstraction rate or drainage system invert level (as appropriate)	Dewatering system designed to accommodate extracted water volume.
Works to determine summer level of the water table. Annual actual recharge and proposed maximum drawdown.	Manual and electronic groundwater monitoring and comparison with sea tide levels within the WwTP.
Works to determine aquifer properties, seasonal variations in water levels, extents of cone of depression or drawdown of surrounding water levels (as appropriate) and alterations in groundwater flow pattern.	Manual and electronic groundwater monitoring and comparison with sea tide levels within the WwTP.
Excavation of materials above the water table	
Site works to characterise nature, thickness, permeability and stratification of soils, subsoils, bedrock geology.	Site specific site investigation carried out across the study area.
Works to determine groundwater level, flow direction and gradient.	Manual and electronic groundwater monitoring and comparison with sea tide levels within the WwTP.
Excavation of materials below the water table	

Work Required under Activity and Type Class (based on IGI Guidelines)	Details of works completed to date
Site works to characterise nature, thickness, permeability and stratification of soils, subsoils, bedrock geology.	Site specific site investigation carried out across the study area.

14.4 Likely Significant Effects

14.4.1 Do Nothing Scenario

14.4.1.1 Alps SWO and Storm Water Storage Tank and Interceptor Sewers

In accordance with EC Guidance[19] and after reviewing the baseline data, the 'do nothing' scenario (i.e. if nothing is done) will result in no effect on the land and soils. Also, this situation is not likely to change over time and the likely significant effect on the land and soils can be considered negligible.

14.4.2 Assessment of Effects during Construction

14.4.2.1 Proposed SWO and Stormwater Tank

The potential impacts of the proposed 'Alps' SWO and Stormwater Tank on the Geological Features identified are listed below and discussed in the following sections thereafter:

- Compression of substrata;
- Loss of grassland/made ground;
- Loss of solid geology;
- Earthworks haulage;
- Impact on surrounding ground.
- Excavation of Soft Soils
- Impact of dewatering
- Impact on Bedrock Aquifer
- Groundwater Level and Flow
- Water Level in the Avoca River
- Pollution from Construction Activities
- Impact on Water Quality

Compression of Substrata

Subsoils are likely to be removed to allow construction of the SWO and Stormwater Tank.

Construction may result in increased loading on the sandstone/shale which could affect the current characteristics of the ground. However, given the general nature of these rocks, the significance of this potential impact is deemed to be Imperceptible.

Loss of Grassland/Made ground

It is expected that much of the topsoil and overburden at the proposed 'Alps' SWO and Stormwater Storage Tank site will be excavated to allow for construction of the proposed works and hardstanding for vehicular access. During the storage and transport of excavated material off-site there is the potential for silt or mud to enter adjacent water courses. Given the relatively small quantity of topsoil and overburden which will be removed, it is not considered to be a resource of any regional significance.

The overburden material will generally be suitable for re-use as an engineered fill for other adjacent development schemes, where they are available and subject to appropriate approvals/notifications. Residual material will need to be removed off-site to a suitable facility. It is also anticipated that all of the excavated topsoil may be reused in landscaping throughout the site where possible. The significance of this potential impact is Imperceptible. See **Chapter 16** for details on resource and waste management.

Loss of Solid Geology

Excavation of rock will be required to construct the proposed SWO and Stormwater Tank. The excavated material may be reused elsewhere on the proposed development if it can be shown to economically fulfil an appropriate engineering specification, such as pipe bedding or capping material.

The quantity of rock which will be removed is small and this is considered to be a small adverse impact. It is also of low importance, and there are readily available alternative sources of similar bedrock available. Therefore, this has been described as having an Imperceptible impact upon the local environment.

Earthworks Haulage

During earthworks, heavily loaded large earthmoving vehicles will travel through the proposed storm water tank and SWO site, causing ground vibrations, unwanted compaction and disturbance of natural ground on unfinished road surfaces. This will also result in increased traffic on the roads to and from the proposed 'Alps' site. Increased noise, dust and vibration will also be generated.

Details in relation to the disposal of these soils is discussed in **Chapter 16**.

These works are expected to have a low importance given that the volume of the material for removal is low on a local scale. The magnitude of the impact of this activity would be small adverse. The significance of the potential impact is Imperceptible.

Impact on Surrounding Ground

Soil and rock excavation has the potential to induce movement and settlement of surrounding ground and the potential to impact on adjacent assets.

The breaking of the bedrock could result in ground vibrations and destabilisation of existing slopes and existing rock slopes, with impacts felt in the immediate vicinity of the works.

These works may also give rise to excessive noise and vibration impacts and may result in the generation of dust.

These works are expected to have a low importance given the soils in question are to be generally removed and the pipe and stormwater tank in question will lie on rock. The magnitude of the impact of this activity would be small adverse. The significance of the potential impact is imperceptible.

Excavation of Soft Soils

Limited soft soils will require excavation and replacement when encountered at the base of excavations for the proposed SWO and storm water tank. These are expected to be localised and minor in extent. Given the relatively small quantity of soils which will be removed, it is considered to be a small adverse impact that does not have any regional significance. The significance of the potential impact is Imperceptible.

Impact of Dewatering

Due to the relatively high-water table in the area (approximately 2m below ground level), dewatering works may be required. However, due to the likely relatively low permeability of the rock, limited pumping of water will be required. Dewatering is considered to be a small adverse impact and the significance of this impact is moderate/slight. Discharge from the dewatering process would be passed to a suitably sized settlement pond or a proprietary silt removal system located within the working area, before discharge to the Avoca River or the local sewer network. Any discharge to either sewer or watercourse would be subject to a discharge licence.

Impact on Bedrock Aquifer

Excavation of shale and sandstone bedrock is required to construct the Alps SWO and stormwater storage tank. This bedrock is classified as a Locally Important Aquifer which has a medium importance. However, due to the nature of the excavation, the magnitude of the impact of this activity would be small adverse. The significance of the potential impact is slight.

Groundwater Level and Flow

Groundwater dewatering using a series of sumps and submersible pumps is proposed during the construction of the SWO and stormwater tank. To reduce the amount of dewatering required at any given time, it is likely that any sewer works will be constructed in sections.

The construction of these works will have a negligible effect on the groundwater levels and flows in the sand and gravels which have a low importance. Hence, the magnitude of the impact of this activity would be negligible and the overall significance rating of the impact of groundwater levels and flow is imperceptible.

Water Level in the Avoca River

The Avoca River is in continuity with the groundwater in the sand and gravels throughout the study area and is likely to be at least partly dependent on water levels in the aquifer.

As limited dewatering is proposed as part of the construction of the SWO and stormwater tank as outlined above, the effect on groundwater levels in the aquifer and river water levels in the Avoca River during construction is negligible. The magnitude of the impact of this activity would be negligible and the overall significance rating of the impact on river water levels and flow is imperceptible.

Pollution from Construction Activities

The construction of the proposed SWO and stormwater tank will require the use of fuels and materials which will have the potential to pollute the site, and adjacent, environment. Good housekeeping will be carried out on the sites during construction, and the proper use, storage and disposal of all substances and their containers will help prevent soil contamination. Pollution from construction activities is considered to be a small adverse impact and the significance of this impact is moderate/slight.

Impact on Water Quality

No planned construction activities have the potential to impact on groundwater or surface water quality. The unplanned activities which may impact upon the groundwater quality beneath the proposed scheme during the construction phase are:

- Accidental spillages of polluting materials onsite;
- Release of fines into the groundwater and surface water; and
- The potential for contaminated runoff to enter the groundwater and surface water.

If any of these occur, they may potentially contaminate the groundwater beneath the proposed development and also impact the groundwater quality at receptors such as the Avoca River. These are potential short-term impacts. The magnitude and significance of these potential impacts on the receptors are summarised below:

- The magnitude of this potential impact on the sand and gravel aquifer could potentially be small adverse leading to a significance rating of slight;
- The magnitude of this potential impact on the River Avoca and the Irish Sea could potentially be small adverse leading to a significance rating of slight.
- The magnitude of this potential impact on the Locally Important aquifer could potentially be small adverse leading to a significance rating of slight.

Summary of Proposed SWO and Stormwater Tank Construction Impacts

Table 14.16 summarises the predicted impacts during this phase of construction.

Table 14.16: Summary of Impacts on Geological Attributes at the Proposed SWO and Stormwater Tank

Feature/	Importance		Magnitude of Impact		Significance of Impact
	Ranking	Justification	Ranking	Justification	
Compression of substrata	Low	Subsoils are likely to be removed. Increased loading on Sandstone/shale only	Small adverse	Removal of soils and replacement with structure and pipeline will not impact on the characteristics of the soils and rock.	Imperceptible
Loss of Grassland/Made ground and Overburden	Low	Small layer of well drained/high fertility soil (topsoil)	Small adverse	Loss of a small proportion of local high fertility soils	Imperceptible
Loss of solid geology	Low	Attribute has a low value on a local scale	Small adverse	Excavation of approx.5.5m of rock Loss of small proportion of future quarry reserves	Imperceptible
Earthworks haulage	Low	Volume of material for removal is low on a local scale	Small adverse	Limited excavation and disposal	Imperceptible
Impacts on surrounding ground	Low	Soils will be removed. Foundations on rock	Small adverse	Movements expected to be minimal due to underlying ground conditions	Imperceptible
Excavation of soft soils	Low	Volume of soft alluvial soil is small	Small adverse	Only a small proportion/if any of soft soils beneath the foundations will require excavation	Imperceptible
Impact of Dewatering	Medium	Volume of water to be pumped is small due to the relatively low permeability of the bedrock	Small adverse	Limited pumping of water required	Slight

Feature/	Importance		Magnitude of Impact		Significance of Impact
	Ranking	Justification	Ranking	Justification	
Impact on Bedrock Aquifer	Medium	Locally important aquifer.	Small adverse	Excavation of small portion of locally important aquifer.	Slight
Impact on groundwater flow and groundwater levels in the aquifer	Low	Groundwater flow may be affected temporarily on a local scale.	Negligible	Pumping of groundwater will not have an impact on groundwater levels or flow.	Imperceptible
Impact on water levels in the Avoca River	Low	Groundwater flow may be affected on a small scale only.	Negligible	Groundwater and other sources will continue feeding the Avoca River.	Imperceptible
Pollution from construction activities	Medium	Potential pollution is low on a local scale	Small adverse	Limited construction traffic and construction activities	Slight

14.4.2.2 Southern Interceptor Sewer (MHS1 to MHS9)

Section 5.6.3 of Chapter 5 describes in detail the construction methodology for the proposed interceptor sewer routes. The construction impacts of the proposed interceptor sewer route on the Geological Attributes identified are listed below:

- Loss of topsoil and overburden;
- Loss of solid geology;
- Excavation of soft mineral soils beneath the route;
- Earthworks haulage;
- Impact on surrounding ground.
- Impact of dewatering; and
- Pollution from Construction Activities.

Loss of Topsoil and Overburden

It is expected that much of the topsoil and overburden from MHS1 to MHS9 will be excavated to allow for construction of the proposed sewer at this location. During the storage and transport of excavated material off-site there is the potential for silt or mud to enter adjacent water courses. Given the relatively small quantity of topsoil and overburden which will be removed, it is not considered to be a resource of any regional significance.

The overburden material will generally be suitable for re-use as an engineered fill for other adjacent development schemes, where they are available and subject to appropriate approvals/notifications. See **Chapter 16** for details on resource and waste management. Residual material will need to be removed off-site to a suitable facility. It is also anticipated that all of the excavated topsoil may be reused in landscaping throughout the site where possible. The significance of this potential impact is Imperceptible.

Loss of solid geology

Excavation of rock will be required to construct the interceptor sewer at the start of the alignment where the rock is shallow. The excavated material may be reused elsewhere on the development if it can be shown to economically fulfil an appropriate engineering specification, such as pipe bedding or capping material.

The quantity of rock which will be removed is small and this is considered to be a small adverse impact. It is also of low importance, and there are readily available alternative sources of similar bedrock available. Therefore, this has been described as having an Imperceptible impact upon the local environment.

Excavation of soft soils beneath the route

Limited soft soils will require excavation and replacement when encountered at the base of excavations for the proposed alignment. These are expected to be localised and minor in extent. Given the relatively small quantity of soils which will be removed, it is considered to be a small adverse impact that does not have any regional significance. The significance of the potential impact is Imperceptible.

Earthworks haulage

During earthworks construction, heavily loaded large earthmoving vehicles will travel to the interceptor sewer, causing ground vibrations, unwanted compaction and disturbance of natural ground on unfinished road surfaces. This will also result in increased traffic on the roads to and from the sewer alignment. Increased noise, dust and vibration will also be generated.

Details in relation to the disposal of these soils is discussed in **Chapter 16.**

These works are expected to have a low importance given the volume of the material for removal is low on a local scale. The magnitude of the impact of this activity would be small adverse. The significance of the potential impact is Imperceptible.

Impact on Surrounding Ground

Soil and rock excavation has the potential to induce movement and settlement of surrounding ground. The breaking of the bedrock could result in ground vibrations and destabilisation of existing slopes and existing rock slopes, with impacts felt in the immediate vicinity of the works.

These works may also give rise to excessive noise and vibration impacts and may result in the generation of dust.

At the start of the alignment these works are expected to have a low importance given the soils in question are generally removed and the pipe in question will lie on rock. The magnitude of the impact of this activity would be small adverse. The significance of the potential impact is imperceptible. From MHS5 to MHS9, the pipe in question will lie on some soft soils. Settlement is likely to be small since the soil (mainly sands to be excavated) will be replaced with fill with similar densities.

Impact of Dewatering

Due to the relatively high-water table in the area (approximately 2m below ground level), dewatering works may be required. To reduce the amount of dewatering required at any given time, it is likely that the contractor would construct the sewer in sections. Due to the nature of the weathered rock groundwater cut off would not be possible using trench boxes and would only be achieved if temporary sheet piles were employed on either side of the trench excavation. Dewatering is considered to be a small adverse impact and the significance of this impact is moderate/slight. Discharge from the dewatering process would be passed to a suitably sized settlement pond or a proprietary silt removal system located within the working area, before discharge to the Avoca River or the local sewer network. Any discharge to either sewer or watercourse would be subject to a discharge licence

Groundwater Level and Flow

Groundwater dewatering using a series of sumps and submersible pumps is proposed during the construction of the sewer. To reduce the amount of dewatering required at any given time, it is likely that the sewer will be constructed in sections.

The construction of the sewer will have a negligible effect on the groundwater levels and flows in the sand and gravels which have a low importance. Hence, the magnitude of the impact of this activity would be negligible and the overall significance rating of the impact on groundwater levels and flow is imperceptible.

Water Level in the Avoca River

The Avoca River is in continuity with the groundwater in the sand and gravels throughout the study area and is likely to be at least partly dependent on groundwater levels in the aquifer for baseflow. As limited dewatering is proposed as part of the construction of the sewer e as outlined above, the effect on groundwater levels in the aquifer and river water levels in the Avoca River during construction is negligible. The magnitude of the impact of this activity would be negligible and the overall significance rating of the impact on river water levels and flow is imperceptible.

Pollution from Construction Activities

The construction of the proposed development will require the use of fuels and materials which will have the potential to pollute the site, and adjacent, environment. Good housekeeping will be carried out on the site during construction, and the proper use, storage and disposal of all substances and their containers will help prevent soil contamination.

Pollution from construction activities is considered to be a small adverse impact and the significance of this impact is moderate/slight.

Impact on Water Quality

No planned construction activities have the potential to impact on groundwater or surface water quality. The unplanned activities which may impact upon the groundwater quality beneath the proposed scheme during the construction phase are:

- Accidental spillages of polluting materials onsite;
- Release of fines into the groundwater and surface water; and
- The potential for contaminated runoff to enter the groundwater and surface water.

If any of these occur, they may potentially contaminate the groundwater beneath the proposed development and also impact the groundwater quality at receptors such as the Avoca River. These are potential short-term impacts. The magnitude and significance of these potential impacts on the receptors are summarised below:

- The magnitude of this potential impact on the sand and gravel aquifer could potentially be small adverse leading to a significance rating of slight;
- The magnitude of this potential impact on the River Avoca and the Irish Sea could potentially be small adverse leading to a significance rating of slight.
- The magnitude of this potential impact on the Locally Important aquifer could potentially be small adverse leading to a significance rating of slight.

Summary of southern Interceptor Sewer (MHS1 to MHS9) Impacts

Table 14.17 summarises the predicted impacts during this phase of construction.

Table 14.17: Summary of Impacts on Geological Attributes at the proposed southern Interceptor Sewer (MHS1 to MHS9)

Feature/	Importance		Magnitude of Impact		Significance of Impact
	Ranking	Justification	Ranking	Justification	
Loss of Topsoil and Overburden	Low	Small layer of well drained/high fertility soil (topsoil)	Small adverse	Loss of a small proportion of local high fertility soils	Imperceptible
Loss of solid geology	Low	Attribute has a low value on a local scale	Small adverse	Excavation of approx. 2m of rock at start of alignment	Imperceptible
Excavation of soft soils	Low	Volume of soft alluvial soil/peat is small	Small adverse	Only a small proportion/if any of soft soils beneath the foundations will	Imperceptible

Feature/	Importance		Magnitude of Impact		Significance of Impact
	Ranking	Justification	Ranking	Justification	
				require excavation	
Earthworks haulage	Low	Volume of material for removal is low on a local scale	Small adverse	Limited excavation and disposal	Imperceptible
Impacts on surrounding ground	Low	Soils will be under a similar loading after construction compared to existing loading	Small adverse	Movements expected to be minimal due to underlying ground conditions	Imperceptible
Impact of dewatering	Medium	Contractor likely to construct sewer in sections. If high volume of water to be pumped, temporary sheet piling to be used	Small adverse	Construction technique will mitigate pumping required	Slight
Impact on groundwater flow and groundwater levels in the aquifer	Low	Groundwater flow may be affected temporarily on a local scale.	Negligible	Pumping of groundwater will not have an impact on groundwater levels or flow.	Imperceptible
Impact on water levels in the Avoca River	Low	Groundwater flow may be affected on a small scale only.	Negligible	Groundwater and other sources will continue feeding the Avoca River.	Imperceptible
Pollution from Construction Activities	Medium	Potential pollution is low on a local scale	Small adverse	Limited construction traffic and construction activities	Slight

14.4.2.3 Southern Interceptor Sewer (Bridge Underpinning)

Section 5.6.3.5 outlines the construction methodology for the Arklow Bridge works. The proposed construction impacts of these underpinning works on the Geological Attributes identified are listed below:

- Infilling of river channel;
- Earthworks haulage;
- Impacts on surrounding ground
- Installing sheet piles
- Impact of dewatering; and

- Pollution from Construction Activities.

Infilling of river channel

To facilitate underpinning of Arklow Bridge, a temporary causeway is required to support construction activities. A small portion of the river channel therefore will be infilled with inert fill and compacted. The temporary causeway will be contained on the river side to mitigate siltation migration into the Avoca River. The two most likely methods to achieve this containment would either be an additional row of sheet piles on the river side of the causeway or alternatively a row of stone gabions wrapped in a geotextile membrane (see **Section 5.6.3 of Chapter 5**). It is possible that fill will be lost through the pile clutches.

Earthworks haulage

During earthworks construction, heavily loaded large earthmoving vehicles will travel to the bridge location, causing ground vibrations, unwanted compaction and disturbance of natural ground on unfinished road surfaces. This will also result in increased traffic on the roads to and from the sewer alignment. Increased noise, dust and vibration will also be generated.

Details in relation to the disposal of these soils are provided in **Chapter 16**.

These works are expected to have a low importance given the volume of the material for infilling is low on a local scale. The magnitude of the impact of this activity would be small adverse. The significance of the potential impact is Imperceptible.

Impacts on surrounding ground

Underpinning and infilling, will induce a larger stress on the existing ground which has the potential to induce movement and settlement of surrounding ground.

These works are expected to have a low importance given the underlying soils which are medium dense and dense sands and gravels. The magnitude of the impact of this activity would be small adverse. The significance of the potential impact is imperceptible.

Installing Sheet Piles

Once the temporary causeway is in place, the sheet pile wall would be formed by vibrating steel sheets into the ground and the sheet piles would be interlocked to provide continuity. Sheet piling could result in ground vibrations and destabilisation of existing slopes with impacts felt in the immediate vicinity of the works.

Impact of Dewatering

To provide groundwater cut off, the temporary sheet piles should extend into the underlying Cohesive Deposits. Once both lines of sheet piles are in place, the excavation would be dewatered. Limited dewatering will be required during construction due to groundwater cut off.

Discharge from the dewatering process would be passed to a suitably sized settlement pond or a proprietary silt removal system located within the working area, before discharge to the Avoca River or the local sewer network. Any discharge to either sewer or watercourse would be subject to a discharge licence

Groundwater Level and Flow

Groundwater dewatering using a series of sumps and submersible pumps is proposed during these works. To reduce the amount of dewatering required at any given time, it is likely that the sewer will be constructed in sections.

The construction of the pipeline will have a negligible effect on the groundwater levels and flows in the sand and gravels which have a low importance. Hence, magnitude of the impact of this activity would be negligible and the overall significance rating of the impact of groundwater levels and flow is imperceptible.

Water Level in the Avoca River

The Avoca River is in continuity with the groundwater in the sand and gravels for throughout the study area and is likely to be at least partly dependent on water levels in the aquifer. As limited dewatering is proposed as part of the construction works as outlined above, the effect on groundwater levels in the aquifer and river water levels in the Avoca River during construction is negligible. The magnitude of the impact of this activity would be negligible and the overall significance rating of the impact on river water levels and flow is imperceptible.

Pollution from Construction Activities

The construction of the proposed development will require the use of fuels and materials which will have the potential to pollute the site, and adjacent, environment. Good housekeeping will be carried out on the sites during construction, and the proper use, storage and disposal of all substances and their containers will help prevent soil contamination. Pollution from construction activities is considered to be a small adverse impact and the significance of this impact moderate/slight.

Summary of southern Interceptor Sewer (Bridge Underpinning) Impacts

Table 14.18 summarises the predicted impacts during this phase of construction.

Table 14.18: Summary of Impacts on Geological Attributes at the proposed southern Interceptor Sewer (Bridge Underpinning)

Feature/	Importance		Magnitude of Impact		Significance of Impact
	Ranking	Justification	Ranking	Justification	
Infilling of river channel	Low	Fill is inert. Escape of fill through pile clutches is likely to be small	Small adverse	Loss of a small proportion of fill through the pile clutches	Imperceptible
Earthworks haulage	Low	Volume of material for infilling is low on a local scale	Small adverse	Limited haulage of fill	Imperceptible

Feature/	Importance		Magnitude of Impact		Significance of Impact
	Ranking	Justification	Ranking	Justification	
Impacts on surrounding ground	Low	Underlying soils are medium dense and dense sand and gravels	Small adverse	Movements expected to be minimal due to underlying ground conditions	Imperceptible
Installing sheet piles	Low	Slopes are shallow and underlying soils are medium dense and dense sand and gravels	Small adverse	Instability unlikely due to underlying soils	Imperceptible
Impact of dewatering	Medium	Temporary sheet piling to be used	Small adverse	Construction technique will mitigate pumping required	Slight
Impact on groundwater flow and groundwater levels in the aquifer	Low	Groundwater flow may be affected temporarily on a local scale.	Negligible	Pumping of groundwater will not have an impact on groundwater levels or flow.	Imperceptible
Impact on water levels in the Avoca River	Low	Groundwater flow may be affected on a small scale only.	Negligible	Groundwater and other sources will continue feeding the Avoca River.	Imperceptible
Pollution from Construction Activities	Medium	Potential pollution is low on a local scale	Small adverse	Limited construction traffic and construction activities	Slight

14.4.2.4 Southern Interceptor Sewer (MHS9 to TSS1)

Section 5.6.3 of Chapter 5 outlines the construction methodology for the interceptor sewer. The proposed construction impacts of the construction of this section of the alignment on the Geological Attributes identified are listed below:

- Infilling of river channel;
- Earthworks haulage;
- Impacts on surrounding ground
- Installing sheet piles
- Impact of dewatering; and
- Pollution from Construction Activities.

Infilling of river channel

To facilitate construction of the interceptor sewer in the river channel, a temporary causeway will be required to support construction activities. A small portion of the river channel therefore will be infilled with inert fill and compacted. The causeway would be contained on the river side to mitigate siltation migration into the Avoca River. The two most likely methods to achieve this containment would either be an additional row of sheet piles on the river side of the causeway or alternatively a row of stone gabions wrapped in a geotextile membrane (see **Section 5.6.3 of Chapter 5**). It is possible that fill will be lost through the pile clutches.

Earthworks haulage

During earthworks construction, heavily loaded large earthmoving vehicles will travel to the interceptor sewer, causing ground vibrations, unwanted compaction and disturbance of natural ground on unfinished road surfaces. This will also result in increased traffic on the roads to and from the sewer alignment. Increased noise, dust and vibration will also be generated.

Details in relation to the disposal of these soils are provided in **Chapter 16**.

These works are expected to have a low importance given the volume of the material for infilling is low on a local scale. The magnitude of the impact of this activity would be small adverse. The significance of the potential impact is Imperceptible.

Impacts on surrounding ground

Infilling, will induce a larger stress on the existing ground which has the potential to induce movement and settlement of surrounding ground.

These works are expected to have a low importance given the underlying soils which are medium dense and dense sands and gravels. The magnitude of the impact of this activity would be small adverse. The significance of the potential impact is imperceptible.

Installing Sheet Piles

Once the temporary causeway is in place, the sheet pile wall would be formed by vibrating steel sheets into the ground and the sheet piles would be interlocked to provide continuity. Sheet piling could result in ground vibrations and destabilisation of existing slopes with impacts felt in the immediate vicinity of the works.

Impact of Dewatering

To provide groundwater cut off, the temporary sheet piles should extend into the underlying Cohesive Deposits. Once both lines of sheet piles are in place, the excavation would be dewatered. Limited dewatering will be required during construction due to groundwater cut off. Discharge from the dewatering process would be passed to a suitably sized settlement pond or a proprietary silt removal system located within the working area, before discharge to the Avoca River or

the local sewer network. Any discharge to either sewer or watercourse would be subject to a discharge licence

Groundwater Level and Flow

Groundwater dewatering using a series of sumps and submersible pumps is proposed during the construction of the sewer. To reduce the amount of dewatering required at any given time, it is likely that the sewer will be constructed in sections.

The construction of the sewer will have a negligible effect on the groundwater levels and flows in the sand and gravels which have a low importance. Hence, the magnitude of the impact of this activity would be negligible and the overall significance rating of the impact on groundwater levels and flow is imperceptible.

Water Level in the Avoca River

The Avoca River is in continuity with the groundwater in the sand and gravels throughout the study area and is likely to be at least partly dependent on water levels in the aquifer. As limited dewatering is proposed as part of the construction of the sewer pipe as outlined above, the effect on groundwater levels in the aquifer and river water levels in the Avoca River during construction is negligible. The magnitude of the impact of this activity would be negligible and the overall significance rating of the impact on river water levels and flow is imperceptible.

Pollution from Construction Activities

The construction of the proposed development will require the use of fuels and materials which will have the potential to pollute the site, and adjacent, environment. Good housekeeping will be carried out on the sites during construction, and the proper use, storage and disposal of all substances and their containers will help prevent soil contamination. Pollution from construction activities is considered to be a small adverse impact and the significance of this impact moderate/slight.

Summary of southern Interceptor Sewer (MHS9 to TSS1) Impacts

Table 14.19 summarises the predicted impacts during this phase of construction.

Table 14.19: Summary of Impacts on Geological Attributes at the proposed southern Interceptor Sewer (MHS9 to TSS1)

Feature/	Importance		Magnitude of Impact		Significance of Impact
	Ranking	Justification	Ranking	Justification	
Infilling of river channel	Low	Fill is inert. Escape of fill through pile clutches is likely to be small	Small adverse	Loss of a small proportion of fill through the pile clutches	Imperceptible
Earthworks haulage	Low	Volume of material for infilling is low on a local scale	Small adverse	Limited haulage of fill	Imperceptible

Feature/	Importance		Magnitude of Impact		Significance of Impact
	Ranking	Justification	Ranking	Justification	
Impacts on surrounding ground	Low	Underlying soils are medium dense and dense sand and gravels	Small adverse	Movements expected to be minimal due to underlying ground conditions	Imperceptible
Installing sheet piles	Low	Slopes are shallow and underlying soils are medium dense and dense sand and gravels	Small adverse	Instability unlikely due to underlying soils	Imperceptible
Impact of dewatering	Medium	Temporary sheet piling to be used	Small adverse	Construction technique will mitigate pumping required	Slight
Impact on groundwater flow and groundwater levels in the aquifer	Low	Groundwater flow may be affected temporarily on a local scale.	Negligible	Pumping of groundwater will not have an impact on groundwater levels or flow.	Imperceptible
Impact on water levels in the Avoca River	Low	Groundwater flow may be affected on a small scale only.	Negligible	Groundwater and other sources will continue feeding the Avoca River.	Imperceptible
Pollution from Construction Activities	Medium	Potential pollution is low on a local scale	Small adverse	Limited construction traffic and construction activities	Slight

14.4.2.5 Southern Interceptor Sewer (TSS1 to TSS3), Northern Interceptor and River Crossing

Section 5.6 of Chapter 5 outlines the construction methodology for the proposed interceptor sewer route. Tunnelling techniques will be used to install the interceptor sewer on South Quay (between TSS1 and TSS3), the river crossing and the entire North Quay interceptor sewer (between TSN1 and TSN8).

The construction impacts of these sections on the Geological Attributes identified are listed below:

- Earthworks haulage;
- Ground movements of overlying soils/sediments; and
- Pollution from Construction Activities.

Earthworks haulage

During earthworks construction, heavily loaded large earthmoving vehicles will travel to the interceptor sewer, causing ground vibrations, unwanted compaction and disturbance of natural ground on unfinished road surfaces. This will also result in increased traffic on the roads to and from the sewer alignment. Increased noise, dust and vibration will also be generated.

Details in relation to the disposal of these soils are provided in **Chapter 16**.

These works are expected to have a low importance given the volume of the material is low on a local scale. The magnitude of the impact of this activity would be small adverse. The significance of the potential impact is Imperceptible.

Ground movements of overlying soils/sediments

Tunnelling works have the potential to cause disturbance of the watercourses due to either ground movements in the overlying sediments and/or release of tunnelling slurry into the water course during tunnelling works. Given the sensitive nature of the environment, this is considered as having a high importance, but given the nature of the ground conditions and the proposed construction methods (see **Section 5.6.3.4 of Chapter 5**), it is classified as having a small adverse impact. The overall impact would be described as Slight.

Pollution from Construction Activities

The construction of the proposed development will require the use of fuels and materials which will have the potential to pollute the site, and adjacent, environment. Good housekeeping will be carried out on the site during construction, and the proper use, storage and disposal of all substances and their containers will help prevent soil contamination. Pollution from construction activities is considered to be a small adverse impact and the significance of this impact moderate/slight.

Summary of southern Interceptor Sewer (TSS1 to TSS3), northern Interceptor Sewer and river crossing Impacts

Table 14.20 summarises the predicted impacts during this phase of construction

Table 14.20: Summary of Impacts on Geological Attributes at the southern Interceptor Sewer (TSS1 to TSS3), northern Interceptor Sewer and river crossing

Feature/	Importance		Magnitude of Impact		Significance of Impact
	Ranking	Justification	Ranking	Justification	
Earthworks haulage	Low	Volume of material for removal is low on a local scale	Small adverse	Limited excavation and disposal. Excavation footprint minimised through construction practise	Imperceptible

Feature/	Importance		Magnitude of Impact		Significance of Impact
	Ranking	Justification	Ranking	Justification	
Ground movements of overlying soils/sediments	Low	Volume of material excavated is low	Small adverse	Movements expected to be minimal due to construction technique being used	Imperceptible
Pollution from Construction Activities	Medium	Potential pollution is low on a local scale	Small adverse	Limited construction traffic and construction activities	Slight

WwTP and Revetment

The likely significant effects of the construction of the proposed WwTP and revetment on land and soils are listed below and described in the following sections:

- Compression of substrata;
- Removal of contaminated soils;
- Groundwater quality;
- Groundwater flow; and
- Ground Movements.

Compression of Substrata

During earthworks, upgrading of the revetment and groundwater treatment, heavily loaded HGVs would travel through the WwTP site potentially generating ground vibration, unwanted compaction and disturbance of natural ground on unfinished road surfaces. Construction traffic may therefore result in increased loading on underlying soils which could affect the current characteristics of the ground by compressing substrata.

Given the nature of the soils and the site history of industrial use, the effect would be negligible, therefore the impact is deemed to be imperceptible and thus not significant during construction.

Removal of Contaminated Soils

The excavation on the WwTP site and removal of soils unsuitable for reuse or retention on site would be of low importance given the volume of the material that would be removed is low on a local scale. Further, where possible suitable material would be retained within the proposed development.

The removal of soils unsuitable for reuse or retention on site would be a small adverse effect, therefore this impact is deemed to be imperceptible during construction.

Groundwater Quality

Contaminated groundwater would be generated during excavation and removed from the excavated areas and either transported off site to a suitably licensed facility or stored and treated on site before disposal off site. Any groundwater removed from the excavated area would be required to undergo treatment given the background concentrations as described in **Section 14.3.12.11**. Groundwater would generally not be treated unless encountered during dewatering that would be required as part of the excavation activities. The volume of water requiring treatment will depend on the extent of the excavations requiring dewatering.

The removal and treatment of groundwater during dewatering and excavation would be negligible impact and the effect is deemed to be imperceptible during construction.

Refer to **Section 15.4 of Chapter 15** for further detail on the likely significant effects of the proposed development on surface water quality.

Groundwater Flow

During excavation, groundwater would be managed by dewatering the sands and gravels around the excavation area. Temporary construction methods such as sheet piles or other methods will be used to minimise water ingress into excavations. Limited pumping may be required to manage seepage, basal flow and rainfall into the excavated area. This may cause a cone of depression and redirect groundwater flow on a local scale.

The potential to influence groundwater flow would be negligible impact, therefore this effect is deemed to be imperceptible during construction.

Ground Movements

The excavation and dewatering activities generate the potential to induce ground movements and potentially settlement adjacent to excavations and dewatering operations across the study area. However this would be typical of a development of this scale and would be considered as standard for these types of works.

The potential to induce movement and settlement would be of low importance given the limited area to be excavated and the provision of appropriate temporary support measures, including but not limited to sheet piling. The potential to induce movement and settlement would be small adverse and this effect is deemed to be Slight.

Summary of Proposed WwTP and Revetment Impacts

Table 14.21 summarises the predicted impacts during this phase of construction

Table 14.21: Impacts on geological and hydrogeological attributes for the Proposed WwTP site.

Feature	Importance		Magnitude of Impact		Significance of Impact
	Ranking	Justification	Ranking	Justification	
Compression of substrata	Low	Site history of industrial use.	Negligible	Removal of soils and replacement with structure will not impact on the characteristics of the soils.	Imperceptible
Removal of contaminated soils	Medium	Volume of material for removal is low on a local scale. Material will be retained on site where possible.	Negligible	Removal of contaminated soils on a local level. However, this may positively impact on the characteristics of the natural soils and groundwater.	Imperceptible
Impact on groundwater quality	Low	Volume of groundwater removed will be minor.	Negligible	Dewatering will be managed and pumped water will be treated if necessary prior to discharge or disposal off site under licence	Imperceptible
Impact on groundwater flow	Low	Groundwater flow may be affected on a small scale only.	Negligible	Pumping of groundwater will not have an impact due to the tidal influence on groundwater levels.	Imperceptible
Impacts on surrounding ground	Medium	Excavated area supported by temporary works such as but not limited to sheet piling.	Small Adverse	Movements expected to be minimal due to temporary works / support structure.	Slight

14.4.2.6 Long Sea Oufall and SWO at WwTP

Compression of Substrata

During construction of the long sea outfall and SWO, heavily loaded HGVs would travel through the WwTP site, potentially causing ground vibrations, unwanted compaction and disturbance of natural ground. Construction traffic may therefore result in increased loading on underlying soils which could affect the current characteristics of the ground by compressing substrata.

These works are expected to have a low importance given the volume of the material for removal is low on a local scale. The magnitude of the impact of this activity would be small adverse. The significance of the potential impact is Imperceptible.

Ground Movements

Soil excavation and/or the construction of the long sea outfall via tunnelling methods (using methods such as HDD) have the potential to induce movement and settlement of surrounding ground.

The potential to induce movement and settlement would be of low importance. Through the implementation of appropriate design and best practice construction methods, the potential to induce movement and settlement is deemed to be small adverse and thus the effect is Imperceptible during construction.

Mobilisation of Contaminated Sediment

Given the background concentrations as described in detail in **Section 14.3.12.11**, there is the possibility that contaminated sediments may be excavated during the construction of the long sea outfall.

This is considered as having a low importance as there are no ecologically designated sites in the immediate vicinity and the potential effects of the construction of the outfall on coastal processes (see **Chapter 15** and **Appendix 15.5**) are deemed not be significant. Two pNHA's are present nearby, one relating to Arklow Town Marsh (001931), which is upstream from the site of the outfall and the other relating to Arklow Sand Dunes to the north of the site. Given the nature of the ground conditions and the proposed construction methods, the potential to mobilise suspected contaminated sediment is deemed to be negligible and thus the effect is Imperceptible during construction.

Summary of Outfall and WwTP SWO Impacts

Table 14.22 summarises the likely impacts during this phase of construction.

Table 14.22: Impacts on geological and hydrogeological attributes for the Proposed Outfall and SWO (Marine Section)

Feature	Importance		Magnitude of Impact		Significance of Impact
	Ranking	Justification	Ranking	Justification	
Earthworks haulage	Low	Volume of material requiring excavation and removal off-site is small.	Small adverse	Excavation footprint minimised through construction practices.	Imperceptible
Impacts on surrounding ground	Low	Soils are generally sand and gravels or glacial tills.	Small adverse	Tunnelling through sand and gravel and/or glacial tills would not result in substantial ground movements.	Imperceptible
Mobilisation of suspected contaminated sediments during excavation	Low	Suspected locally contaminated seabed sediments.	Negligible	Based on ground conditions and testing results, there should be limited mobilisation of those sediments.	Imperceptible

14.4.3 Assessment of Effects during Operation

The operational phase of the proposed development will have an overall neutral long-term impact on land and soils.

The potential impacts on land and soils during the operational phase will be limited to accidental spillage of potentially polluting substances including fuel, oils, paints, incoming wastes and raw materials. All potential impacts on land and soils from the operation of the proposed development will be of Slight significance.

The pipes and tanks will convey and store wastewater and storm water which are potentially polluting. The pipes and tanks will be constructed in accordance with best practice measures and constructed with appropriate engineering supervision. Consequently, the risk of a leak from the sewers or tanks impacting on groundwater quality is considered to be negligible and the magnitude of the impacts on the aquifers will be Imperceptible.

The sewer pipes and associated shafts will comprise relatively small features within the bedrock and sand and gravel aquifers. In addition, the pipe is orientated generally normal to the groundwater flow direction in both aquifers and will therefore only present a small surface area (the diameter of the pipe) which groundwater would need to flow around.

Hence the operation of the interceptor sewer network will have a negligible impact on groundwater flows in both aquifers and a significance rating of Imperceptible for all receptors identified in Table 14.14.

Flow in the bedrock aquifer is facilitated by the natural connectivity of the fracture network. The fracture network provides pathways around the underground storage tanks and will not cause groundwater to rise at the location. As the storage tanks will cause groundwater to flow around them they have a permanent localised small adverse impact. Hence, the significance of the impact on groundwater flow will be Slight.

The proposed development will convey and store wastewater and storm water that are potentially polluting. The proposed development will be constructed in accordance with the relevant design standards by means of best practice measures under appropriate engineering supervision. All subsurface structures will also be lined with impermeable concrete.

Consequently, the risk of a leak from the proposed development impacting on soils, geology and hydrogeology is considered to be low. As such, effects on soils, geology and hydrogeology will be negligible and the effect of the proposed development is considered to be Imperceptible during operation.

14.5 Mitigation Measures and Monitoring

14.5.1 Mitigation

14.5.1.1 Mitigation During Construction

General

As outlined in **Section 5.8 of Chapter 5** and in the Outline CEMP (Refer to **Appendix 5.1**), the adopted construction techniques will comply with the requirements of statutory bodies (Building Control Amendment Regulations, Health Service Executive inspections, Irish Water inspections and compliance with Employers Requirements).

Precautionary measures will be taken to contain any areas within the planning boundary at risk of contaminated run-off in addition to the following:

- Potential pollutants shall be adequately secured against vandalism and will be provided with proper containment according to the relevant codes of practice. Any spillages will be immediately contained and contaminated soil shall be removed from the proposed development and properly disposed of in an appropriately licensed facility.
- Dust generation shall be kept to a minimum through the wetting down of haul roads as required and other dust suppression measures.
- Any stockpiles of earthworks and site clearance material shall be stored on impermeable surfaces and covered with appropriate materials.

- Silt traps shall be placed in gullies to capture any excess silt in the run-off from working areas.
- Soil and water pollution will be minimised by the implementation of good housekeeping (daily site clean-ups, use of disposal bins, etc.) and the proper use, storage and disposal of these substances and their containers as well as good construction practices as described in **Section 5.8 of Chapter 5** Construction Strategy, **Appendix 5.1** as well as the CIRIA guidance[41].
- A contingency plan for pollution emergencies will also be developed by the contractor prior to the commencement of the works and regularly updated during construction. This contingency plan will identify the actions to be taken in the event of a pollution incident in accordance with the CIRIA guidance[41] which requires the following to be addressed:
    - Containment measures;
    - Emergency discharge routes;
    - List of appropriate equipment and clean-up materials;
    - Maintenance schedule for equipment;
    - Details of trained staff, location and provision for 24-hour cover;
    - Details of staff responsibilities;
    - Notification procedures to inform the EPA or Environmental Department of the Wicklow County Council;
    - Audit and review schedule;
    - Telephone numbers of statutory water consultees; and
    - List of specialist pollution clean-up companies and their telephone numbers.

Alps SWO and Stormwater Tank

Compression of Substrata

- Excavations shall be kept to a minimum, using shoring or trench boxes where appropriate. For more extensive excavations, a temporary works designer shall be appointed to design excavation support measures in accordance with all relevant guidelines and standards.

Loss of grassland/made ground and solid geology

- All excavated material will, where possible, be reused as construction fill. The appointed contractor will ensure acceptability of the material for reuse for the proposed development with appropriate handling, processing and segregation of the material.

[41] Masters – Williams et al (2001) Control and management of water pollution from construction sites in their publication Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors

This material would have to be shown to be suitable for such use and subject to appropriate control and testing according to the Earthworks Specification(s).

- These excavated soil materials will be stockpiled using an appropriate method to minimise the impacts of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff. Any surplus suitable material excavated that is not required elsewhere for the proposed development, shall be used for other projects where possible, subject to appropriate approvals/notifications.

Earthworks Haulage

- Earthworks haulage will be along agreed predetermined routes along existing national, regional and local routes. Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to its original condition. Where practicable, compaction of any soil or subsoil which is to remain in situ along the sites will be avoided.
- Earthworks operations shall be carried out such that surfaces shall be designed with adequate falls, profiling and drainage to promote safe runoff and prevent ponding and flooding. Runoff will be controlled through erosion and sediment control structures appropriate to minimise the water impacts in outfall areas. Care will be taken to ensure that the bank surfaces are stable to minimise erosion.

Impact of Surrounding Ground

- Ground settlement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations.
- Ground settlements will be controlled through the selection of a foundation type and method of construction which are suitable for the particular ground conditions.

Impact of Dewatering

- To reduce the amount of dewatering required at any given time, it is likely that the contractor would construct the sewer in sections. Discharge from the dewatering process would be passed to a suitably sized settlement pond or a proprietary silt removal system located within the working area where possible, before discharge to the Avoca River or the local sewer network. Any discharge to either sewer or watercourse would be subject to a WWDA.

Interceptor Sewers

Loss of topsoil/overburden and solid geology

- All excavated material will, where possible, be reused as construction fill. The appointed contractor will ensure acceptability of the material for reuse for the proposed development with appropriate handling, processing and segregation of the material.

This material would have to be shown to be suitable for such use and subject to appropriate control and testing according to the Earthworks Specification(s). These excavated soil materials will be stockpiled located within the working area where possible, using an appropriate method to minimise the impacts of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff. Any surplus suitable material excavated that is not required elsewhere for the proposed development shall be used for other projects where possible, subject to appropriate approvals/notifications.

Earthworks Haulage

- Earthworks haulage will be along agreed predetermined routes along existing national, regional and local routes. Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to its original condition. Where practicable, compaction of any soil or subsoil which is to remain in situ along the sites will be avoided.
- Earthworks operations shall be carried out such that surfaces shall be designed with adequate falls, profiling and drainage to promote safe runoff and prevent ponding and flooding. Runoff will be controlled through erosion and sediment control structures appropriate to minimise the water impacts in outfall areas. Care will be taken to ensure that the bank surfaces are stable to minimise erosion.

Impact of Surrounding Ground

- Ground settlement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations. Monitoring will be more rigorous at Arklow bridge as it is a protected structure. This will include more frequent monitoring and more monitoring points. Monitoring points will be located on the face of the bridge piers and centred every 1m or at least one monitoring point for each phase in the underpinning procedure. Horizontal, vertical and rotational displacement in all directions will be monitored.
- Ground settlements will be controlled through the selection of a foundation type and method of construction which are suitable for the particular ground conditions

Impact of Dewatering

- To reduce the amount of dewatering required at any given time, it is likely that the contractor would construct the sewer in sections. Discharge from the dewatering process would be passed to a suitably sized settlement pond or a proprietary silt removal system located within the working area, before discharge to the Avoca River or the local sewer network. Any discharge to either sewer or watercourse would be subject to a EEDA.

Infilling of river channel and installing sheet piles:

- The causeway would be contained on the river side to mitigate against siltation migration into the Avoca River. The two most likely methods to achieve this containment would either be an additional row of sheet piles on the river side of the causeway or alternatively a row of stone gabions wrapped in a geotextile membrane. Either method would require that the containing material (i.e. the sheet piles or the gabion walls) are extended (i.e. to a height above the surface of the causeway) to be effective. The infilling will produce a favourable lateral force on the existing quay wall but an unfavourable lateral force on the sheet piles. Horizontal movement monitoring of the sheet piles will be implemented during construction activities to ensure that the movement does not exceed the design limitations.

WwTP and Revetment

Compression of substrata:

- Excavations and therefore the transport of soils across the site shall be kept to a minimum, using shoring or trench boxes where appropriate. For more extensive excavations, a temporary works designer shall be appointed to design excavation support measures in accordance with all relevant guidelines and standards.
- It should be noted that both the excavation and import of materials will be required for construction of the revetment.

Removal of contaminated soils:

- Excavations in made ground for the WwTP and the revetment will be monitored by an appropriately qualified person to ensure that any spots of contamination (such as nitrocellulose or asbestos) encountered are identified, segregated and stored in an area where there is no possibility of runoff generation or infiltration to ground or surface water drainage. Care will be taken to ensure no cross-contamination with clean soils elsewhere throughout the site.

Groundwater quality:

- Excavated contaminated soils will be segregated and stored in an area where there is no possibility of runoff generation or infiltration to ground or surface water drainage. Care will be taken to ensure no cross-contamination with clean soils elsewhere throughout the site.

Groundwater flow:

- Dewatering will be required for the construction of the WwTP. Discharge volumes could be up to 250m^3/day and would be passed to a suitably sized settlement pond or a propriety silt removal system, along with any other treatment as required by WCC before discharge to the Avoca River or the local sewer network. This will most likely include treatment to remove elevated heavy metals which were noted during the ground investigation. Any discharge to either sewer or watercourse would be subject to a WWDA.

Impact on surrounding ground:

- Ground settlement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations.
- Ground settlements will be controlled through the selection of a foundation type and construction methods which are suitable for the particular ground conditions. See **Sections 5.6.4 and Section 5.6.6 in Chapter 5** for details.

Earthworks haulage:

- All excavated material will, where possible, be reused as construction fill. The appointed contractor will ensure acceptability of the material for reuse for the proposed development with appropriate handling, processing and segregation of the material. This material would have to be shown to be suitable for such use and subject to appropriate control and testing according to the Earthworks Specification(s). These excavated soil materials will be stockpiled using an appropriate method to minimise the impacts of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff. Any surplus suitable material excavated that is not required elsewhere for the proposed development shall be used for other projects where possible, subject to appropriate approvals/notifications.
- Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to its original condition. Where practicable, compaction of any soil or subsoil which is to remain in situ along the sites will be avoided.
- Earthworks operations shall be carried out such that surfaces shall be designed with adequate falls, profiling and drainage to promote safe runoff and prevent ponding and flooding. Runoff will be controlled through erosion and sediment control structures appropriate to minimise the water impacts in outfall areas. Care will be taken to ensure that the bank surfaces are stable to minimise erosion.

Outfalls (Long Sea outfall and SWO at WwTP)

Compression of Substrata and Ground Movements:

- Ground settlement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations.
- Ground settlements will be controlled through the selection of methods of construction as outlined in **Section 5.6.5 of Chapter 5** which are suitable for the particular ground conditions.

Mobilisation of contaminated sediment:

- Based on ground conditions and construction methods, there should be limited mobilisation of those sediments.

- Best practice guidelines[42] will be adhered to as a minimum for any dredging exercises to be carried out. Measures to minimise disruption to the seabed and mobilisation of sediments will be applied and seabed conditions will be taken into account when selecting construction methods.

14.5.1.2 Mitigation During Operation

No mitigation has been proposed with respect to effects from operation of the proposed development in relation to land and soils.

14.5.2 Monitoring

14.5.2.1 Monitoring During Construction

Excavations in made ground will be monitored by an appropriately qualified person to ensure that any contaminated material is identified, segregated and disposed of appropriately. Any identified hotspots shall be segregated and stored in an area where there is no possibility of runoff generation or infiltration to ground or surface water drainage. Care will be taken to ensure that the hotspot does not cross-contaminate clean soils elsewhere.

Any excavation shall be monitored during earthworks to ensure the stability of side slopes and to ensure that the soils excavated for disposal are consistent with the descriptions and classifications according to the waste acceptance criteria testing carried out as part of the site investigations.

Ground settlement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations. Monitoring will be more rigorous at Arklow bridge as it is a protected structure. This will include more frequent monitoring and more monitoring points. Monitoring points will be located on the face of the bridge piers and centred every 1m or at least one monitoring point for each phase in the underpinning procedure. Horizontal, vertical and rotational displacement in all directions will be monitored.

The construction of the offshore elements shall follow international best practice in regard to the management of the trenching / excavations, the stability of the excavation/trenched area and the disposal of any spoil generated from either the excavation or the tunnelling and/or horizontal directional drilling works.

Movement monitoring shall be carried out during any activities which may result in ground movements or movements of any nearby structures.

Water quality monitoring will be carried out at all discharge points as per the requirements of the issued WWDA.

[42] British Standards (2016) BS6349-5 - Maritime works – Part 5: Code of practice for dredging and land reclamation

14.5.2.2 Monitoring During Operation

Ongoing monitoring of the infrastructure for leaks shall be carried out during operation. If leaks are detected, the system should include measures for the management of any resulting contamination of the surrounding soils.

14.6 Residual Effects

With the implementation of the proposed mitigation measures and monitoring, the effect of the proposed development on land and soils is considered to be of negligible magnitude and imperceptible significance during construction and operation.

No residual effects of significance on land and soils have been identified.

14.7 References

An Foras Talúntais (1978). Ireland: Peatland Map. An Foras Talúntais, Dublin;

Apex Geoservices (2017). Report on the Geophysical Investigation for the Marine Outfall Pipeline, Arklow Waste Water Treatment Plant for Byrne Looby Arup. AGL16077_01

Arup (2018). Arklow Waste Water Treatment Plant, Preliminary Site Assessment. 247825_PSA_31-07-2017

Arup (2018). Arklow Waste Water Treatment Plant, Detailed Site Assessment for the Wastewater Treatment Plant. 247825-00_13-03-2018-DSA

Bing Maps (2018). Aerial photography. Available at: https://www.bing.com/maps, Accessed 18-07-2018;

British Geological Survey (BGS) (2018). Offshore Bedrock Map, 1:250,000. Available at: http://www.maremap.ac.uk/view/search/searchMaps.html, Accessed 18-07-18;

British Standards (2015). Code of practice for ground investigations. BS5930:2015. 4th Ed. ISBN: 978 0 580 80062 7

Causeway Goetech (2017). Arklow Sewerage Scheme – Marine Outfall Site Investigation. Report No. 17-0167.

Causeway Geotech (2018). Arklow WwTP Land – Ground Investigation. Report No. 17-1455.

Department of Communications, Climate Action and the Environment (2018). INFOMAR Seabed Mapping. Available at: https://jetstream.gsi.ie/iwdds/delivery/INFOMAR_VIEWER/index.html, Accessed 18-07-18;

Department of Communications, Energy and Natural Resources (2011). State Mining and Prospecting Facilities. Available at:

http://www.mineralsireland.ie/files/Competition_Booklet_May2011_web.pdf, Accessed 18-07-18;

EPA (2018). Corine Land Cover 2012 datasets. Available at: https://gis.epa.ie/EPAMaps, Accessed 18-07-18;

EPA (2018). DaS Permits, Dumping at Sea Search, Dumping at Sea, Water & Waste Water, Licensing and Permitting. Available at: http://www.epa.ie/terminalfour/DaS/DaS-search.jsp?status=%25&county=Wicklow&Submit=Search+by+Combination, Accessed: 16/08/2018

EPA (2018). EPA Maps, Environment and Wellbeing, Clean Water and Health. Available from: https://gis.epa.ie/EPAMaps/, Accessed 18-07-18

EPA (2018). EPA Maps, Water, Water Framework Directive. Available from: https://gis.epa.ie/EPAMaps/, Accessed 18-07-18

EPA (2018). Office of Licencing and Guidance. Available at: https://gis.epa.ie/EPAMaps, Accessed 18-07-18.

EPA (2013). Guidance on the management of Contaminated Land and Groundwater at EPA licensed sites. ISBN: 978-1-84095-511-8. Available at: https://www.epa.ie/pubs/advice/waste/contaminatedland/contaminatedland/Guidance_on_the_Management_of_Contaminated_Land_and_Groundwater_at_EPA_Licensed_Sites_FINAL.pdf

GSI (2018). Groundwater Data Viewer. Available from: http://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228, Accessed 18-07-18

GSI (2018). Geological maps of the site area produced by the Geological Survey of Ireland. Available at: http://map.geohive.ie/mapviewer.html, Accessed 18-07-2018

GSI (2014). Directory of Active Quarries and Pits in Ireland. 4th Ed. ISBN 189970265-2. Database available at: http://map.geohive.ie/mapviewer.html, Accessed 18-07-2018

GSI (2003). Wicklow GWB: Summary of Initial Characterisation. Groundwater Bodies. Available at: https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/understanding-ireland-groundwater/Pages/Groundwater-bodies.aspx, Accessed 18-07-18

Google Maps (2018). Aerial photography. Available at: https://www.google.ie/maps/, Accessed 18-07-2018;

Institute of Geologists of Ireland, 2013. Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impact Statements.

Irish Statute Book (1992). Environmental Protection Agency Act, 1992. Available from: http://www.irishstatutebook.ie/eli/1992/act/7/enacted/en/print#sec2, Accessed 16/08/2018

Minerex Geophysics Limited (2016). Geophysical Survey. Site at Ferrybank, Arklow, County Wicklow. MGX File Ref: 6049d-005.doc

Murphy Surveys (2016). Arklow SS Topo Survey. Drawing Nos. MSL15547-T_0 scale 1:1000 @ A1 and MSL15547-T_1 to MSL15547-T_4 scale 1:250 @A1.

Murphy Surveys (2018). Survey Old Wallboard Factory Site North Quay Arklow. Drawing No. MSL24433_T_Rev1_0 to MSL24433_T_Rev1_4, Scale 1:250 @A1 and Drawing No. MSL24433_KP, MSL24433_XS_01 to MSL24433_XS_03, Scale 1:500 @A1.

National Parks and Wildlife Service (2018). Proposed / Designated NHA, SPA, SAC Sites. Available at: http://webgis.npws.ie/npwsviewer/, Accessed 18-07-18.

NRA (2008). Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes. Available at: http://www.tii.ie/technical-services/environment/planning/Guidelines-on-Procedures-for-Assessment-and-Treatment-of-Geology-Hydrology-and-Hydrogeology-for-National-Road-Schemes.pdf

NSS of Ireland (1980) Soil Associations of Ireland and Their Land Use Potential.

Tobin Consulting Engineers (2005). Site Investigation Programme for Foundi Limited, c/o ID Partnership Ireland Ltd. At IFI Tank Farm, Arklow, County Wicklow.

UK Hydrographic Office (1999). Republic of Ireland – East Coast. Arklow to the Skerries Islands. Scale: 1:100000 at lat 15°30'. Sheet no. 1468. 3rd Ed.

Water Framework Directive (WFD) Ireland (2018). Water Maps. Available at: http://watermaps.wfdireland.ie/NsShare_Web/Viewer.aspx?Site=NsShare&ReloadKey=True, Accessed 18-07-18

15 Water

15.1 Introduction

This chapter describes the likely significant effects associated with the construction and operation of the proposed development on surface and coastal water quality, the existing hydrological regime, including flood risk and coastal processes. Groundwater features of relevance and hydrogeology have been considered separately in **Chapter 14**.

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 water assessment:

- Design:
  - Interceptor Sewers and Storm Water Overflows (SWOs);
  - WwTP and outfall design; and
  - Hydrology and flood risk due to permanent sewer encroachment in the Avoca River.
- Construction:
  - Interceptor sewer construction by open cut excavation and tunnelling;
  - WwTP and outfall construction; and
  - Flood risk due to the presence of temporary causeway construction in the Avoca River.
- Operation:
  - Performance of the SWOs;
  - Performance of the treated effluent discharging via the outfall;
  - Operation of the WwTP; and
  - Flood risk during operation of the proposed development

15.2 Assessment Methodology

15.2.1 General

The proposed development includes works within and adjacent to the Avoca River and the Irish Sea therefore, potential direct and indirect effects on surface and coastal waters during construction and operation of the proposed development have been considered herein.

15.2.1.1 Hydrology and Water Quality

The hydrological assessment has considered the likely significant effects of the proposed development on surface watercourses and hydrological features in proximity to the proposed development during construction and operation. This includes in particular, the Avoca River and Estuary, the Irish Sea and the Arklow Town Marsh proposed Natural Heritage Area pNHA (site code 001931 - Refer to **Chapter 11** for further information).

An investigation of the impact of discharges from the proposed treated effluent outfall and the SWO at the WwTP site on coastal water quality (Irish Sea) has also been undertaken. Irish Hydrodata has undertaken this assessment and has prepared a report (Refer to **Appendix 15.2**).

A hydraulic assessment of the proposed interceptor sewer (including the temporary causeway required during construction) and associated encroachment in the river channel has also been undertaken by Hydro Environmental (Refer to **Appendix 15.3**).

A hydraulic model has been prepared for the catchment and has considered the potential impact of any spills associated with SWOs proposed as part of the interceptor sewer network (Refer to **Appendix 15.4**). Infoworks software was used to model the existing and future wastewater collection system and to design the proposed interceptor sewers to achieve the required design parameters. The hydraulic model of the future system (incorporating the proposed interceptor sewers, SWOs and the WwTP) was run with Time Series Rainfall (TSR) event for assessment of spill frequency and volume of discharge via the proposed SWOs at the WwTP, South Quay and at the Alps. SWO performance assessment was carried out to assess its impact on the Avoca River in accordance with the requirements in the Irish Water Standard[1].

15.2.1.2 Coastal Processes

The assessment of coastal processes examines the existing coastal processes in the area and assesses the likely significant effects of the proposed long sea outfall, SWO at the WwTP and the revetment may have on the dynamic coastal system during the construction and operation of the proposed development (Refer to **Appendix 15.5** for further information).

The assessment consists of a desktop study of the site metocean conditions (including metocean, tidal levels, extreme sea level, currents, wind and wave data), ground conditions and environmental constraints, as well as any other relevant historical information and aerial photographs.

Wave propagation from offshore to the proposed locations was also modelled using MIKE21-SW. Sediment transport patterns have been estimated using the CERC formula[2].

[1] Irish Water (2017) Technical Standard: Storm Water Overflows. Document No: IW-TEC-800-03. Revision 1.0 (October 2017)
[2] U.S. Army Corps of Engineers (1984) 'Shore Protection Manual'

15.2.1.3 Flood Risk

As outlined in **Section 15.2.1.1,** hydraulic modelling and two reports have been prepared by Hydro Environmental and Byrne Looby to assess flood risk from the sewer network within Arklow (Refer to **Appendix 15.3 and Appendix 15.4** respectively).

A flood risk assessment (**Appendix 15.6**) has considered the likely significant effects of the proposed development on flood risk at the WwTP site. Flood risk from multiple sources have been considered including coastal/tidal flooding, fluvial flooding, pluvial flooding and groundwater flooding, as well as the potential risk of a breach of the revetment at the WwTP site.

15.2.2 Guidance and Legislation

This assessment has been undertaken with due regard to the overarching EIA guidance (described in **Section 1.4.3 of Chapter 1**).

The following provide the statutory framework for the protection and control of river and transitional/coastal water quality:

- Council Directive 2000/60/EC[3] establishing a framework for Community action in the field of water policy (the WFD)
- European Union Environmental Objectives (Surface Water) (Amendment) Regulations 2015 (S.I. No.386 of 2015) [4]
- European Communities (Quality of Salmonid Waters) Regulations 1998 (S.I. No. 293 of 1998) [5]

Each of these are described in **Sections 15.2.2.1** and the National Planning Guidelines[6] have also been given due regard during the assessment (Refer to **Section 15.2.2.5** for further detail).

15.2.2.1 Water Framework Directive

The WFD aims at improving the water environment in the EU and requires all Member States to protect and improve water quality in all waters so that they achieve good ecological status by 2015 or, at the latest, by 2027.

[3] Directive 2000/60/EC of the European Parliament and of the Council, as amended by Decision No 2455/2001/EC of the European Parliament and of the Council, Directive 2008/32/EC of the European Parliament and of the Council, Directive 2008/105/EC of the European Parliament and of the Council, Directive 2009/31/EC of the European Parliament and of the Council and Directive 2013/39/EU of the European Parliament and of the Council.
[4] European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI No 272 of 2009) as amended by the European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2012 (SI No. 327 of 2012); and the European Communities Environmental Objectives (Surface Water) (Amendment) Regulations 2015) (SI No 386 of 2015). And defined as "European Communities Environmental Objectives (Surface Waters) Regulations 2009 – 2015"
[5] "European Communities (Quality of Salmonid Waters) Regulations 1988 (SI No 293 of 1988)"
[6] Office of Public Work and Department of the Environment, Heritage and Local Government in (2009) The Planning System and Flood Risk Management Guidelines for Planning Authorities

The WFD has been transposed in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003)[7]. The WFD applies to rivers, lakes, groundwater, and transitional coastal waters and requires that management plans are prepared on a river basin basis through the specified structured method.

The River Basin Management Plans (RBMPs) have been prepared to protect and improve Ireland's water environment. They are reviewed and updated every six years. The first RBMPs covered the period 2009 to 2014 and identified the waterbodies that may not meet the environmental objectives of the WFD by 2015. The latest RBMPs (for 2018 to 2021) were published in April 2018 and these set out the actions to improve water quality and achieve 'good' ecological status in water bodies (rivers, lakes, estuaries and coastal waters) by 2027.

15.2.2.2 Bathing Water Directive

Council Directive 2006/7/EC concerning the management of bathing water quality and repealing Directive 76/160/EEC (The Bathing Water Directive) aims to improve the protection of bather's health and provides standards for water quality and method of assessment. It is transposed into Irish law as the Bathing Water Regulations, 2008 (SI No. 79 of 2008).

Bathing waters are classed into quality categories, being 'Excellent', 'Good', 'Sufficient' or 'Poor' with a minimum target of 'Sufficient' required to be achieved for all bathing waters.

Local authorities are responsible for bathing water quality in their areas in addition to monitoring bathing water quality and making information available to the public on water quality during the summer season. The EPA publishes a Bathing Water Quality report (latest report in 2017) which assesses compliance with the standards. The 2017 report is based on monitoring covering the 2014 – 2017 period.

15.2.2.3 The European Union Environmental Objectives (Surface Water) (Amendment) Regulations, 2015

The European Union Environmental Objectives (Surface Water) Regulations 2015, as amended, provide a more complete and stringent set of surface water quality regulations which address the requirements of the WFD and Council Directive 2006/11/EC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community. These regulations specify the conditions and physico-chemical concentrations that should be considered in the assessment of surface water quality.

[7] "European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003) as amended by the European Communities (Water Policy) (Amendment) Regulations, 2005 (S.I. No. 413 of 2005); the European Communities (Water Policy) (Amendment) Regulations, 2008 (S.I. No. 219 of 2008); European Communities (Water Policy) (Amendment) Regulations, 2010 (S.I. No. 93 of 2010); and the European Communities (Drinking Water) Regulations 2014 (S.I. No 350 of 2014)." And defined as European Communities (Water Policy) Regulations 2003 – 2014.

These regulations also give effect to Council Directive 2008/105/EC on environmental quality standards in the field of water policy.

15.2.2.4 European Communities (Quality of Salmonid Waters) Regulations, 1988

Legislation for salmonid waters was first established under Council Directive 78/659/EEC on the quality of freshwaters needing protection or improvement in order to support fish life (the Freshwater Fish Directive). The Freshwater Fish Directive was subsequently superseded by the European Communities (Quality of Salmonid Waters) Regulations 1988.

The Freshwater Fish Directive defines freshwaters as being waters capable of supporting Salmon (*Salmo Salar*), Trout (*Salmo trutta*), Char (*Salvelinus*) and whitefish (*Coregonus*) and are hereby designated as Salmonid waters.

The surface water quality standards specified across a range of relevant legislation are outlined in **Table 15.1 in Appendix 15.1**.

15.2.2.5 The Planning System and Flood Risk Management Guidelines for Planning Authorities

In November 2009, the (then) Department of Environment, Heritage and Local Government and the Office of Public Works jointly published their guidance[6]. The aim of the Guidelines is to ensure that flood risk is neither created nor increased by inappropriate development.

The Guidelines[6] are issued under Section 28 of the Planning and Development Act 2000, as amended and planning authorities and An Bord Pleanála are therefore required to implement these guidelines in carrying out their functions under the Planning Acts. The Guidelines[6] require the planning system to avoid development in areas at risk of flooding, unless the development can be justified on wider sustainability grounds and the risk can be reduced or managed to an acceptable level.

The Guidelines[6] specifically require the adoption of a Sequential Approach (to Flood Risk Management) of Avoidance, Reduction, Justification and Mitigation and they require the incorporation of Flood Risk Assessment into the process of making decisions on Planning Applications and Planning Appeals. Fundamental to the Guidelines[6] is the introduction of flood risk zoning and the classifications of different types of development having regard to their vulnerability.

The management of flood risk is therefore a key element of any development proposal in an area of potential flood risk and should therefore be addressed as early as possible in the site master planning stage.

15.2.3 Study Area

15.2.3.1 Hydrology and Water Quality

This study area comprises all surface water catchments that could potentially be impacted by the proposed development and is illustrated in Figure 15.1.

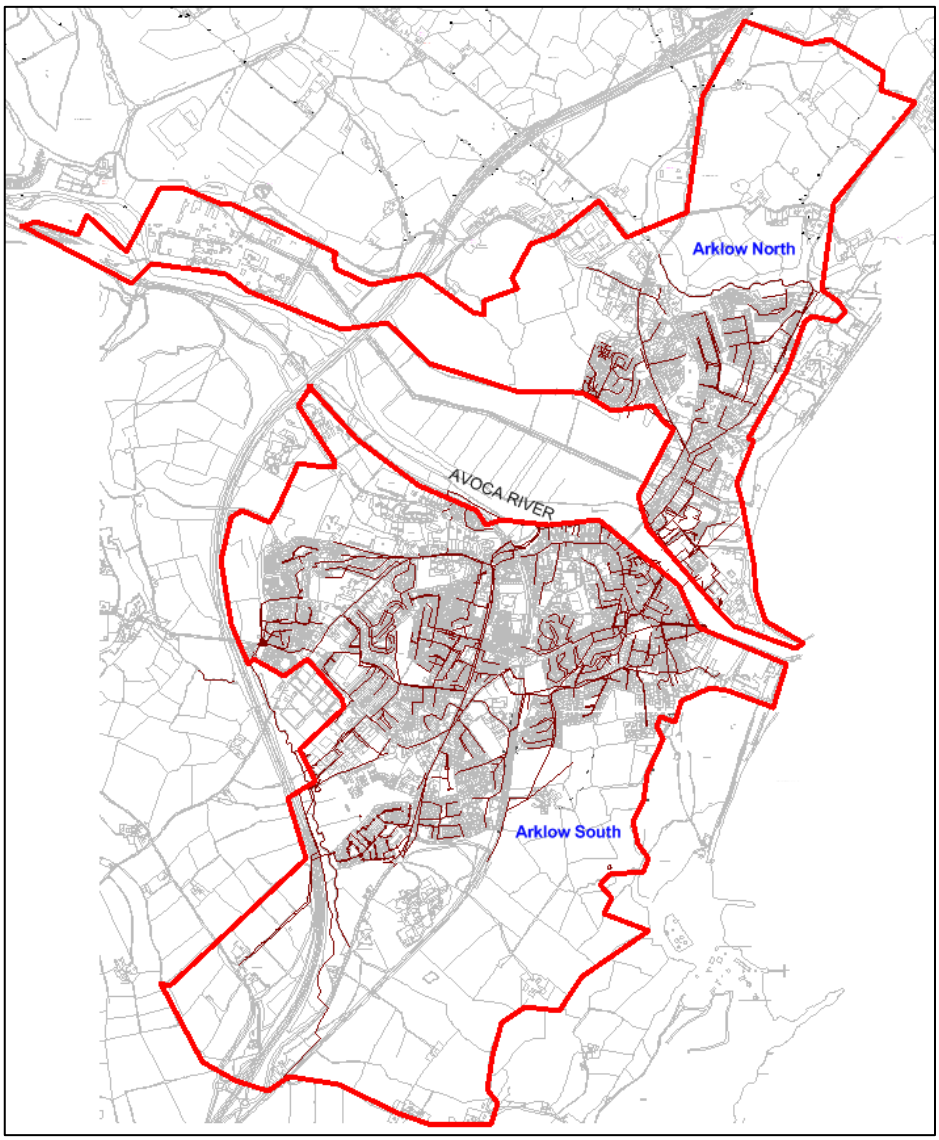

Figure 15.1: Extent of Drainage Catchment impacted by Proposed Development

The study area for the assessment of treated wastewater discharges to the Irish Sea was the Arklow coastal area (Refer to **Appendix 15.2** for further details. The main areas of concern for the assessment were potential impacts on nearby bathing waters, which include Brittas Bay and Clogga, as well as two European sites (Wicklow Head Reef and Blackwater Bank SACs) and the Arklow Town Marsh pNHA.

15.2.3.2 Coastal Processes

The study area for the coastal processes assessment is as illustrated in Figure 15.2, however where further detail is available and relevant on coastal processes in the wider area of interest adjacent to the study area, this has been considered accordingly as part of this assessment. The coastline in the vicinity of the site consists of beaches limited by headlands. Barriers such as headlands accompanied by change in orientation of the adjoining areas suggest limited exchange of sediment between them. The proposed development is located within the Kilmichael Point to Mizen Head area, in a stretch of coastline that is limited to the south by breakwaters which protect the entrance to Arklow harbour, and to the North by the headland located at the north end of the Arklow North Beach. The extent and features of this sub-physiographic unit defined as an Area of Interest are shown in Figure 15.2.

15.2.3.3 Flood Risk

The study area for the Flood Risk Assessment incorporates the planning boundary of the proposed development.

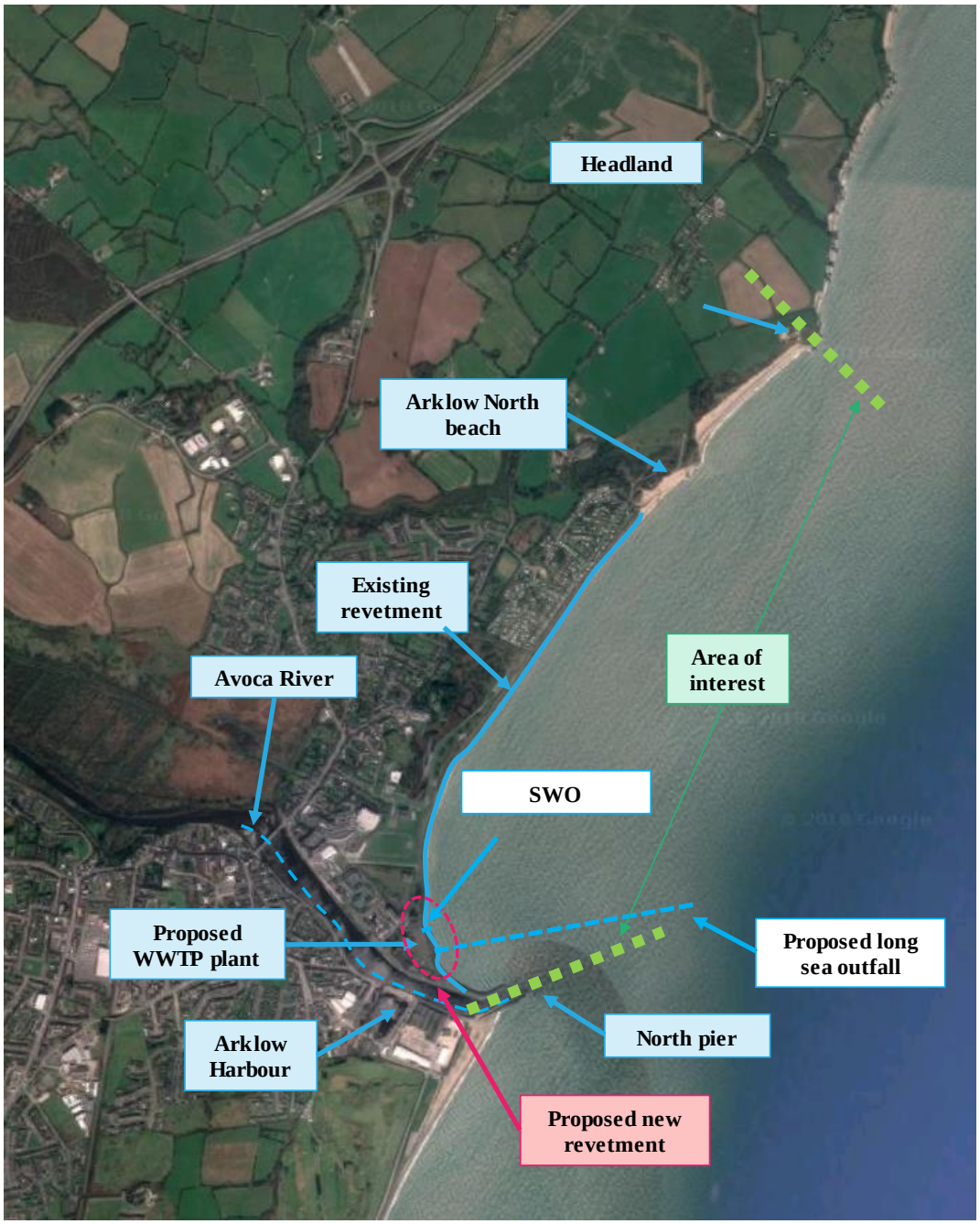

Figure 15.2: Main study area for coastal processes assessment – Extent and features of the Area of Interest

15.2.4 Site Visits

An inspection of the existing revetment was carried out in February 2017 by a chartered senior maritime engineer from Arup. During the inspection visit, the conditions of the structure were assessed and the damage levels evident in different areas of the revetment were investigated.

The topography of the site was studied during a site visit undertaken in April 2018. During the visit, several photographs were taken by members of the project team, which were subsequently used for the assessment.

15.2.5 Consultation

The EPA and Inland Fisheries Ireland were contacted to obtain relevant biological and physico-chemical water quality data for the Avoca River/Estuary.

The project team met Inland Fisheries Ireland on 16 March 2018 to discuss the proposed development (in conjunction with representatives from the proposed Arklow Flood Relief Scheme who were also present to discuss their proposal given the physical overlap of the two schemes within the river channel). An overview of the proposed development was provided.

The physico-chemical water quality information for the period 2008-2017 and the biological water quality (Q Values[8]) information for the period 1974 to 2015 for the Avoca River was provided by the EPA in April 2018.The transitional/coastal water quality information for the Avoca Estuary for the period 2008 to 2017 was provided by the EPA in May 2018.

The water quality status with regard to fish population based on a fish stock survey conducted in the Avoca Estuary in 2015 by Inland Fisheries Ireland was provided in May 2018.

15.2.6 Categorisation of the Baseline Environment

15.2.6.1 Water Quality

A desktop study of relevant water quality data has been undertaken to obtain information on the existing surface water quality within the study area. The following documentation and sources were reviewed as part of this desktop study:

- Survey information from the EPA on the water quality of the study area has been obtained[9]. Specifically, water quality data was collected from the EPA's monitoring stations on the Avoca River (River water quality status of the Avoca River is recorded at the EPA's river water quality monitoring stations [RSA10A031140 and RSA10A031200] located upstream of the Arklow Bridge). The water quality status of the Avoca Estuary is recorded at the EPA's transitional water quality monitoring stations (AV10, AV20, AV30 and AV40). Figure 15.3 shows the location of the EPA monitoring stations;
- There is a now a national RBMP based on a single national River Basin District for 2018 - 2021 which were published in April 2018 and sets out the actions that Ireland will take to improve water quality and achieve 'good' ecological status in water bodies (rivers, lakes, estuaries and coastal waters) by 2027. The information contained in the RBMP was reviewed in relation to water quality[10];

[8] Note - Q values are biotic indicators used to express biological water quality that are based on changes in the macroinvertebrate communities of riffle areas brought about by organic pollution. A seriously polluted river is indicated by Q1 while Q5 indicates unpolluted waters of high quality.
[9] EPA(2018), River water quality reports and maps. Available from: https://gis.epa.ie/EPAMaps/ [Accessed: 27 April 2018)]
[10] RBMP . Available from https://www.housing.gov.ie/water/water-quality/river-basin-management-plans/river-basin-management-plan-2018-2021 [Accessed: 10th July 2018)]

- European Communities Environmental Objectives (Surface Water) Regulations 2009-2015 require monitoring of phytoplankton biomass (chlorophyll), phytoplankton composition and macroalgae in transitional and coastal waters**.** However, it is understood from consultation with the EPA that phytoplankton biomass (chlorophyll) and phytoplankton counts only are used to determine the biological quality element in Arklow transitional/coastal waters. (Refer Tables 15.3 and 15.4 in **Appendix 15.1** for further detail). Biological water quality information was obtained from EPA in the form of Q values[11] and chlorophyll concentrations (Phytoplankton Biomass) in Arklow transitional/coastal waters. The rating for the Q values are shown in Table 15.2 in **Appendix 15.1**;
- Reports were also taken from the Irish WFD website[12] in relation to the water quality status of the Avoca Estuary. Information on the WFD Risk status in relation to the Avoca Estuary was also obtained from EPA website (https://gis.epa.ie/EPAMaps/).

Coastal Water Quality

Background water quality for the Arklow coastal area was derived from EPA[13] and Marine Institute[14] monitoring datasets.

[11] EPA (2018) Q value for the Avoca-Vartry hydrometric area. Available from: http://www.epa.ie/QValue/webusers/ [Accessed: May 2018]
[12] www.wfdireland.ie [Accessed: May 2018]
[13] EPA Water Framework Directive monitoring programme for Transitional and Coastal Waters (TraCs), 2017-2016
[14] Marine Institute, Winter nutrient monitoring western Irish Sea, Arklow Transect, June 2018

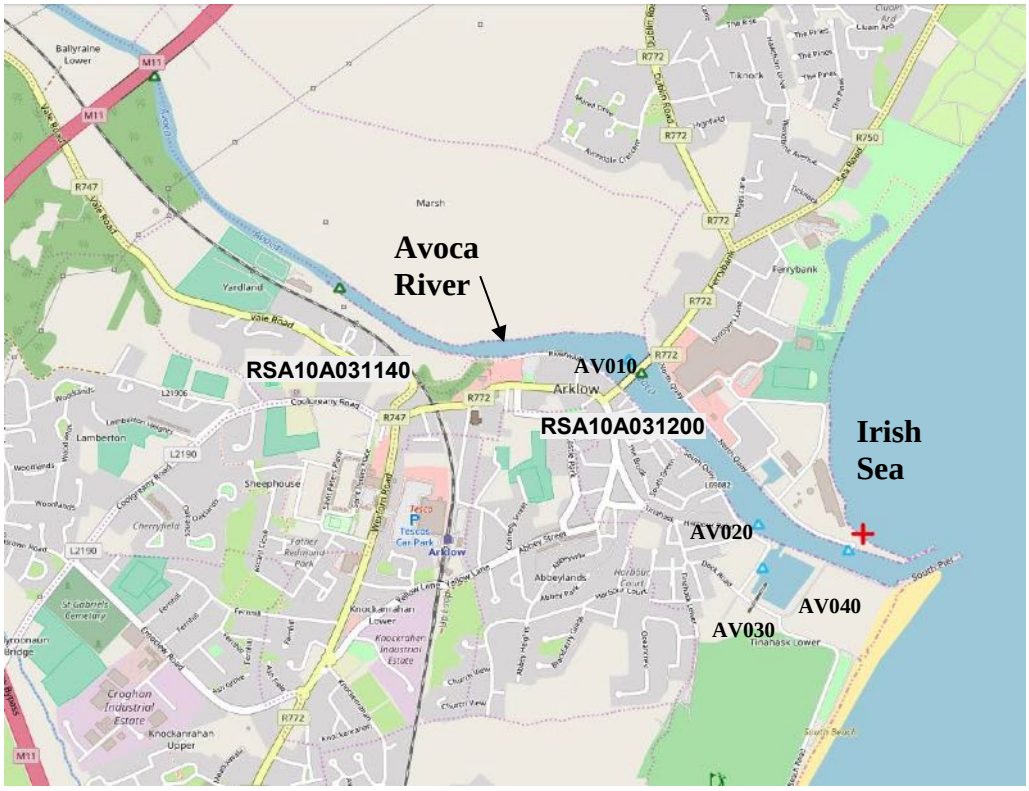

Figure 15.3: Study Area and water quality monitoring stations in Avoca River (extracted from EPA[15]

15.2.6.2 Hydrological Regime

Hydrological Regime

The drainage characteristics of the existing environment were obtained through a desktop study utilising existing topographical surveys to establish the existing drainage routes and storage areas within the study area.

A desktop study was undertaken to establish the baseline information for the study area in relation to flooding and the hydrological regime. Previous flood studies that have been reviewed include the National Preliminary Flood Risk Assessment (PRFA)[16] and the current fluvial flood extent maps[17]. Further, the Strategic Flood Risk Assessment Report produced for Arklow LAP was reviewed with regard to existing and predicted flooding within the study area.

The hydraulic model of the existing and future sewer system was run for various modelling scenarios as per specific recommendations given in the Greater Dublin Strategic Drainage Study (GDSDS) Final Strategy Report[18] for carrying out joint probabilistic flooding assessment of Arklow Sewer Network.

[15] https://gis.epa.ie/EPAMaps/
[16] The National Preliminary Flood Risk Assessment (PFRA) Overview Report (2012)
[17] http://www.floodinfo.ie/map/floodmaps/[Accessed: May 2018]
[18] Greater Dublin Strategic Drainage Study (GDSDS) Final Strategy Report (2005)

The flood simulations undertaken by Hydro Environmental assessed the existing and predicted flood risk due to sewer encroachment and temporary causeway construction in the Avoca River.

15.2.6.3 Coastal processes

A desktop study of relevant data has been undertaken to obtain information on the existing coastal processes within the study area. The following documentation and sources were reviewed as part of this desktop study:

- J.P Byrne & Partners (1990) Coastal Protection Works at North Beach Arklow;
- Byrne, J.P. and Motherway, F.K. (1990) 'Design and construction of coastal protection works at north beach, Arklow, Co Wicklow', Paper presented to a seminar on 'Engineering for Coastal protection' at the Institution of Engineers of Ireland;
- Ordnance Survey Map, 1980. Sheet 40;
- Irish Hydrodata Limited report, 'Arklow WWTP Comparison of marine bathymetric data sets, Irish Hyrdodata 1985 & 1996 vs GSI Informar 2016'
- Reeve, D., Chadwick, A. and Fleming, C. (2004) Coastal engineering: Processes, theory and design practice;
- U.S. Army Corps of Engineers (2002) Coastal Engineering Manual;
- U.S. Army Corps of Engineers (1984) Shore Protection Manual;
- ICPSS report Irish Coastal Protection Strategy Study Phase 2 - South East Coast;
- Irish Hydrodata Limited report (2018), 'Arklow WWTP Investigation of the Impact of Treated Wastewater discharges to the Irish Sea'
- Aerial historical photographs (Google Earth) and historical photographs; and
- Wave modelling as described in Appendix A of **Appendix 15.5.**

A review of the existing ground conditions at the site, both onshore and offshore, from the ground investigations (Refer to **Chapter 14**) and any available historical information, was also undertaken.

15.2.6.4 Flood Risk

A desktop study was undertaken to establish the baseline information for the study area in relation to flood risk. The information with respect to flood risk considered various flood studies including the National Preliminary Flood Risk Assessment (PRFA)[19], the Irish Coastal Protection Strategy Study (ICPSS)[20] and the Eastern Catchment Flood Risk Assessment and Management Study (Eastern CFRAM)

[19] The National Preliminary Flood Risk Assessment (PFRA) Overview Report (2012)
[20] ICPSS documents: https://www.opw.ie/en/flood-risk-management/floodanderosionmapping/icpss/ [Accessed: May 2018]

flood maps and reports[21]. The Strategic Flood Risk Assessment Report produced as part of the Arklow LAP was also reviewed with regard to existing and predicted flooding within the study area.

The baseline assessment of the coastal revetment protecting the site has been categorised based on a review of the following:

- The results of the revetment inspection discussed in **Sections 15.2.1 and 15.2.3**.
- Observations and photographs taken during the site visit discussed in **Section 15.2.3.**

15.2.7 Impact Assessment Methodology

15.2.7.1 Hydrological Regime and Drainage

The assessment considers the proposed development and how relevant aspects have the potential to change the physical characteristics and thus the drainage and flood characteristics of the study area. The assessment specifically considers how any change interacts with the drainage network and how significant the change is in the context of the relevant legislation.

The baseline data (particularly the topography) has been used to establish drainage characteristics within the study area. The proposed development has been assessed to ascertain if there would be any likely significant effects on the natural drainage and the sewer network within the study area. Hydraulic modelling of the sewer network was carried out in Infoworks software program to assess the performance of the existing sewer network for flooding. Details of the hydraulic assessment are described in **Section 15.2.7.4** with further detail in available in **Appendices 15.3 and 15.4**.

15.2.7.2 Water Quality

Surface Water Quality

Surface water quality has been assessed by determining the baseline as described in **Section 15.2.5.1**, reviewing the data and establishing the likely significant effects as a result of the proposed development based on the parameters outlined in the legislation (Refer to **Section 15.2.2**). To achieve this, the proposed development has been reviewed in detail and considered to assess the likely significant effects on surface water quality. The assessment specifically considers how any change interacts with the receiving waters and how significant is the change in the context of the relevant legislation.

[21] Eastern CFRAM reports and maps available to download from: http://www.floodinfo.ie/ [Accessed: May 2018]

Inland Fisheries Ireland information and guidance[22] was also used in the assessment of construction effects on surface water quality.

Coastal Water Quality

The likely significant effects of the proposed discharges from the long sea outfall and SWO at the WwTP on coastal water quality were assessed using various calculations and hydraulic modelling methods. These included:

- Initial dilution simulations of the outfall diffuser;
- Water circulation modelling;
- Contaminant dispersion modelling.

A jet type model was used to simulate the effluent stream issuing from the diffuser and to estimate the near-field dilutions at the immediate discharge location. Water movements in the wider area were simulated with a 2D-hydrodynamic model driven by tidal forcing. A contaminant simulation model, driven by hydrodynamics was used to evaluate the location-specific impacts of discharges within the mid- and far-field areas. **Appendix 15.2** provides further details of the assessment methodology.

In terms of applicable water quality standards, given that none of the local waterbodies are designated 'sensitive', the minimum design parameters for the plant used in the assessment were those in Table 15.1

Table 15.1: Minimum WwTP Design Standards (Source: Urban Wastewater Treatment Regulations)

Parameters	Final Effluent Concentration	Minimum Percentage Reduction on Source Effluent
BOD5	25mg/l O2	70 - 90
COD	125mg/l O2	75
SS	35 mg/l	90

The target water quality standards for various environments are listed in Table 15.2 and Table 15.3. The parameters that are most relevant to the proposed outfall are e.coli, intestinal enterococci (IE), dissolved inorganic nitrogen (DIN) and biochemical oxygen demand (BOD). Concentrations for other parameters such as orthophosphate (PO4) and total ammonia (TA) are not specified for coastal waters but are included here for completeness.

Under the European Union Environmental Objectives (Surface Water) (Amendment) Regulations 2015 (S.I. No.386 of 2015)[4], the DIN target must be achieved at the edge of the mixing zone. A regulatory method for determining the extent of the mixing zone is not defined. It is required to be restricted to the proximity of the discharge and be proportionate.

[22] Inland Fisheries Ireland (2016) Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters

Various non-binding guidelines for the assessment of discharges have been developed under the EC Common Implementation Strategy for the Water Framework Directive. The general approaches for identifying mixing zones[23] are followed. The design objective of 'High Status' is used to delineate the mixing zone extent.

Table 15.2: Target water quality standards for surface waters (SI 272/2009, SI 386/2015)

Parameter	**Transitional Waters**	**Coastal Waters**
BOD (mg O2/l)	<4.0 (Good Status, 95%ile)	Not Specified
Dissolved Oxygen (DO) (% sat)	Summer (95%ile) 80%<DO<120% (35psu) 70%<DO<130% (0psu)	Summer (95%ile) 80%<DO<120% (35psu)
Suspended Solids (SS) (mg/l)	Not Specified	Not Specified
Total Ammonia (mg N/l)	Not Specified	Not Specified
PO4 (mg P/l)	0.06mg/l (0-17psu) median 0.04mg/l (34psu) median	Not Specified
Dissolved Inorganic Nitrogen DIN (mg N/l)	Good Status <2.6mg/l(0psu) median Good Status <0.25mg/l(34.5psu) median High Status <0.17mg/l(34.5psu) median	

Table 15.3: Target bacterial water quality standards for bathing waters

	Bathing Waters Target	**Regulation/Code**
E.coli	<250 cfu/100ml (Excellent Quality)	Bathing Waters: SI 79/2008, 2006/7/EC Based on 95%ile evaluation
Intestinal enterococci (IE)	<100 cfu/100 ml (Excellent Quality)	

Only three of these target values are of particular significance for the marine outfall. These are e.coli, IE and DIN. The relatively high levels of bacterial contamination in the treated effluent mean that e.coli and IE are usually the most critical parameters in outfall evaluation when bathing areas are located nearby.

There are no standardised decay times for these two parameters as they vary substantially with environmental stress factors including ambient solar radiation, season and water clarity. Typically a conservative e.coli decay time of 12 hours and an IE decay time of 24 hours are used in the industry.

While it is acknowledged that the WwTP will likely comprise two phases (in terms of the process installation), the assessment has considered the full design capacity (36,000PE). Tables 3.8 and 3.9 of **Appendix 15.2** set out the water quality standards that will be achieved in the final effluent and the SWO design standards, respectively.

[23] EC (2009) Technical Guidelines for the Identification of Mixing Zones pursuant to Art.4(4) of the Directive 2008/105/EC.

15.2.7.3 Coastal Processes

The coastal processes assessment uses the desk based study of the historical evolution of the coastline within the study area, previous studies undertaken, as well as the wave modelling and empirical formulae (see **Appendix 15.5**) to assess the likely significant effects of the proposed outfall, revetment and the SWO at the WwTP site on coastal processes.

The impact assessment methodology has categorised the likely significant effects during construction and operation of the proposed development in accordance with the overarching EIA guidance (described in **Section 1.4.3 of Chapter 1).**

15.2.7.4 Flood Risk

Flood risk has been assessed by determining the baseline conditions (fluvial and coastal flood extents) and establishing the likely significant impact of the proposed development on flood risk.

For the site of the WwTP a desktop study is sufficient to assessment the likely significant effects of the proposed development. For the interceptor sewers however, detailed hydraulic modelling has been undertaken in order to assess in detail the impact of construction of the interceptor sewers on flood risk. (Refer to **Appendix 15.3** and **Appendix 15.4**). This information was then used to identify the likely significant effects that the proposed development may have on flood risk along the routes of the interceptor sewers.

The baseline data has been used to establish flood routes, levels and storage areas within the study area. A detailed hydraulic modelling exercise of the Arklow sewerage network incorporating the proposed development was carried out to determine the flooding impacts (Refer to **Appendix 15.4**).

The hydraulic assessment of the existing sewer system of Arklow was carried out to assess baseline existing flooding risk. The hydraulic assessment results indicate that the existing wastewater network in Arklow is significantly under capacity and is predicted to flood at more than 100 locations with flood volumes greater than 25m³ for a 1 in 30-year storm event. The assessment of the spill volumes shows that approximately 7,566m³ of raw wastewater is predicted to spill via the existing outfalls into the Avoca River during Dry Weather Flow (DWF).

The above information was then used to identify the likely significant effects that the proposed development may have on flooding in the study area.

15.3 Baseline Conditions

15.3.1 Introduction

The study area is located in the Arklow catchment, in Arklow town, which is located at the mouth of the Avoca River. Arklow Municipal District has a population of 26,185[24] while the urban settlement had a population of 13,163[25].

The key water features in the study area include:

- Avoca River;
- Arklow Estuary;
- Arklow Town Marsh pNHA; and
- Irish Sea.

15.3.2 Hydrology and Water Quality

15.3.2.1 Hydrological Regime

The main hydrological feature within the study area is the Avoca River as shown on Figure 15.4. The Avoca River is the longest river in County Wicklow and it's catchment covers an area of approx. 650km² on the eastern flanks of the Wicklow Mountains. The Avoca River discharges into the Irish Sea in Arklow town.

The main tributaries of the Avoca River, that join the river upstream of Arklow, include the Aughrim, Avonbeg and Avonmore Rivers as shown in Figure 15.5.

The study area drains directly into the Avoca River as overland flow and also via the Aughrim and Avonbeg rivers, their associated tributaries and other manmade drains and/or surface water outfalls within the Avoca catchment. The construction of major motorways and significant residential development throughout Arklow and Aughrim towns has significantly modified the natural drainage characteristics of the catchment of the Avoca River. Figure 15.4 illustrates the catchment of the Avoca River.

[24] Arklow and Environs Local Area Plan 2018 - 2024
[25] Central Statistics Office - census.SWO.ie/sapmap

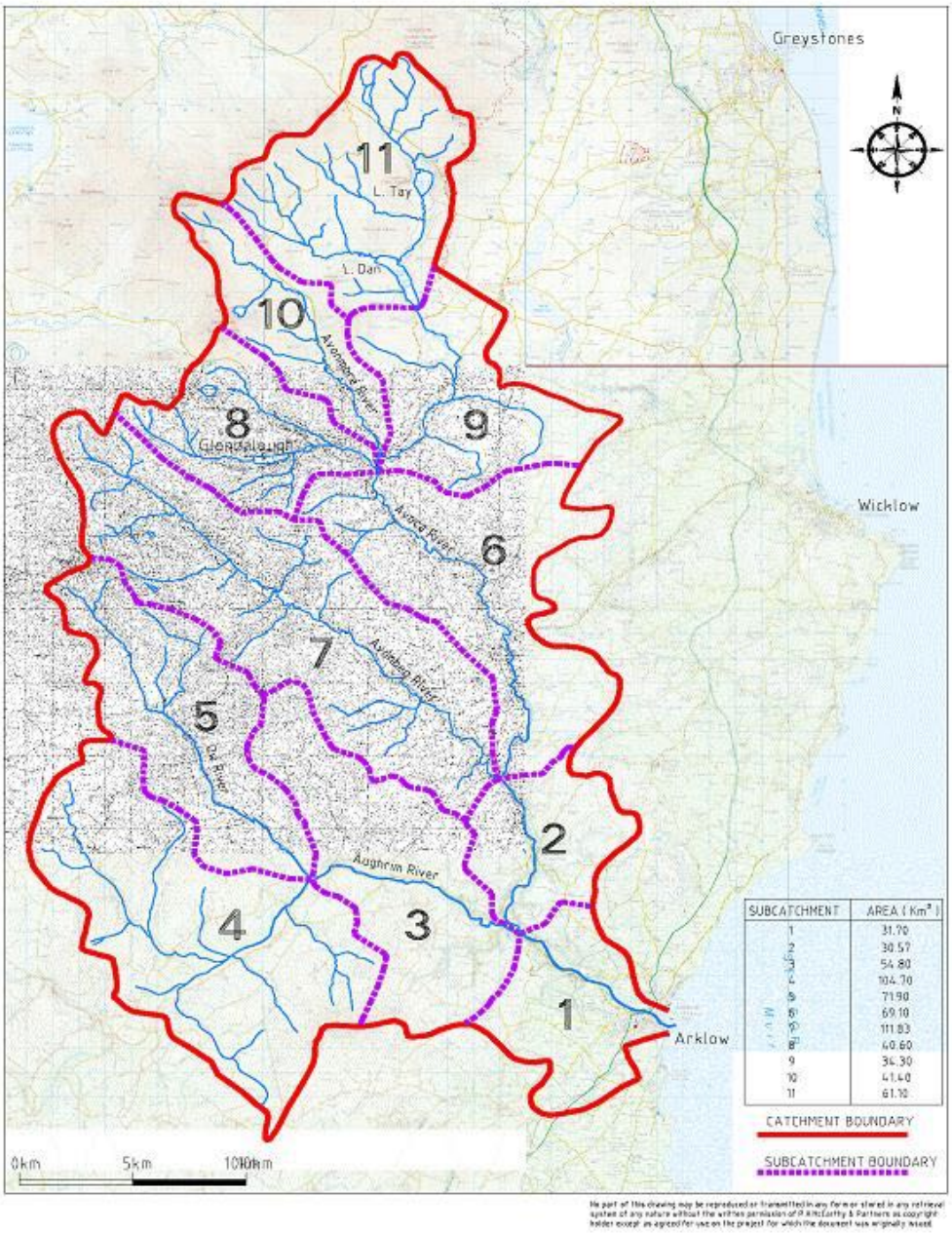

Figure 15.4: Avoca River Catchment

Figure 15.5: Catchment Area and main tributaries of Avoca River

Arklow is divided by the Avoca River, which is crossed by the Arklow Bridge, a stone arch bridge linking the southern of the town with the northern part, called Ferrybank.

Ferrybank is predominantly residential in nature with a large recreational amenity and a wetland wildfowl park at Arklow Town Marsh which is the primary ecological feature that is designated as a proposed natural heritage area (pNHA). Arklow Town Marsh is located to the north of the river channel, extending upstream from Arklow Bridge to within 235m of the M11 flyover. It should be noted that Ferrybank is impacted by fluvial rather than tidal flooding. Flooding occurs in Ferrybank when floodwater exits the Arklow Town Marsh.

The Avoca Estuary is a relatively small, narrow estuary that runs from Pearse Park Yard located near the Alps to Arklow Bay. The river channel (which is part of the Avoca Estuary) is within the Arklow Town Marsh pNHA. The estuary primarily consists of sea walls, boat moorings and piers. The estuary upstream of the Arklow Bridge has steep banks and is heavily wooded with large trees on both banks. The estuary covers an area of 0.17km². Downstream of Arklow Bridge (along the North Quay and South Quay) is prone to tidal flooding. This area experiences periodic flooding from significant tidal events.

It should be noted that water quality in the Avoca Estuary is currently impacted by the discharge of untreated wastewater via 19 existing SWOs and/or outfalls located along the northern and southern sides of the river channel within the study area.

As noted in **Sections 1.4.2 of Chapter 1** and **Section 2.3.1 of Chapter 2**, the practice of discharging untreated wastewater to the Avoca River is not compliant with the obligations of the UWWT Directive[26] and the proposed development is being progressed to address this issue.

Coastal regime

The general bathymetry for the Arklow area is available on the Admiralty chart of the area (See Figure 2.1a in **Appendix 15.2**). The nearshore coastal area was surveyed in 2016 by the Geological Survey of Ireland under the Infomar programme[27] and shows that there are no major differences between the older Admiralty and the more recent Infomar datasets in the vicinity of the proposed development. However, some erosion has taken place locally adjacent to the shoreline, as documented in **Section 15.3.3**.

Tidal ranges are small and the tidal elevation curves are somewhat complex due to the proximity of a degenerate amphidrome near Courtown[28]. Predicted water levels at Arklow (based on a 2015 representative year – See **Appendix 15.2** for further detail) indicate a highest predicted tide level over the year of 0.58m OD while the lowest level is -0.85m OD.

The oceanography at the site, based on previous Irish Hydrodata studies (see **Appendix 15.2** for further detail) can be described as energetic with strong tidal currents, brief slack waters, large tidal excursions and good dispersive characteristics. Durations of slack water at the site are limited, as confirmed by drogue surveys undertaken by Irish Hydrodata in September 2017 (see **Appendix 15.2** for further detail).

15.3.2.2 Water Quality

Surface Water Quality

Avoca River

The quality of surface waters in Ireland is examined regularly by the EPA to monitor performance against a number of biological parameters. The EPA's trophic status assessment compares the compliance of individual parameters against a set of criteria indicative of trophic state. These criteria fall into three different categories which broadly capture the cause-effect relationship of the eutrophication process, namely nutrient enrichment, accelerated plant growth, and disturbance to the level of dissolved oxygen normally present. Each water body assessed is categorised as either eutrophic, potentially eutrophic, intermediate or unpolluted with respect to nutrient enrichment.

[26] Council Directive 91/271/EEC, as amended by Commission Directive 98/15/EC, Regulation (EC) No 1882/2003 of the European Parliament and of the Council, Regulation (EC) No 1137/2008 of the European Parliament and of the Council and Council Directive 2013/64/EU
[27] GSI Informar data, 2016
[28] Admiralty, 1980, Chart 5058, Co-tidal and Co-range Lines for the British Isles and adjacent waters.

The Avoca River/Estuary falls under 'Transitional Waters' and was given 'Moderate' water quality status by the EPA in the last reporting period 2010 - 2015.

It should be noted that 55 out of the 80 monitored transitional water bodies (69%) were classified at moderate or worse status during 2010 – 2015[29], with 25 (31%) at high or good status. Four water bodies were classified as bad status.

The Q values (i.e. biological quality rating as described in detail in **Section 15.2.6.1**) for the Avoca River within the study area are summarised below (Refer to Table 15.5 in **Appendix 15.1** for further detail):

- The Q value for the Avoca River was '1' in 1990 at Arklow Bridge River Monitoring Station (Station No. RS10A031200) which indicates serious pollution of the river. There has not been any biological quality survey undertaken since 1990 at this monitoring station.
- The river monitoring stations upstream of Arklow Bridge at Shelton Abbey (Station No RS10A031000) and at the footbridge 500m downstream of the Aughrim River and just upstream of the Avoca River confluence (Station No RS10A030900) were last surveyed in 1986 and 1994. The respective monitoring stations were given Q values of 2 and 1 in 1994 indicating serious pollution of the Avoca River at this location.
- The only monitoring station that has been regularly surveyed is at the Avoca Bridge (Station No RS10A030700) which is approximately 10.5km upstream of the Arklow Bridge and 2.6km downstream of the Avoca Mines. A Q value of 3 was determined during the latest survey in 2015. This Q value indicates that the Avoca River is moderately polluted at this location.

The latest Biological River Quality Surveys Report[30] indicates that the paucity of pollution macroinvertebrate fauna continues to indicate poor ecological conditions with toxic effects due to acid mine drainage at Avoca Bridge in July 2015. Further detail on the baseline aquatic ecology conditions is provided in **Section 11.3 of Chapter 11**.

The surface water quality of the Avoca River within the study area was found to have a Q value of less than 4 which is classed as 'polluted' and determined as 'unsatisfactory' condition by the EPA. This indicates significant interferences with beneficial or potential beneficial uses of the Avoca River due to the pollution, in part, caused by discharge of untreated wastewater into the Avoca River within Arklow town via the existing 19 SWOs and/or outfalls.

[29] EPA Water Quality in Ireland (2010 -2015) - http://www.epa.ie/pubs/reports/water/waterqua/Water%20Quality%20in%20Ireland%202010-2015.pdf

[30] EPA River Quality Surveys: Biological - http://www.epa.ie/QValue/webusers/PDFS/HA10.pdf?Submit=Get+Results – [Accessed 27th April 2018]

In contrast, the main tributaries to the Avoca River – the Aughrim, Avonbeg and Avonmore Rivers which lie outside the study area were given Q values of 4-5 indicating that these rivers are mostly 'unpolluted' and generally in 'satisfactory' condition with respect to beneficial uses.

As noted in **Section 15.2.6.1**, chlorophyll (phytoplankton biomass) and phytoplankton counts have been used to determine the Phytoplankton Biological Quality Element.
The EPA has indicated that in the last assessment (2010-2015) for the Avoca/Arklow Estuary the Phytoplankton Biological Quality Element was assessed as 'High'. This indicates that the estimated values in Avoca Estuary for Biological Quality elements can generally be designated as high ecological status (Refer to **Section 11.3 of Chapter 11** for further details on aquatic ecology).

The EPA's physio-chemical data from the 2013-2015 sampling periods for monitoring points immediately upstream and within the study area are shown in Tables 15.6 - 15.10 in **Appendix 15.1**. The locations of all stations where water quality is monitored are shown in Figure 15.3. In summary, the majority of the parameters are in compliance with the surface water quality standards. Parameters that are above the standards are highlighted in bold in Tables 15.6 – 15.10 in **Appendix 15.1**.

Overall the physio-chemical parameters indicate compliance with the European Communities Environmental Objectives (Surface Water) Regulations 2015[4], with the exception of BOD_5 and Ammonia Total values which were found to be above the limits outlined in these regulations.

WFD Status & Risk

The study area is located within the national river basin district under the RBMP 2018 – 2021.

The most recent water quality status report[31] on the Avoca Estuary showed the following (Refer to Table 1 in **Appendix 15.1** for further detail):

- The overall WFD status of the Avoca River within the study area was 'Moderate' (Refer to Figure 15.6);
- The Avoca Estuary was given 'At risk' status;
- Ecological status for the Avoca Estuary was classed as 'Unassigned' due to insufficient information;
- Chemical surface water status was classed as 'Failing to achieve good';
- Hydro-morphological status was specified as 'Moderate'; and
- A stretch of the Avoca River within the study area fails the Specific Pollutant Conditions.

[31] Transitional Waterbody WFD Status 2010-2015 IE_EA_150_0100 https://gis.epa.ie/EPAMaps/ [Accessed 3rd May 2018]

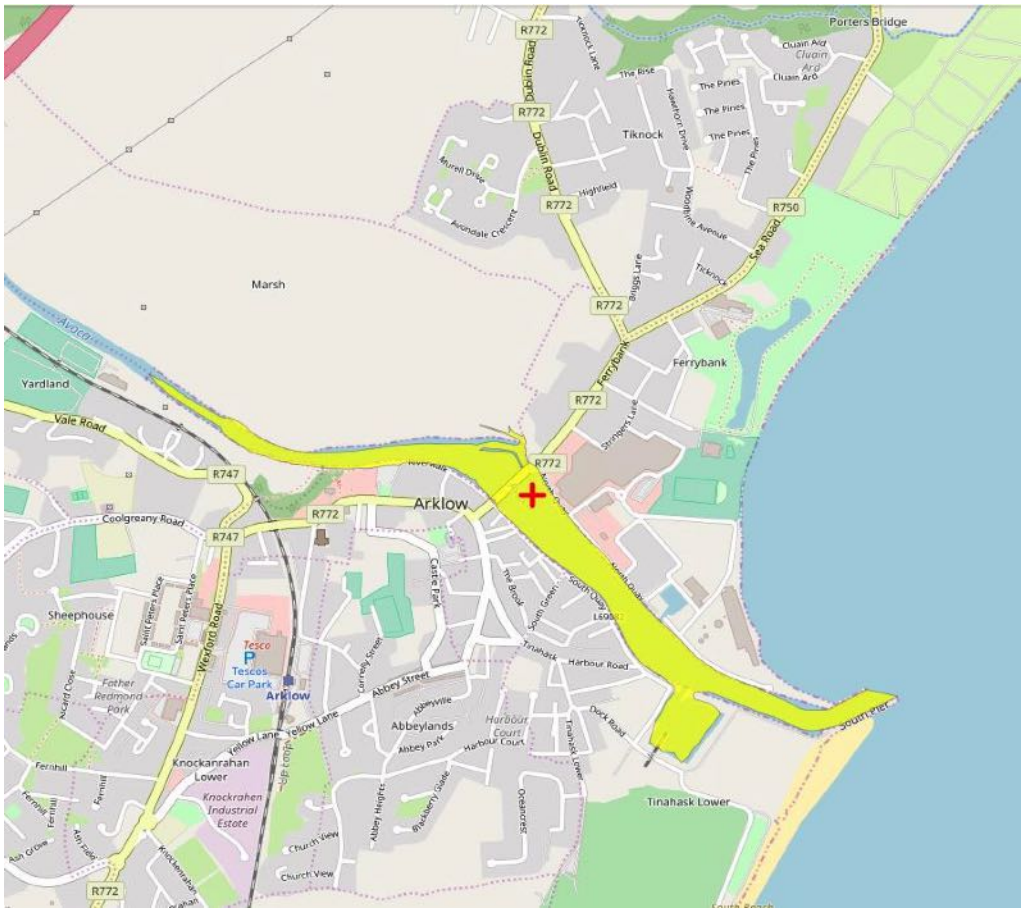

Figure 15.6: Avoca Estuary Water Quality Status – Moderate, WFD (extracted from EPA[15])

Whilst the ecological status was 'unassigned', the Avoca Estuary has been assigned a draft ecological status classification of 'good' (EQR=0.68) based on the fish populations present during a 2015 fish stock survey[32] carried out at sites on the Avoca Estuary by Central Fisheries Board and the Eastern Regional Fisheries Board.

The risk report for the Avoca River[33] identified that the surface water quality is at risk from diffusion contamination, particularly pollutants from road washing activities. The report also specified that at present there is no hydrological risk or morphological risk to the Avoca River. Table 15.4 outlines the WFD's water quality data for the Avoca Estuary.

[32] WFD Fish Stock Survey of Transitional Waters in the Eastern River Basin District – Avoca Estuary 2015
[33] Transitional Waterbodies RiskIE_EA_150_0100 https://gis.epa.ie/EPAMaps/ [Accessed 3rd May 2018]

Table 15.4: WFD Status of the Avoca Estuary 2010 – 2015 (Source: EPA[34])

European_Code	IE_EA_150_0100	Comment
Name	Avoca Estuary	-
Status	Moderate	-
Period_for_WFD_Status	SW 2010-2015	This data is from the period 2010 - 2015
Bio_Status	Good	Good status indicates that macro invertebrate and fish quality elements assessed were in compliance with WFD standards
Chemical_SW_Status	Failing to achieve good	Chemical status is assessed by compliance with environmental standards for priority substances and priority hazardous substances such as metals, pesticides etc Avoca Estuary is one of the 21% of river water bodies that failed to achieve their chemical status objective during this period.
Dissolved_ Oxygen_ Saturation	Good	Low DO affects aquatic life & organisms that live in the sediments. A good status of DO in Avoca River indicates it supports aquatic life
Fish Status	Good	Good Fish status indicates that fish species composition and abundance corresponds with little anthropogenic disturbance
General Conditions	Good	Good status of general conditions includes oxygenation & nutrient conditions, thermal conditions, transparency salinity
Hydromorphological_Conditions	Bad	Good hydromorphological conditions support aquatic ecosystems (i.e. hydromorphological elements such as water flow and substrate provide physical habitat for biota such as fish, invertebrates and aquatic macrophytes). However, it was classed as Bad for Avoca River which indicates that waterflow and substrate provided are not adequate.
Nutrient Conditions	Good	Monitoring of phosphorus (P) and nitrogen (N) nutrients causing eutrophication, is undertaken by the EPA. A good nutrient condition indicates there is no eutrophication of Avoca river
Other_Nutrient_Conditions	Good	Nutrients other than phosphorus (ortho Phosphate) and nitrogen (Nitrate & Ammonia) were found to be within reference conditions values

[34] EPA Transitional Waterbody WFD Status 2010-2015 IE_EA_150_0100 https://gis.epa.ie/EPAMaps/ [Accessed 3rd May 2018]

European_Code	IE_EA_150_0100	Comment
Other_Oxygenation_Conditions	High	Oxygenation conditions other than BOD and DO were found to be meet reference conditions values to be classed as High
Oxygenation_Conditions	Good	Oxygenation conditions are classified as Good based on being 99% confident that relevant water quality standards in SI 272 of 2009 are exceeded
Phytoplankton_Status	High	Measure of phytoplankton biomass as concentration of chlorophyll a in µg/l. Degradation in ecological status measured by increase in chlorophyll concentrations assessed against a salinity related threshold.
Specific_Pollutant_Conditions	Fail	All priority substances plus other pollutant substances discharged in significant quantities are measured. An assessment of dangerous substances in Water Framework Directive Transitional and Coastal Waters indicates that face value comparison against standards set out in Schedule 5, Table 10 of SI 272 of 2009 is not met by Avoca Estuary
Supporting_Chemistry_Conditions	Moderate	The values for Supporting Physico-Chemical elements should not exceed levels established so as to ensure: (a) The functioning of ecosystem; and (b) The achievement of the values specified for the biological quality elements. Avoca River is given moderate status as it fails on the supporting physico-chemical quality elements.

Coastal Water Quality

In terms of background coastal water quality, the available data for both the Avoca estuary and coastal waters in the vicinity are provided in Table 15.5, Table 15.6 and Table 15.7.

Table 15.5: Coastal background water quality data (2007 – 2016)

Station No	Sample Depth	Salinity	TON mg/l N	NH_3 mg/l N	DIN mg/l N	BOD mg/l	Season
AV110	0.0	33.22	0.16	0.014	0.174	1.0	Winter
AV110	9.7	33.25	0.15	0.022	0.172	1.0	Winter
AV110	0.0	34.14	0.01	0.016	0.026	1.0	Summer
AV110	9.7	34.17	0.01	0.021	0.031	1.0	Summer
AV120	0.0	28.87	0.21	0.122	0.332	1.0	Summer
AV120	9.8	34.15	0.01	0.023	0.033	1.0	Summer
AV130	0.0	32.93	0.19	0.016	0.206	1.0	Winter
AV130	10.1	33.20	0.15	0.018	0.168	1.0	Winter
AV130	0.0	30.78	0.02	0.017	0.037	1.0	Summer
AV130	6.4	34.12	0.02	0.050	0.07	1.0	Summer
AV150	0.0	33.38	0.14	0.014	0.154	1.0	Winter
AV150	18.0	33.39	0.14	0.022	0.162	1.0	Winter
AV150	0.0	34.14	0.02	0.014	0.034		Summer
AV150	15.0	34.19	0.02	0.012	0.032		Summer
AV160	0.0	33.25	0.14	0.022	0.162		Winter
AV160	13.5	33.36	0.14	0.014	0.154		Winter
Average			0.10	0.026	0.122	1.0	
Median		33.37	0.14	0.017	0.154	1.0	

Table 15.6: Avoca Estuary background water quality data (Station Av010) (2007 – 2016)

Sample Depth	‰	TON mg/l N	NH3 mg/l N	B.O.D. mg/l O2	DIN mg/l N	PO4 µg/l P
0	0.03	2.50	0.05	1.0	2.55	25
0	0.04	2.60	0.03	3.0	2.63	12
0	0.25	2.60	0.03	3.0	2.63	12
0	0.02	0.99	0.05	1.0	1.04	33
0	0.02	1.20	0.08	1.0	1.28	2.5
0	0.03	1.30	0.08	1.0	1.38	6
0	0.03	1.30	0.08	1.0	1.38	6
0	0.04	1.90	0.10	1.0	2	24
0	0.07	2.80	0.14	1.0	2.94	5
0	0.18	2.20	0.20	2.0	2.4	8.4

Sample Depth	‰	TON mg/l N	NH3 mg/l N	B.O.D. mg/l O2	DIN mg/l N	PO4 µg/l P
3	1.28	2.10	0.12		2.22	6.1
3	0.04	1.70	0.14	1.0	1.84	12
0	0.04	1.82	0.055	0.5	1.875	2.5
0	0.03	1.02	0.095	0.5	1.115	5
0	0.06	1.5	0.132	0.5	1.632	7
2.6	0.11	1.49	0.129	0.5	1.619	5
0	2.03	1.43	0.196	1.2	1.626	10
0	2.16	1.36	0.245	1.4	1.605	11
Average	0.36	1.77	0.11	1.21	1.87	10.69
Median	0.04	1.60	0.10	1.00	1.74	7.70

Table 15.7: Clogga Beach and Brittas Bay South bacterial water quality data (2016-2017)

Clogga Beach			Brittas Bay South		
Date	**e.coli/100ml**	**IE/100ml**	**Date**	**e.coli/100ml**	**IE/100ml**
04/09/2017	98	35	04/09/2017	243	25
21/08/2017	160	92	21/08/2017	51	<10
14/08/2017	110	<10	14/08/2017	52	<10
31/07/2017	52	53	31/07/2017	10	10
17/07/2017	<10	<10	17/07/2017	41	<10
03/07/2017	10	<10	03/07/2017	10	<10
19/06/2017	10	<10	26/06/2017	63	13
12/06/2017	20	23	19/06/2017	<10	<10
22/05/2017	<10	10	12/06/2017	20	<10
05/09/2016	605	240	22/05/2017	<10	<10
22/08/2016	10	68	05/09/2016	20	<10
08/08/2016	187	20	22/08/2016	10	12
25/07/2016	122	20	08/08/2016	51	14
11/07/2016	122	73	25/07/2016	10	<10
04/07/2016	<10	<10	11/07/2016	183	53
27/06/2016	<10	<10	04/07/2016	20	<10
13/06/2016	20	<10	27/06/2016	<10	<10
30/05/2016	31	<10	20/06/2016	20	11

The median background values are summarised as follows:

Coastal locations AV110 to AV160 (Refer to Table 15.5):

- DIN = 0.154mg/l N;

- A = 0.017mg/l N

Corresponding values for the estuary location AV010 (Refer to Table 15.6):

- DIN = 1.74mg/l N;
- TA = 0.1mg/l N.

Whilst the median DIN in the Marine Institute data for the sites shoreward of the Arklow Bank is 0.156mg/l N.

Bacterial sampling data is available for both Clogga beach to the south and Brittas Bay beach to the north. Data for the bathing seasons in 2016 and 2017 are listed in Table 15.7. Both beaches are assigned Excellent Status in terms of the Bathing Quality Regulations (e.coli <250 cfu/100ml, IE <100 cfu/100ml).

The calculated 95%ile values based on the last 4 years of sampling data for Clogga are e.coli = 185cfu/100ml and IE = 79 cfu/100ml and for Brittas e.coli = 173 cfu/100ml and IE = 68 cfu/100ml respectively. There is some appreciable overall variation in this data and the results may be impacted either by the existing Arklow town discharges or also possible contamination from more local licensed outfalls.

15.3.3 Coastal Processes

A detailed description of the existing coastal processes in the study area is provided in **Appendix 15.5**. A summary of the main conclusions with regard to the baseline coastal processes is as follows:

- The existing structures (i.e. existing revetment and harbour entrance at the mouth of the Avoca River) influence coastal processes in the study area. The construction of the revetment (in 1972 and subsequent upgrade in 1990) caused the coastline in the study area to be rigidized over a length of approximately 900m as demonstrated by Irish Hydrodata[35].
- Whilst the coastline has been fixed for a number of years, there is evidence of an ongoing natural loss of seabed material as the previously existing beach (in front of the revetment at the WwTP site) is no longer visible. Seabed lowering between 1985 and 2016 in front of the revetment at the WwTP site ranges between 0.5m and 2m. This value in addition to the 30-year difference between the two surveys, suggests that the sediment transport processes in this specific area are limited.
- In areas to the north of the WwTP site, seabed erosion continues to approximately 400m offshore (to a depth of approximately 6m). Beyond this point, the seabed remained relatively stable between the survey dates.

[35] Irish Hydrodata Limited report, 'Arklow WWTP Comparison of marine bathymetric data sets, Irish Hydrodata 1985 & 1996 vs GSI Informar 2016'

Seabed lowering is shown to be higher towards the north, which could be explained by the shelter, provided by the north pier at the entrance, to the southern end of the revetment (i.e. area adjoining the WwTP site).

- The predominant direction of offshore waves along the coastline are north-east and south-east. The main longshore drift of sediments moves from South to North in the study area. Therefore, the two piers (which form the entrance of the Arklow harbour mouth) act as a barrier to sediment transport from the south. Hence, accretion of sediment is expected to be occurring to the south of the study area (south of the entrance to Arklow Harbour) with further loss of sediments likely in the north.
- The existence of the harbour entrance provides shelter to the existing revetment at the WwTP site from wave action from the second quadrant directions (i.e. south to east south-east). This shelter means that the stretch of the revetment to be upgraded is more protected from wave action from the directions coming from the second quadrant (i.e. east-southeast to south) than the remainder of the existing revetment to the north of the WwTP site.
- The stable coastline created by the revetment also means that there is a very limited sediment source existing in the Area of Interest apart from the seabed material and the unprotected areas to the north.
- Based on the results from the desk study and wave model (Refer to Appendix A within **Appendix 15.5**), and considering a return period of five years and climate change, it could be expected that the surf zone, where most of the sediment transport occurs in this scenario due to wave breaking and currents, would be limited offshore to the bathymetric line of -6.5m CD. For annual average conditions, the extent of the surf zone is limited to shallower waters, closer to the coastline.

15.3.4 Flood Risk

Arklow has experienced recurring flooding events in the past, some of which have resulted in damage to property. The largest flood event recorded in the study area was in August 1986 resulting from extreme meteorological conditions commonly referred to as ‘Hurricane Charlie’. The following major flooding events have occurred between 1989 and 2015 - December 1989, November 2000, February 2002, October 2004, October 2005, January 2010, January 2013 and December 2015.

Information on historical flooding events was obtained by reviewing the OPW’s flood database[36]. In total 18 flood events have been recorded in Arklow town since 1986, of which 15 were recorded on the southern side of the Avoca River in Arklow town (Refer to Figure 15.7). Recurring flooding was reported on several sites to the south of the river channel including along South Quay. The Arklow Flood Relief Scheme, is proposed to address this flooding risk.

[36] OPW Floodmaps http://www.floodmaps.ie/View/Default.aspx [Accessed May 2018]

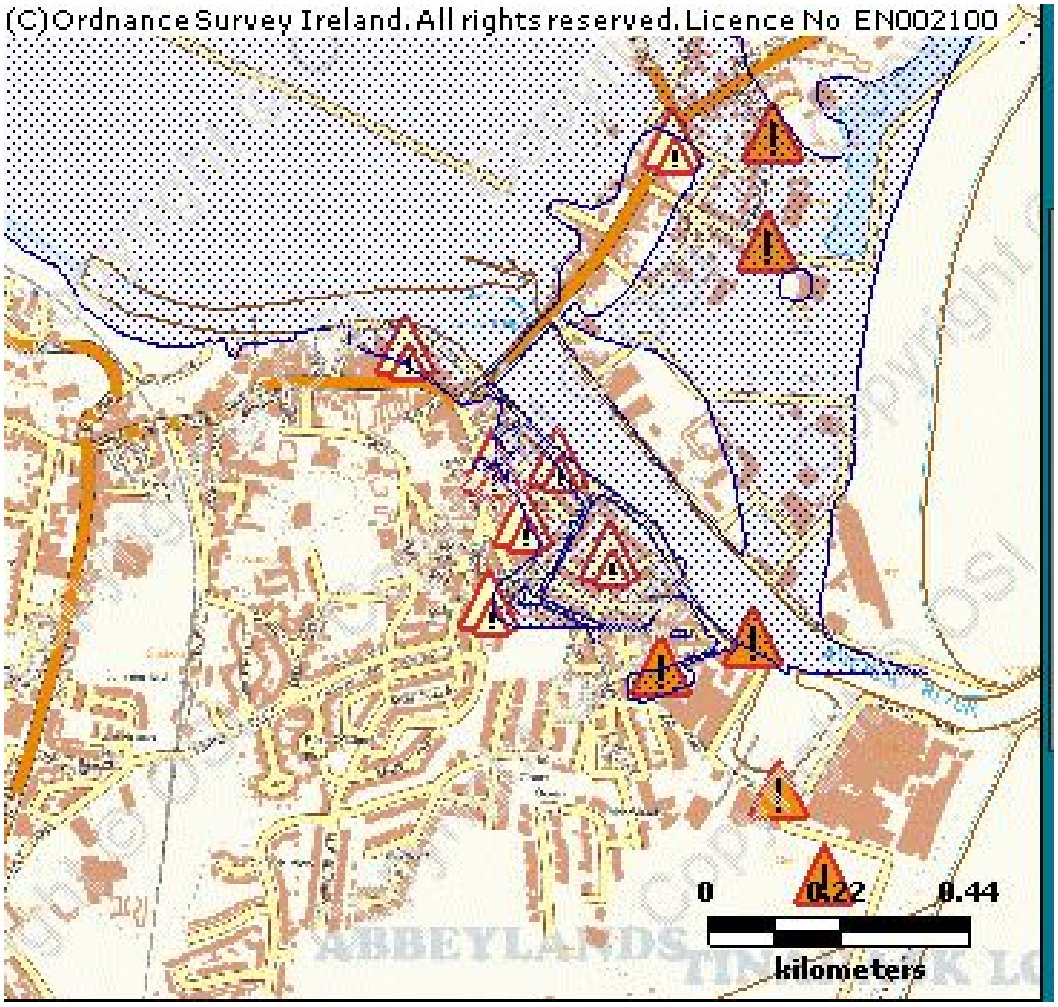

Figure 15.7: Flood events recorded on OPW Flood database (Source: OPW[37]

The WwTP site is not within the historic floodplain. The risk of fluvial flooding to the site of the WwTP is low. The risk of coastal flooding to the WwTP site is also considered to be low (Refer to **Appendix 15.6** for further detail).

Groundwater levels recorded at the site indicate that the groundwater table is circa 2m below ground level. The risk of groundwater flooding to the site is therefore considered to be low. The risk of pluvial flooding to the site is also considered to be low (refer to **Appendix 15.6** for further detail).

The area north of the site of the proposed WwTP is protected from coastal inundation by an embankment. In the event of a breach however the flood risk to the site is considered to be low (Refer to **Appendix 15.6**).

The site of the proposed WwTP is therefore classified as Flood Zone C and a Justification Test for the development is therefore not required.

[37] http://www.floodmaps.ie/

Interceptor Sewers

A hydraulic and flood risk assessment of the proposed interceptor sewer pipe encroachment of the Avoca River channel at Arklow was carried out by Hydro Environmental Ltd (Refer **Appendix 15.3**).

The design flow rates have been derived from the Flood Studies Report (FSR) ungauged catchment characteristic Index Flood Method. Table 15.8 provides the estimated design flood flows in the Avoca River with and without climate change allowance.

The design flood event for the fluvial flood impact assessment is the combined 200-year event represented by the 100 year river flood and the 0.35 year tide (which is the critical combination of fluvial and tidal event). The design flow includes the OPW factors of safety in respect to factorial errors of the Flood Study estimation method.

Table 15.8: Summary of design flood flows with and without climate change

Return Period	**Design Flow m^3/s (no climate change allowance)**	**Design Flow m^3/s (with climate change allowance**)**	**Design Flow with SFE* m^3/s (no climate change allowance)**
2	231	277	340
5	322	386	473
10	381	457	560
25	457	548	672
50	512	614	753
100	568	682	835
200	627	752	922
1000	698	838	1026

*SFE is the standard factorial error of the regression equation used (SFE = 1.47)

** Climate Change Allowance – 20% increase in Flow Rate

15.4 Likely Significant Effects

15.4.1 Do-Nothing Scenario

The do-nothing scenario refers to what would happen if the proposed development was not implemented and appropriate wastewater treatment was not provided in Arklow town. As outlined in **Chapters 1 and 2**, the need for wastewater treatment provision in Arklow town has been well documented in national, regional and local policy as well as legal cases.

The UWWT Directive and the transposing Urban Wastewater Treatment Regulations, 2001, as amended set standards to be met in the collection and treatment of wastewater as well as the monitoring requirements for wastewater discharges from urban areas.

The Directive and the Regulations require that secondary or equivalent treatment is provided for wastewater generated in urban areas such as Arklow. Furthermore, the Water Framework Directive (WFD) sets objectives to reduce the discharge of pollutants to waters, to prevent deterioration in water quality and achieve 'Good Status' in all waters over time.

The European Commission is currently taking a case against Ireland at the Court of Justice of the European Union (ECJ) for its failure to ensure that urban wastewater in 38 agglomerations (of which Arklow is one such named agglomeration) is adequately collected and treated to prevent serious risks to human health and the environment. Indeed, the referral decision also raises additional concerns about the failure to ensure that a correct operating licence has been issued for the treatment plants serving the agglomerations of Arklow and Castlebridge.

Notwithstanding the legislative requirements, the provision of appropriate treatment of wastewater in Arklow is required to improve water quality in the Avoca River and enable further development in Arklow town, which is currently constrained by the absence of treatment.

For those reasons, the 'do-nothing' scenario was considered to have negative effects with regards to water.

15.4.2 Assessment of Effects during Construction

15.4.2.1 Hydrology and Water Quality

Hydrology

The construction activities associated with the enabling works (as described in detail in **Chapter 5**), including the diversion of utilities and services could have a significant effect on the drainage characteristic of the study area. The existing surface water drainage network that currently discharges into the Avoca River will therefore require diversions/temporary pumping during construction. Further, activities such as stockpiling, hoarding etc can also block overland drainage flow paths, which can result in potential flood risk.

Some construction activities that have the potential to impact the hydrological regime include:

- Temporary stockpiling of material at working areas;
- The erection of hoarding around working areas;
- The release of grouting and cement materials;
- Wash water from dust suppression sprays; and
- Spillage of fuel and lubricants from maintenance of construction vehicles and mechanical equipment.

The construction activities outlined above have the potential to alter the hydrological regime temporarily in the study area. This would be considered a significant short term negative effect.

Drainage

The construction activities associated with the enabling works (as described in detail in **Chapter 5**), includes diversion of existing combined/surface water sewers currently that discharge via outfalls into the Avoca River. These sewer diversions could have a potential short-term significant negative effect on the drainage characteristics by blocking or interfering with existing surface water drains that discharge into the Avoca River during construction of the interceptor sewers.

Water Quality

There are numerous substances used on construction sites that are potential pollutants to water bodies that could affect surface water quality. Runoff from the working areas during construction may contain increased sediment loads, suspended solids and contaminants. This is typical on construction sites and working areas of this nature.

The key construction works involved in the proposed development are open-cut excavation works for the interceptor sewers, revetment upgrade, long sea outfall, SWOs and WwTP construction as well as tunnelling works. A summary of potential pollutants of relevance to water quality is provided below:

- Potential sources of pollution from site drainage include runoff and erosion from site excavation, earthworks from construction of the temporary causeway and upgraded revetment, underpinning of the bridge, open cut construction of the sewers etc. and associated stockpiles;
- The release of bentonite slurries, concrete washings and other grouting materials via the discharge of construction runoff and storm water from tunnelling working areas; and
- Other major pollutants present include fuels, lubricants, cement, mortar, silt and soils required for plant and equipment on site.
- The washing of construction vehicles and equipment also pose a pollution risk to watercourses in the area if undertaken in inappropriate locations and in the absence of effective management and mitigation.
- Any accidental spillages of fuel and/or discharge of oil from leaks in vehicles or fuel tanks.
- In addition, surface water run-off from surface construction activities has the potential to be contaminated and pose a significant risk to all watercourses as these sites will be exposed to rainfall which has the potential to produce silt laden run-off.

As described in detail in **Section 5.3.6 of Chapter 5**, the interceptor sewers will be constructed using a combination of both open cut and tunnelling techniques. Further, the deep excavations for the proposed launch and reception shafts for tunnelling works and the inlet works sump and SWO at the WwTP will require dewatering which will need to be appropriately disposed of to prevent pollution of the Avoca River. This will be a short term significant negative effect.

Potential effects of tunnelling if not effectively managed and controlled could include discharge of a plume with suspended materials. There is a possibility of suspended sediment plumes or contaminated run off from tunnelling operations including bentonite release which can deterioration of water quality of estuarine habitats.

Further, any unintended release of bentonite into the river channel may result in an initial localised area of high viscosity material onto the riverbed. This will slowly disperse in flowing water to produce a small plume of suspended solids. In this instance, bentonite would remain in suspension in the Avoca Estuary which is likely be flushed in and out of the Arklow Bay due to tidal influence.

It should be noted that the components within the bentonite drilling fluid are inert, naturally occurring and non-toxic to marine benthic fauna. Bentonite is benign, a naturally occurring clay that will disperse normally over a short period of time if an unintended release should occur. As the flow of any plume produced into the fast-flowing tidal currents will be expected to be small, diffuse and short term, this will not provide any impact on benthos, fish or suspension feeding species (including shellfish) located within the estuary. The Avoca Estuary is tidal in nature and any bentonite release during low flow conditions in the Avoca River is expected to be flushed into the Irish Sea during daily high tide periods and therefore is unlikely to cause any significant impacts. **Chapter 11** describes in detail the likely significant effects on aquatic biodiversity.

The generation of silt-laden run-off during construction may result in short term significant negative effects associated with the following:

- There is the potential for silt-laden surface runoff during the enabling works, site clearance and groundworks that would be required to be undertaken throughout the works areas. This potential for silt-laden surface runoff is likely to continue throughout construction until the ground has been completely consolidated and reinstatement of the working area has been completed.
- The proposed development will require construction of temporary sheet pile walls in the river channel to accommodate the open cut construction of the river based section of the interceptor sewer (Refer to **Section 5.6.3.3 of Chapter 5** for further detail). This may disturb the sediment in the river bed and thus could increase in suspended solids concentrations in the Avoca River.

Coastal Waters

Impacts on coastal waters during the construction of the proposed development relate primarily to the excavation and potential dispersion of sediments. This is dealt with under **Section 15.4.2.2**.

15.4.2.2 Coastal Processes

Revetment Upgrade

Given the nature and scale of works, the only likely effect that the revetment upgrade works could have on the existing coastal dynamics during construction is the dispersion of material at this location (Refer to **Appendix 15.5** for further detail).

The excavation of material from the seabed is limited at the toe of the proposed revetment and the volume of material is expected to be small. Excavation of the seabed is limited to the toe along the section of the revetment to be upgraded, therefore the volume of material is expected to be relatively small as detailed in **Section 5.8 of Chapter 5**. Further, excavated sediment may either be reused as part of the material required at the toe of the revetment or disposed of at a suitably licensed facility (in respect of which a waste permit or a waste licence is granted).

The transport of any potential suspended material that may arise from this excavation will be mostly confined within the surf zone (approximately limited by the bathymetric contour -6.5m CD). Moreover, this coastal area is relatively sheltered by the entrance of the Arklow Harbour as described in **Section 15.3.3.** Therefore, any potential dispersion of the material is expected to be naturally deposited within the study area and mostly limited by both the harbour entrance at the south and the natural headland at the north.

On this basis, the likely effect of dispersing material on coastal processes is considered not significant during construction of the revetment upgrade.

Long Sea Outfall

This section considers the likely significant effects on coastal processes as a result of the two open cut construction methodologies for the long sea outfall (i.e., construction by means of the float and flood or bottom pull method which requires a trench to be excavated – Refer to **Chapter 5** for further details). The likely significant effect due to dispersion of the excavated seabed material (which is proposed to be side casted along the edge of the trench during construction), dispersion of any sediment mobilised during the dredging process and the exposure of the outfall and/or scour protection during operation of the proposed development have been assessed.

The likely significant effects associated with the horizontal directional drilling method would not involve any change in the seabed geometry during construction or operation, therefore this option is not considered to result in any significant effects on coastal processes.

The seabed material along the alignment of the long sea outfall is expected to be non-cohesive and with a low content of fines (Refer to **Section 14.3 of Chapter 14** for further details), therefore significant suspension of fines is not anticipated.

CIRIA states[38] that tide-induced seabed velocities alone are rarely sufficient to initiate motion of non-cohesive sediments at coastal sites, and hence significant movement of sand and gravel tends to be associated with periods of high wave activity only. In this regard, the most significant movement may happen in or close to the surf zone.

Construction of the long sea outfall is envisaged to be undertaken in summer to facilitate the necessary calm wave conditions required to operate the plant and equipment required for excavation of the trench (a maximum wave height of 0.5m is a typical operational limit for such operations). Under these wave conditions, the surf zone is estimated to be nearshore.

Given the proximity of the alignment of the long sea outfall with the river's breakwaters, this area is sheltered from the south wave action as described in **Section 15.3.3**. Where the seaward end of the outfall is constructed outside the nearshore surf area and Arklow Harbour entrance, the suspended sediment transport is expected to be very limited, however some local sediment movement on the seabed may occur during construction.

The marine environment is also dynamic and there is a continuous process of sedimentation/deposition which naturally occurs. Against this background, the impact of the sedimentation due to the engineering works will not be significant.

The volumes of excavated material are considered relatively low are and expected to be partially re-used as described in **Chapter 5** and **Chapter 16**, if deemed suitable by the contractor.

Outside the Area of Interest (Refer to **Appendix 15.5**), there is a very limited potential for dredged material to be dispersed within a larger area outside the Area of Interest and the presence of the Arklow Harbour piers provides shelter to the adjacent area to the south in the area where most of sediment transport is expected (nearshore area).

In summary therefore, it is considered that overall coastal patterns will not be affected. No erosion or accretion of adjoining areas is expected to result from the outfall construction.

Thus, the likely significant effect of local sediment movement is considered to be not significant in relation to coastal processes during construction of the long sea outfall by open cut methods.

SWO at the WwTP

The proposed SWO discharges at the shoreline (below Mean Low Water Springs) beneath the toe of the revetment. Given this, the construction of the SWO, similar to that of the revetment, will not result in a significant effect in relation to coastal processes.

[38] CIRIA (1996) 159 Report: Sea outfalls – Construction, inspection and repair. An engineering guide

15.4.2.3 Flood Risk

Interceptor Sewers

The TELEMAC2D hydraulic model of the Avoca River was run to examine the implications of the construction of a temporary causeway 10m wide for approximately 270m within the channel to facilitate the construction of the interceptor sewer and quay wall. The simulation assumed that the upstream in-channel works have been completed, including the deepening and underpinning of the second (southernmost) bridge arch, the construction of the interceptor sewer manhole encroachment upstream of the bridge and all the in-stream works completed at the Arklow Bridge (i.e. interceptor sewer through first arch completed and arch reopened). The river modelling undertaken (refer to **Appendix 15.2 and Appendix 15.3** for further detail) predicts that the construction of the temporary causeway would cause increases in local flood levels downstream of the Arklow Bridge of approximately 1.9cm and 5.5cm with these increases found not to affect the floodplain inundation and flood risk. Further, with the construction sequence described, it was noted that there was an overall minor reduction in the flood extents which would be a short-term slight positive effect.

A temporary causeway, approximately 10m wide (but inclusive of the 6m wide permanent encroachment) will also be constructed within the river channel to facilitate construction of the interceptor sewer. The temporary causeway will be contained on the river side by either gabions or sheet piles, with these raised above the height of the causeway, to be effective. The proposed elevation of the temporary causeway is c. 0.8 m OD which accounts for highwater mean spring tide of 0.5 m OD plus 0.3 m freeboard. There is the potential, without appropriate mitigation, for this temporary causeway to exacerbate flooding risk.

WwTP site

Flood risk associated with the construction of the Arklow WwTP itself is regarded as relatively low. This is due to the fact that the site itself is located outside of the 1 in 1000-year flood zone. Access and egress routes to the WwTP site during the construction period are also regarded as being at relatively low risk from flooding. Please refer to **Appendix 15.6** for further information.

15.4.2.4 Cumulative

It is possible that the construction of the proposed Arklow Flood Relief Scheme may take place in parallel with the construction of the proposed development. The contemporaneous construction of both developments would exacerbate effects on the hydrological regime and flooding.

However, where practicable, coordination would be undertaken by the contractors appointed to each development to ensure that underpinning of the arches and lowering of the arch included as part of the proposed development is undertaken in advance of the construction of the proposed interceptor sewer to mitigate any significant flood risk during construction of the interceptor sewers in the Avoca River.

The construction of interceptor sewers along South Quay and River Walk, and nearby construction of the proposed Arklow Flood Relief Scheme may generate the potential for direct and indirect short term significant negative effects on the hydrology of the Avoca River during construction for those reasons outlined above.

It should be noted that other infrastructure developments in Arklow, as identified in **Sections 2.6.6 and 2.6.7 of Chapter 2** will not exacerbate likely significant effects associated with the proposed development.

15.4.3 Assessment of Effects during Operation

15.4.3.1 Hydrology and Water Quality

The drainage network within Arklow town discharges wastewater directly into the Avoca River. There is a mixture of separate, partially separate and combined sewers. The latter are generally the older sewers within the town, dating back to the 1930's and 1940's and carrying a mixture of foul sewage and surface water. The proposed development includes the construction of interceptor sewers, in order to collect existing discharges to the Avoca River and Estuary and convey wastewater to the proposed WwTP which will have a significant positive effect during operation of the proposed development.

Further, the provision of the new wastewater infrastructure that caters for a 50-year design horizon and likely population growth in Arklow town is considered as a significant positive effect as it would ensure compliance with the UWWT Directive during operation of the proposed development.

The existing sewer network in Arklow town regularly surcharges and spills to the Avoca River via a number of existing outfalls and overflows located along the northern and southern banks of the river channel. The existing SWO at the Alps site is currently spilling in excess of 30 times per year to the Avoca River. Overflows of storm flows would be maintained, however the provision of the stormwater storage tank will limit the frequency of spills to 7 times per bathing season. This would significantly improve the Avoca River water quality and is thus considered a significant positive effect during operation of the proposed development.

In addition, there will be two SWOs provided as part of the proposed development at shaft TSS3 and at the Inlet Works building at the WwTP that would discharge storm flows to the Avoca River and Irish Sea (respectively) during storm events.

Modelling was undertaken for the 10-year Time Series Rainfall events to determine the frequency of discharge from the SWOs.

The modelling has predicted that the SWOs will spill on average once per bathing season which is well below the permitted 7 spills per bathing season for recreational/contact waters. It should be noted that the discharges from all the above SWOs will require the appropriate licensing under the WWDA for the proposed development that would be obtained from the EPA as described in detail in **Section 4.5 of Chapter 4**.

During operation, the majority of the storm flows will be conveyed to the WwTP with the SWOs limited to no more than 7 spills per bathing season in accordance with Waste Water Discharge (Authorisation) Regulations which requires that Storm Water Overflows are assessed and designed in accordance with "Procedures and Criteria in relation to Storm Water Overflow" by the DoEHLG, 1995.

In summary, the proposed development will remove the need to discharge untreated wastewater into the Avoca River in as far as reasonably possible to ensure compliance with the Waste Water Discharge (Authorisation) Regulations. The proposed development will therefore result in a long term significant positive effect on surface water quality.

There will be no significant effects on drainage during operation. All excess storm flows will be discharged via SWOs (as appropriate) and combined flows (foul) will be conveyed to the WwTP via the proposed interceptor sewer network.

Surface Water Quality

The existing sewer network in Arklow town regularly surcharges and spills to the Avoca River via 19 of existing outfalls/CSOs located along the northern and southern banks of the river channel. The proposed development will remove all existing untreated outfalls (excluding the Alps SWO at the head of the interceptor sewer network). This SWO will be upgraded to discharge excess storm flows during operation. In addition, there will be two SWOs provided as part of the proposed development (on South Quay at shaft TSS3 and at the Inlet Works building) to provide relief for excess flows in the sewered catchment during extreme storm events and extended power outages. These SWOs will discharge to the Avoca River and Irish Sea (respectively). During operation, the majority of the storm flows will be conveyed to the WwTP with spills through the SWOs limited to no more than 7 spills per bathing season in accordance with the relevant standards. This will result in a short-term negative effect.

In summary, the proposed development will remove the need to discharge untreated wastewater into the Avoca River in as far as reasonably possible to ensure compliance. The proposed development will therefore result in a long term significant positive effect on surface water quality.

Coastal Water Quality

With regard to the long sea outfall, three potential offshore discharge locations were originally considered, with only the furthest location (900 m outfall) meeting all compliance requirements. The water depth at the proposed outfall discharge point is approximately 10m.

Model simulations of the proposed 900m outfall were conducted for a range of conditions. These included both spring and neap tides for calm and windy conditions and for a full spring–neap cycle. Assessment of the overall existing situation in terms of 95%ile compliance with the bathing water regulations is presented in Figure 4.18 of **Appendix 15.2**. The region of consistently elevated concentrations follows the axis of the plume and remains well offshore.

The bacterial concentrations at all of the identified bathing areas (listed in Table 4.7 of **Appendix 15.2**) are below the model resolution of 5cfu/100ml and well within the target 'Excellent' e.coli category limit of 250 cfu/100ml and the IE limit of 100 cfu/100ml.

The DIN and BOD plumes from the outfall follow the same trajectories as indicated for e.coli. The associated concentrations are very low as once the plume has surfaced from the diffuser and only a small amount of additional dilution is required to reduce levels to near background. The DIN mixing zone envelope is calculated to extend 200m to the north of the proposed outfall on the flood tide and about 100m to the south on the ebb. It will have an overall width of about 40m. This envelope represents the potential zone of influence of the plume for all stages of the tide.

The beaches to the north and south of the harbour mouth are popular bathing areas. The nearest designated bathing waters are at Clogga Beach, 3km to the south of the harbour and Brittas Bay 9km to the north. The design objective is to ensure that all the local beaches will meet the bacterial standards for e.coli and intestinal enterococci (IE) as set out in the Bathing Water Directive (2006/7/EC), which is transposed into Irish law through the Bathing Water Quality Regulations 2008 (SI 79 of 2008). The maximum outfall discharge concentrations for these parameters have been chosen to be conservatively high (e.coli = 1x106 cfu/100ml and IE = 2x105 cfu/100ml). The model data shows that even with these high values any bacterial contamination of bathing areas arising from the proposed outfall will be well below the limits specified in the regulations.

The proposed SWO at the WwTP is to be located at the shoreline to the north of the main outfall route. This will only discharge during exceptional rainfall events. Model simulation of a short term discharge (1 hour) with flows corresponding to the 1-year event show that the e.coli levels on Clogga beach and the bathing area to the north and south of the harbour will be impacted for a period of up to about 24 hours after the event.

The proposed 900m outfall and SWOs will replace the 19 existing SWOs/outfalls and all of which discharge into the harbour. There will thus be a significant improvement in water quality both in the harbour and on the bathing areas, resulting in a long term positive significant effect.

15.4.3.2 Coastal Processes

Revetment Upgrade

No significant effects on existing coastal processes are likely within the study area during operation given that the coastline has already been fixed by the existing rock armour revetment as outlined in **Section 15.3.3**.

Further, the alignment of the upgraded revetment will follow the existing revetment alignment. The revetment upgrade will ensure coastal protection within the site for a 500-year return period storm event as it has been designed to protect against wave overtopping and satisfy functional and safety requirements.

The design ensures that the upgraded revetment can withstand the expected incident waves. The upgraded revetment is a porous flexible structure where wave energy can be partly absorbed and dissipated. For this reason, local wave reflections are expected to be minimum and similar to those currently experienced. The upgraded revetment, being parallel to the coastline and located in the shadow of the Arklow harbour entrance, does not impose a barrier, or an obstruction to the predominant longshore sediment transport patterns. In this regard, no change in sediment transport is expected with the upgraded revetment from that which exists currently.

Therefore, the likely effect of the existence of the upgraded revetment is considered to be not significant in relation to coastal processes, during operation of the proposed development.

Long Sea Outfall

Scour protection will be installed (where construction of the outfall is by open cut methods) to ensure the structural integrity of the outfall during operation. The scour protection will consist of a layer of concrete mattresses embedded in the existing seabed. This scour protection will be designed to be stable and prevent any scour of the seabed against nearshore wave action and currents. The scour protection will be designed to match the seabed level to avoid the creation of a sediment transport barrier. The scour protection will also stabilise and prevent the movement of seabed material in the local area of the outfall.

In the event that seabed levels in the area close to the scour protection reduce, the concrete mattresses would accommodate to the new geometry. It is important to note that the outfall and associated scour protection will be designed against this outcome, but it is assessed as a reasonable worst case scenario given projected climate change and historic trends. This potential lowering of the seabed will not impose a barrier to sediment transport based on the following:

- Longshore sediment transport occurs within the break area.
- The break area of the outfall is mostly sheltered by the entrance of Arklow Harbour.
- Bed load represents a small fraction of longshore transport compared to suspended load transport and therefore any local new feature of the seabed would not change any existing longshore sediment transport patterns.

On this basis, no change in the existing coastal processes (involving erosion or accretion of the adjoining coastal areas) is expected due to the presence of this outfall. Therefore, no significant effects are likely during operation of the proposed development.

Thus, the likely long term effect of the outfall is considered to be not significant with respect to coastal processes within the Area of Interest during operation of the proposed development.

SWO at the WwTP

With regard to the SWO at the WwTP, given that it ceases at the shoreline, the operation of the SWO will not result in a significant effect in relation to coastal processes during operation.

15.4.3.3 Flood risk

Interceptor sewers

The proposed development includes the realignment of the Avoca River (encroaching approximately 6m into the existing river channel) downstream of the Arklow Bridge over a distance of approximately 270m.

The TELEMAC2D hydraulic model of the Avoca was run with the proposed interceptor sewer quay wall encroachment for the design flood event design flood of 835 m^3/s and a corresponding tide with a highwater level of 0.84m OD Malin. The computed river flood levels between the existing and the proposed encroachment case show that the effect of the proposed 6m narrowing over approximately 270m length of the Avoca estuarine channel immediately downstream of Arklow Bridge and the local encroachment immediately upstream of the Bridge produces a c. 3.3cm rise in flood level immediately downstream of the Arklow Bridge. The combined impact upstream of the encroachment including the upstream manhole encroachment produces a small rise of c. 1.9cm (Refer **Appendix 15.3** for further details).

It should be noted that a rise of 3.3cm in flood level from the interceptor sewer encroachment applies to a localised section immediately downstream of Arklow Bridge. Further the hydraulic impact assessment states that for much of the encroachment reach the flow velocity increases which in turn slightly reduces peak flood level in the narrowed river section.

As described in detail in **Section 5.6.3 of Chapter 5**, the Arklow Bridge works would involve underpinning of two arches and the lowering of the second arch by 1m depth which will fully mitigate the effects upstream of the Arklow Bridge at the design flood event and at various return period flood flows. However, such a measure will not mitigate the downstream channel increase of c. 3.3cm at the 100-year design flood event. This downstream increase in flood level will only occur towards the upstream end of the sewer encroachment, close to the downstream face of Arklow Bridge.

This increase is not critical, as locally the existing quay walls are sufficiently elevated to prevent overtopping. Increases in flood levels upstream are more critical as such increases will increase the magnitude and frequency of overtopping onto the southern and northern sides of the river channel producing a larger floodplain flow that bypasses Arklow Bridge and flows eastward through the urban developed areas.

In summary, with the underpinning and lowering of the second bridge arch by c. 1m, a minor reduction in the overall flood extent was predicted for the approximately 6m wide permanent encroachment in the Avoca River which would be a long-term slight positive effect.

Therefore, underpinning of Arklow Bridge should be undertaken prior to the construction of the interceptor sewer in order to increase the capacity of the bridge and to reduce any increased flood risk associated with the construction of the interceptor sewer in the river channel and associated encroachment.

The hydraulic assessment of the existing system incorporating the proposed interceptor sewer and SWOs shows that the total flooding within the Arklow sewerage (wastewater collection network) catchment is only marginally reduced without implementation of all other upgrades proposed in Phase 3 of the GDSDS Study[18]. Further, all the flows from the Arklow catchment will be conveyed to the proposed WwTP at Ferrybank (albeit that emergency relief for excess flows in the sewered catchment is provided by the SWOs). Hence, the discharge of untreated wastewater into Avoca River will, for the most part, be eliminated, following the construction of the proposed development.

The result of the hydraulic assessment of the future sewer system which incorporates all upgrades proposed in Phase 3 of the GDSDS[18], the proposed interceptor sewer, proposed SWOs and WwTP indicates very minor flooding within the catchment for a 1 in 30-year critical duration storm event with MHWS including allowance of climate change.

The results of spill frequency analysis of the future system indicate that proposed SWOs spill on average less than once during bathing season which is well below the permitted 7 spills/bathing season. Therefore, the proposed development would remove the need to discharge untreated wastewater into the Avoca River excluding discharges via SWOs which are compliant with Waste Water Discharge (Authorisation) Regulations, SI No. 684 of 2007 which requires that Storm Water Overflows are assessed and designed in accordance with “Procedures and Criteria in relation to Storm Water Overflow” by the DoEHLG, 1995.

WwTP site

Given the absence of a significant risk of flooding of the site of the proposed WwTP, the impact on flood risk during operation will be very low. Access and egress routes are unlikely to be compromised during flood events and the proposed development will have no impact on floodplain storage and conveyance as it is located outside of the 1 in 1000-year flood plain.

15.5 Mitigation Measures and Monitoring

15.5.1 Mitigation

15.5.1.1 Mitigation During Construction

Hydrology and Water Quality

The standard best practice measures in the Outline CEMP (Refer to **Appendix 5.1**) for the proposed development will mitigate significant negative effects on surface water quality during construction.

Further, temporary works will be designed to minimise effects on the hydrology and flow regime in the study area during construction. The Outline CEMP includes a range of site specific measures which will include the following:

- During construction, surface water runoff would be collected by the temporary drainage system installed by the contractor and then treated or desilted on-site before discharge into the Avoca River;
- Earthworks operations shall be carried out such that the surfaces are designed with adequate slope to promote safe runoff and prevent flooding;
- Good housekeeping such as site clean ups, use of disposal bins, etc will be adopted in construction areas;
- In order to prevent accidental release of hazardous materials such as fuels, cleaning agents etc into surface water during construction, all hazardous materials will be stored within appropriately bunded containment areas designed to retain spillages;
- Temporary bunds will be used for storage of oil/diesel; and
- The temporary causeway and the surface water runoff from this area would be entirely contained to prevent any pollution entering the Avoca River. This would be contained through the implementation of best practice measures outlined in the Outline CEMP (Refer to **Appendix 5.1**).
- As outlined in **Chapter 5**, it is necessary to construct launch and reception chambers to facilitate tunnelling works. As these shafts will extend beneath the ground water level, it will be necessary to "plug" these shafts to prevent water ingress.

Mitigation during construction will include implementing best practice during excavation and tunnelling works to avoid the release of bentonite and prevent sediment running into the drainage network and/or hydrological environment during construction of the proposed development.

Coastal processes

The following mitigation measures have been proposed with respect to effects on coastal processes from construction of the proposed development:

- Construction of the long sea outfall will generally be restricted to the period May – September, with the period between November-February generally avoided. In this manner, the months with likely worst wave and wind conditions, which lead to higher levels of sediment suspension and transport, are avoided.

Flood risk

Site of the proposed WwTP

During the construction period, there is a risk of coastal erosion and a risk of wave overtopping. Similarly, to the construction of the long sea outfall, works between November and February should be avoided. It is also recommended that the contractor considers tidal and wind forecasts and monitors these closely to minimise the risk of coastal erosion and wave overtopping.

Given the absence of a significant risk of flooding at the site of the proposed WwTP, no further mitigation measures to address flood risk during construction are required.

Interceptor sewers

In order to mitigate and minimise the potential flood risk caused by the construction of the temporary causeway and the interceptor sewers in the Avoca river channel, the following sequence of works is proposed prior to construction of the temporary causeway:

- Proposed underpinning of the first 2 arches and lowering of the 2nd Arch by c. 1m at the bridge is completed.
- Proposed in-stream works at and upstream of the bridge is fully completed (i.e. the upstream interceptor sewer manhole and the laying of the interceptor sewer beneath the bed of Bridge Arch 1).
- The temporary works should proceed from downstream to upstream (i.e. from east to west direction).
- Following completion of construction of the interceptor sewer in the Avoca River (i.e. when the causeway is no longer required), the causeway would be removed in a similar sequential manner.
- Timely removal of sections of the causeway should be a priority once works have been completed

15.5.1.2 Mitigation During Operation

Hydrology and Water Quality

The proposed development will improve water quality in the Avoca River by eliminating, in as far as reasonably possible, the discharge of untreated wastewater into the river channel. Excess storm flows would continue to be discharged as emergency overflows in the event of WwTP pumping station failure, however this is likely to occur significantly less than the permitted 7 spills per bathing season.

All storm flows to the Avoca River (discharged as emergency overflows) will be screened via static screens in the SWOs to ensure the maximum particle size in the water column does not exceed 6mm in diameter to ensure compliance with Irish Water standards.

Coastal processes

No mitigation measures have been proposed with respect to effects on coastal processes from operation of the proposed development.

Flood risk

Given the absence of a significant risk of flooding of the site of the proposed WwTP, no mitigation measures to address flood risk during operation are required.

As the proposed development directs almost all wastewater flows to the WwTP shows that the proposed development will result in an overall slight beneficial impact upstream of the bridge in terms of flooding, no mitigation measures are required to address flood risk during operation.

15.5.2 Monitoring

15.5.2.1 Monitoring During Construction

Hydrology and water quality

Visual monitoring will be undertaken as part of the regular site audits during the construction of the proposed development to ensure existing surface water drainage discharge into the Avoca River/coastal waters is not impacted by the proposed development.

This is necessary to ensure that surface water flooding is not caused by any damages to existing surface water sewers/outfalls discharging into the Avoca River during construction of the interceptor sewers.

Flood risk

The contractor is required to monitor tide and wind forecasts to minimise the risk of coastal erosion and wave overtopping. The contractor is required to monitor weather forecasts to inform operation of temporary causeway.

15.5.2.2 Monitoring During Operation

Hydrology and water quality

Monitoring of all SWOs by storm water level indicator instruments will be undertaken by the operator to provide records of any overflows, ensuring that bathing season spill events are recorded.

Coastal processes

The scour protection shall be monitored to ensure its performance and avoid any potential risk derived from the potential future exposure of the pipe. Scour protection will be monitored by Irish Water as part of the overall long outfall maintenance. Outfall monitoring would include visual inspection either by divers or robotics and would be performed every 5 years and after significant storm events as part of the overall operational management regime. The inspection crew would check the pipeline for scour protection damage, slide, anchor, or other damage. Scour protection shall be reinstated and/ or repaired if any damage is observed.

Flood risk

No monitoring during operation is required for flood risk during the operation of the proposed development.

15.6 Residual Effects

15.6.1 Residual Effects during Construction

15.6.1.1 Hydrology and Water Quality

Hydrology

With the implementation of mitigation measures described in **Section 15.5.5.1** and **15.5.5.2**, including in particular, the phasing of works such that the bridge underpinning and upstream works are complete before commencing construction of the temporary causeway downstream of the bridge, there will be no significant residual effect on hydrology during construction.

Drainage

There will be no significant residual effect on drainage during construction.

Water Quality

With the implementation of the mitigation and monitoring measures described in **Sections 15.5.1.1 and 15.5.2.1**, the residual effects on water quality will be short term slight negative effects during construction of the proposed development.

15.6.1.2 Coastal Processes

It is considered that, with the implementation of the proposed mitigation and monitoring measures, that there will be no significant residual effects from the proposed development on coastal processes (including sediment dispersion and local scour/siltation effects).

15.6.1.3 Flood Risk

Interceptor sewers

With the implementation of the mitigation measures, a short term slight negative effect would occur due to the installation of the sheet pile wall in the Avoca River and the alteration to the flow regime during construction. The predicted increase in flood level downstream of Arklow Bridge will only occur towards the upstream end of the sewer encroachment, close to the downstream face of Arklow Bridge, which is not critical, as locally the existing quay walls are sufficiently elevated to prevent overtopping.

With the implementation of mitigation measures described in **Section 15.5.5.1** and **15.5.5.2**, including in particular, the phasing of works such that the bridge underpinning and upstream works are complete before commencing construction of the temporary causeway downstream of the bridge, there will be no significant residual effect on flood risk during construction.

WwTP

No significant residual effect is expected on flood risk to the site of the proposed WwTP during construction.

15.6.2 Residual Effects during Operation

15.6.2.1 Hydrology and Water Quality

Hydrology and Drainage

The hydraulic modelling of the existing system shows that 7,566m³ of untreated wastewater is predicted to spill via the existing outfalls into the Avoca River during Dry Weather Flow (DWF). During operation, all flows from the Arklow catchment will be conveyed to the WwTP, save during extreme rainfall events where overflows through the SWOs may occur (albeit modelling has confirmed that these spills will be very limited). Hence, for the most part, there will be no discharge of wastewater into the Avoca River once operational and this will improve the existing water quality in the Avoca River/Estuary.

During operation as the majority of the storm flows will be conveyed to the WwTP, the spills via the SWO's will be on average less than 1 spill/bathing season which is well below the permitted 7 spills/bathing season. There will be an overall reduction in the frequency of sewer surcharge associated with the proposed development which is considered a significant positive effect during operation of the proposed development.

Therefore, there will be not be any significant residual negative effect on water quality due to SWO discharges and indeed, there will be a significant positive residual impact due to the removal of existing outfalls and appropriate treatment of all wastewater.

Surface Water Quality

During operation, the proposed development would eliminate, in so far as possible, the need to discharge wastewater directly into the Avoca River and thus will have a significant positive residual effect on surface water quality from the operation of the proposed development.

Coastal Water Quality

The proposed 900m outfall and SWO at the WwTP replace approximately 19 existing outfalls and overflows all of which discharge into the harbour. There will thus be a significant positive impact on water quality both in the harbour and on the bathing areas, as a result of the proposed development.

15.6.2.2 Coastal Processes

No significant residual effect is expected on coastal processes during operation.

15.6.2.3 Flood Risk

Two arches of the Arklow Bridge will be underpinned and the second arch lowered by 1m which will mitigate against any rise in flood levels upstream of the Arklow Bridge due to the existence of the interceptor sewer and the manhole in the river channel. Therefore, there will be an overall reduction in the existing flood extent following construction of the proposed development which will be a short-term slight positive effect.

It should be noted that the sheet pile wall constructed as part of the proposed development would also serve as advance works for the flood walls to be built as part of the proposed Arklow Flood Relief Scheme. It is recognised that once constructed, the proposed Arklow Flood Relief Scheme would further reduce any residual flood risk during the operation of the proposed development and thus bring about further positive, cumulative effects on flood risk.

15.7 References

Byrne, J.P. and Motherway, F.K. (1990) 'Design and construction of coastal protection works at north beach, Arklow, Co Wicklow', Paper presented to a seminar on 'Engineering for Coastal protection' at the Institution of Engineers of Ireland

CIRIA (2015) Environmental good practice on site guide (fourth edition) (C741)

CIRIA (1996) 159 Report: Sea outfalls – Construction, inspection and repair: An engineering guide

EPA (2018), Reports and maps. Available from: https://gis.epa.ie/EPAMaps/ [Accessed: 27 April 2018]

EPA (2018) River Quality Surveys: Biological. Available from: http://www.epa.ie/QValue/webusers/PDFS/HA10.pdf?Submit=Get+Results [Accessed: 27 April 2018]

EPA (2018) Q value for the Avoca-Vartry hydrometric area. Available from: http://www.epa.ie/QValue/webusers/ [Accessed: May 2018]

EPA (2012) Water Quality in Ireland 2010 – 2012. Available from: http://www.epa.ie/pubs/reports/water/waterqua/wqr20102012/WaterQualityReport.pdf [Accessed: 16 July 2018]

Government of Ireland (2018) River Basin Management Plan for Ireland. Available from: https://www.housing.gov.ie/water/water-quality/river-basin-management-plans/river-basin-management-plan-2018-2021 [Accessed: 10th July 2018)]

Inland Fisheries Ireland (2018) WFD Fish Stock Survey of Transitional Waters in the Eastern River Basin District – Avoca Estuary 2015

Inland Fisheries Ireland (2016) Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters.

Irish Hydrodata Limited (2017) Report on Arklow WWTP Comparison of marine bathymetric data sets, Irish Hyrdodata 1985 & 1996 vs GSI Informar 2016'

J.P Byrne & Partners (1990) Coastal Protection Works at North Beach Arklow

OPW (2018) Flood maps Available from: http://www.floodmaps.ie/View/Default.aspx [Accessed May 2018]

OPW (2012) The National Preliminary Flood Risk Assessment (PFRA) Overview Report

OPW (2010) Irish Coastal Protection Strategy Study Phase 2 - South East Coast

Ordnance Survey Map, 1980. Sheet 40

Reeve, D., Chadwick, A. and Fleming, C. (2004) Coastal engineering: Processes, theory and design practice

Stevens (2015) Trenchless solutions for sewer networks and sea outfalls

U.S. Army Corps of Engineers (2002) Coastal Engineering Manual

U.S. Army Corps of Engineers (1984) Shore Protection Manual

WRC (1990) Design guide for marine treatment schemes: Volumes I – IV

16 Resource and Waste Management

16.1 Introduction

This chapter describes the likely significant effects of the proposed development in relation to resource and waste management. **Chapter 4** provides a description of the proposed development whilst **Chapter 5** describes the Construction Strategy. The following aspects are particularly relevant to the resource and waste assessment:

Design:

- Throughout the design development for the proposed development, consideration has been given to the minimisation of waste through retention of material on site and material reuse.

Construction:

- During the construction of the proposed development, waste will be generated from site clearance, asbestos removal, demolition and excavation. General construction waste is likely to be generated throughout the construction of the proposed development.

Operation:

- During operation, sludge will be generated from operation of the WwTP. Grit and other materials will also be generated from the preliminary screening of wastewater. Maintenance waste is likely to be generated from repair and maintenance works associated with the proposed development. Office waste will be generated from the Administration building.

16.2 Assessment Methodology

The potential for waste to be generated during the demolition, excavation, construction, operation and decommissioning phases of the proposed development is assessed. Mitigation measures are identified where necessary to reduce the impact of the waste generated by the proposed development in the construction and operational phases.

The principal objective of sustainable resource and waste management is to use material resources more efficiently, where the value of products, materials and resources is maintained in the economy for as long as possible and the generation of waste is minimised. To achieve resource efficiency there is a need to move from a traditional linear economy to a circular economy (Refer to Figure 16.1).

Figure 16.1: Circular Economy (Source: European Environment Agency)

Figure 16.2: Waste Hierarchy

However, where residual waste is generated, it should be dealt with in a way that follows the waste hierarchy set out in the EU Waste Framework Directive (Directive 2008/98/EC) (see Figure 16.2) and actively contributes to the economic, social and environmental goals of sustainable development.

This chapter examines the potential environmental effects of the generation and management of solid waste arising from the proposed development, in the context of the existing local and national resource and waste management environment.

16.2.1 Guidance and Legislation

16.2.2 General

This resource and waste management assessment considers the following aspects:

- The legislative context;
- The construction of the proposed development, including demolition and excavation;
- The operation of the proposed development; and
- The decommissioning of the proposed development.

A literature review was carried out of relevant legislation, policy and best practice guidance (Refer to **Appendix 16.1**). A desk study was undertaken which included the following tasks:

- Review of relevant policy and legislation which creates the legal framework for resource and waste management in Ireland (refer to **Appendix 16.1**), including the Eastern - Midlands Region Waste Management Plan 2015-2021 and the Irish Water National Wastewater Sludge Management Plan 2016;
- Description of estimated waste generation during the construction, operational and decommissioning phases; and
- The proposed development was systematically reviewed to identify mitigation and move waste management up the waste hierarchy through implementation of best practice (refer to Figure 16.1 and **Appendix 16.1**).

Mitigation measures are proposed to minimise the effect of the proposed development on the environment, reduce the quantity of waste sent for final disposal in so far as possible and to promote sustainable waste management practices. These are described in **Section 16.5**.

The construction strategy for the proposed development is set out in **Chapter 5**. The direct and indirect effects of transport (which includes traffic associated with the movement of waste material) are considered in **Chapter 7** and the geological characterisation of the proposed development is considered in **Chapter 14**.

16.2.3 Guidance and Legislation

Resource and waste management takes place in a policy and legislative framework. A review of relevant legislation, policy and best practice guidance was undertaken to inform the impact assessment and recommended mitigation.

The key components of EU, national and local policy, legislation and guidance relevant to the proposed development (See **Appendix 16.1**) are summarised as follows:

- Prevention of waste is the preferred option such that the value of products, materials and resources are maintained in the economy for as long as possible, the generation of waste is minimised and the principles of circular economy are implemented;
- Where construction waste is generated it should be source separated to facilitate reuse, recycling and maximise diversion of waste from landfill;
- Where operational waste is generated it should be source separated to facilitate reuse, recycling and maximise diversion, including biodegradable waste, from landfill;
- Where waste may not be prevented, reused or recycled it should be transported and disposed in accordance with the Waste Management Acts 1996 to 2011; and
- Waste may only be transferred from site by a waste collection permit holder and delivered to an authorised waste facility (i.e. a facility which holds a Certificate of Registration, Waste Facility Permit or Waste Licence).

16.2.4 Study Area

Chapter 4 provides a description of the proposed development whilst Section 5 describes the Construction Strategy.

Waste Management Planning in Ireland takes place on a regional basis and the proposed development is located in the Eastern-Midlands Region for the purpose of waste planning. However, Arklow is adjacent to County Wexford which is located in the Southern Region for the purpose of waste planning. Waste statistics are also published in Ireland on a national basis. Therefore, the study area in relation to the consideration of baseline waste generation and treatment is regional and national whilst the study area in relation to effects is local, regional and national.

16.2.5 Assessment Methodology

The methodology followed in carrying out this resource and waste impact assessment aligns with the overarching EIA guidance as described in **Section 1.4.3 of Chapter 1**.

16.3 Baseline Conditions

16.3.1 Construction Waste

Construction waste, including demolition and excavation waste, will be generated as a result of the proposed development. In order to establish a baseline and review capacity in relation to construction waste, a review of published data and statistics was undertaken.

The most recent complete figures published by the EPA relating to construction and demolition waste are for the year 2014 with 3.314Mt (million tonnes) of C&D waste finally treated (recovered or disposed).

The quantity of construction and demolition waste managed in Ireland is indicative of economic activity. At the peak of the economic and construction boom in 2007, approximately 17.8Mt of C&D waste was collected for treatment. This fell to 3Mt in 2011 and 3.314Mt of construction and demolition waste was treated in Ireland in 2014. The EPA states[1] that:

"With a government policy focus on the provision of social housing, major road infrastructural projects and the new children's hospital, construction and demolition waste generated will increase again in the coming years."

The Eastern Midlands Regional Waste Management Strategy 2015-2021 reports that 1.911Mt of construction and demolition waste was collected within the region in 2012. The nearby Southern Regional Waste Management Strategy 2015-2021 reports that 970,319 tonnes of construction and demolition waste was collected within the region in 2012.

An indicative breakdown of the composition of construction and demolition waste in Ireland in 2014 is set out in Table 16.1. These figures should be considered as a guide only as construction and demolition waste can vary significantly from one project to another, depending on the nature of the development and the waste management practices employed on-site.

Soil and stones accounted for almost 75 % of the total quantity of construction and demolition waste finally treated in 2014 and is a significant waste stream in terms of quantity arising. The quantity of contaminated soil (hazardous waste) has also increased due to increasing construction activity in recent years.

[1] EPA (2016) Ireland's Environment –An Assessment 2016

Table 16.1: Material categories of construction and demolition waste treated in Ireland in 2014 (Source: EPA[1])

Material from construction and demolition sources	Quantity (tonnes)	% of material stream in reference to total
Metal waste	173,810	5.24%
Glass waste	2,904	0.09%
Paper and cardboard waste	211	0.01%
Plastic waste	348	0.01%
Wood waste	52,155	1.57%
Waste containing PCBs	2	0.00%
Mixed waste	2,504	0.08%
Mineral waste	401,409	12.11%
Asbestos waste	6,246	0.19%
Soil and stones	2,463,749	74.35%
Residue from treatment of mixed waste	210,520	6.35%
Total	3,313,858	100.00%

Figure 16.3 shows the final treatment routes for construction and demolition waste material classes in 2014. Recycling was the dominant treatment activity for separated materials (e.g. construction and demolition waste glass). Residues from sorting (e.g. fines) were used as landfill cover (backfilling) and difficult wastes that could not be recovered were disposed of (e.g. residues from sorting of waste, construction and demolition waste containing asbestos or polychlorinated biphenyls (PCBs)).

Final treatment operations (recycling, backfilling, use as a fuel, disposal) varied greatly between material streams. By far the biggest amount of construction and demolition waste was used for backfilling (a recovery operation), which mainly reflects the dominance of soil and stones in the overall composition mix.

Under the Waste Framework Directive (2008/98/EC) there is a target for Member States to achieve 70% material recovery of non-hazardous, non-soil & stones C&D wastes by 2020. Ireland achieved 68% recovery in 2014.

The construction sector also generates hazardous waste such as hazardous soils, lead-acid batteries, waste electrical and electronic equipment, asbestos, solvent-based paints and varnishes, pesticides and waste oils. The EPA reports that in 2016 80,273 tonnes of hazardous soil was exported from Ireland for treatment. Over 90% was exported to Germany and Belgium[2].

[2] http://www.epa.ie/nationalwastestatistics/hazardous/ [accessed 29/8/2018]

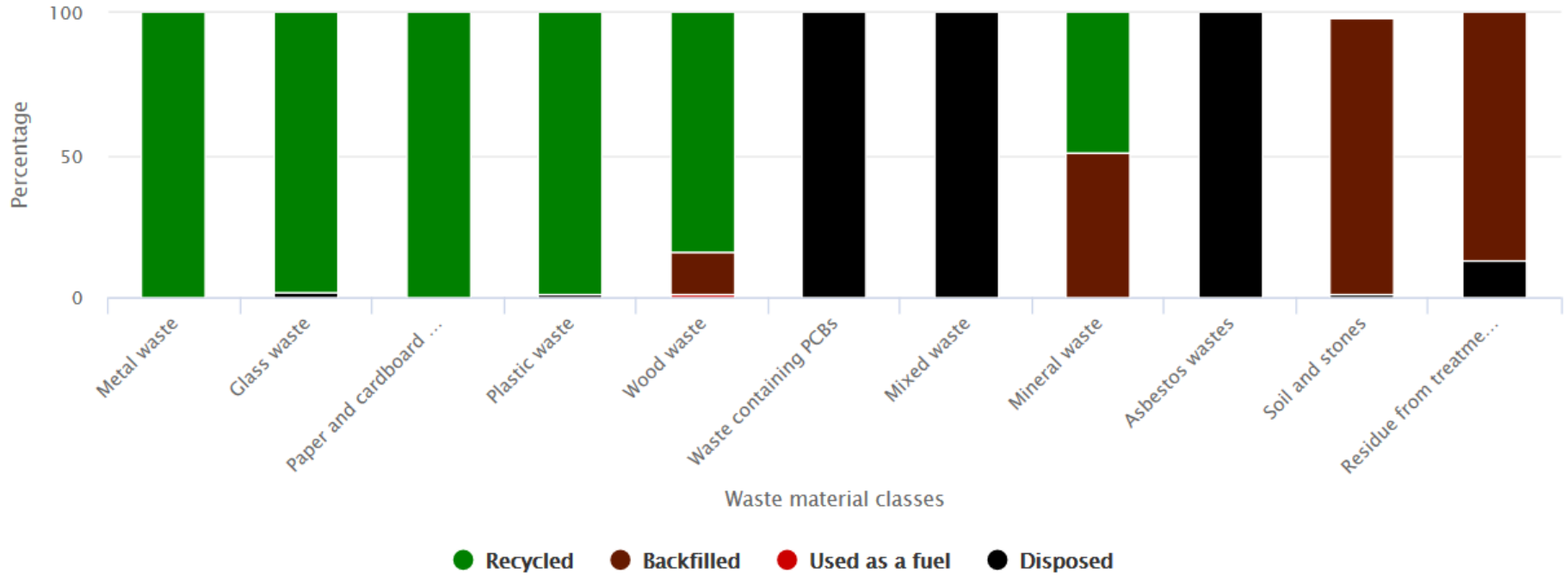

Figure 16.3: Final Treatment for construction and demolition waste Material Classes in Reference to Total for each Material Class, 2014 (Source: EPA[3])

[3] http://www.epa.ie/nationalwastestatistics/constructiondemolition/ [Accessed 30 August 2018]

16.3.2 Operational Waste

The solid wastes typically generated during operation of a WwTP of this nature include sludge from waste water treatment, grit and other materials from the inlet works screening processes, maintenance and office wastes.

In 2016 Irish Water published the National Wastewater Sludge Management Plan (NWSMP) outlining its standardised nationwide approach for managing wastewater sludge for the next 25 years. In 2016, 98% of wastewater sludge was treated to produce a biosolids product, which was being reused in agriculture.

In the Eastern Midlands Region 227,988t of sludges were collected in 2012. An additional 43,933 tonnes of water treatment sludges were also collected. In the Southern Region 144,525 tonnes of sludges were collected in 2012. An additional 7,255 tonnes of water treatment sludges were also collected.

16.4 Likely Significant Effects

16.4.1 Do-Nothing Scenario

In the scenario where the proposed development did not proceed as planned (and ignoring the necessity for a WwTP at Arklow to comply with statutory regulations and facilitate future growth), it is likely that the eastern end of the North Quay area may remain substantially unchanged in the short to medium term, while there would not be a requirement for the interceptor sewers.

In this event, the resource and waste management effects described in this chapter would not arise.

16.4.2 Assessment of effects during construction

16.4.2.1 Site Clearance and Demolition

Prior to commencing work the contractor will need to strip surface material within the working areas for the proposed development. This will comprise soils, rock, topsoil, vegetation etc. which is typical of a project of this nature and scale, and this material will be reused within the proposed development in so far as reasonably practicable or transferred for recovery or disposal at appropriately authorised waste facilities in respect of which a waste permit or a waste licence is granted.

An estimated 23,500 tonnes of surplus demolition materials will be generated as a result of demolition of existing buildings and structures to facilitate the proposed development. This material will be predominantly comprised of concrete and ferrous metals. A recycling rate of 68% is assumed to be achieved for this material in line with current national construction and demolition waste management practices.

Chapter 5 provides a description of where asbestos has previously been identified at the WwTP site. Prior to any demolition, a Refurbishment / Demolition Asbestos Survey (RDAS) will be undertaken by the contractor so that all asbestos containing materials are correctly identified before any demolition works take place. Asbestos arising during demolition will be removed from site to an appropriately licensed facility (in respect of which a waste permit or a waste licence is granted) in accordance with the Outline CEMP (Refer to **Appendix 5.1**) and with the Waste Management Acts 1996 to 2011. Where transportation of asbestos waste from the proposed development takes place within Ireland this will be undertaken in accordance with the European Communities (Shipments of Hazardous Waste exclusively within Ireland) Regulations 2011. Where export of asbestos waste from the site takes place this will be undertaken in accordance with the Waste Management (Shipments of Waste) Regulations, 2007.

16.4.2.2 Excavation

Topsoil, soil, rock and naturally occurring material excavated in the course of construction activities will be reused within the proposed development where feasible, subject to further testing to determine if materials meet the specific engineering standards for their proposed end-use.

Where naturally occurring material is used for the purpose of construction in its natural state within the proposed development this material is not deemed to be a waste in accordance with Article 2 of the Waste Directive 2008/98/EC, the European Communities (Waste Directive) Regulations, 2011 and Section 3 of the Waste Management Acts, 1996-2011 as amended.

Reuse must be certain, there must be no intention or requirement for it to be discarded and no further processing required in order for it to be reused.

Alps SWO and Stormwater Storage Tank

The Alps SWO and storage tank will be constructed using open cut techniques including the stormwater tank and overflow to the existing SWO and proposed manholes (MHA3, MHA4, MHA5, MHA6 and MHA7). An estimated 50% of the estimated material excavated at this area could be reused for backfilling the tank and regrading of site levels. It will be used within the boundary of the site of the proposed development and therefore is not classified as waste.

An estimated additional 4,000 tonnes of soil and rock will be excavated at the Alps SWO and stormwater storage tank and will require removal from site.

Interceptor Sewers

The existing wastewater network pipes that are redundant are likely to be abandoned in situ, typically by pumping concrete to form a plug at either end of the line. Downstream of Arklow Bridge (between MHS10 and MHS15), the existing sewer running along the quayside on South Quay will be maintained during construction before being abandoned in situ and plugged.

The proposed interceptor sewer on River Walk/South Quay (between MHS1 to MHS15) will be laid using open cut techniques.

Tunnelling techniques will be used to install the remainder of the proposed interceptor sewer on South Quay (between TSS1 and TSS3), the river crossing and the entire North Quay interceptor sewer (between TSN1 and TSN8). **Chapter 5** provides a detailed description of the indicative construction activities associated with constructing the sewers using these methods.

To facilitate construction of the interceptor sewer in the river channel, a temporary causeway will be required to be installed in the Avoca River to support construction activities at this location. The temporary causeway will be constructed from clean, suitable engineered fill (coarse granular material free from fines with a maximum particle size of 500mm) and will be removed on completion of construction, with the materials re-used elsewhere on site where feasible and subject to testing to ensure it is suitable for the proposed end use.

The tunnel shafts will be constructed using caisson top down construction methods. A number of manholes will be constructed to connect the existing sewer network and the proposed interceptor sewers. These will be constructed using open cut techniques on the existing alignment of the wastewater collection network.

Due to a relatively high water table, dewatering of some excavation material generated from open cut methods will be required before removal from site. The dewatering process will include the use of a silt bag, settlement tanks or other appropriate silt removal systems. The residual silt will be removed from site periodically and delivered for recovery or disposal at licensed and/or permitted waste facilities.

Waste from tunnelling will consist of soil, stone and bentonite clay. A description of the likely method of tunnelling slurry separation is provided in Chapter 5. Where separation plant for drilling slurry on site requires authorisation such as a waste facility permit, this will be obtained from the local authority by the contractor in advance of the activity commencing. Excavated material from tunnel construction will comprise gravel and coarse sand particles, fine sand and silt particles and clay. Temporary stockpiling of excavated tunnel material may take place within the site boundary prior to recovery or recycling at licensed and/or permitted waste facilities. Bentonite clay, a naturally occurring non- hazardous material will be used as a lubricant in tunnelling and as such may be present in tunnelling residues. Bentonite containing waste will also be removed from site for recovery or disposal at appropriately authorised waste facilities in respect of which a waste permit or a waste licence is granted.

Estimated excavation quantities from construction of the South and North Quay Interceptor Sewer are as follows:

- c. 9,700t from open cut construction;
- c. 23,600t from tunnel shaft construction;
- c. 1,400t from underpinning of Arklow Bridge;
- c. 6,110t from tunnelling;
- c. 4,000t from service diversions; and

- c. 17,000t engineered fill from removal of the temporary haul road.

Excavated material is likely to predominantly consist of soil and stones with some non-hazardous materials such as uncontaminated made ground and bitumen. There are likely to be some hazardous materials such as contaminated soils.

WwTP

Construction of the WwTP will occur at the Old Wallboard site which has a history of industrial use as described in **Chapter 2**. Excavation is required to allow for the construction of the foundations and other structures. This is described in further detail in **Chapter 5**. Estimated excavation quantities are summarised as follows:

- c. 26,250t inert excavation material;
- c. 9,400t non-hazardous excavation material; and
- c. 25,200t hazardous excavation material.

During construction, an aqueous sludge will be generated during dewatering activities at the WwTP site. As outlined in **Section 5.5.4 of Chapter 5**, the sludge may be transferred by tanker to at an appropriately licensed facility. Given the reasonable worst case of 250m^3 of groundwater per day being generated during excavation and dewatering, it is anticipated that this will require up to one tank visit per day to remove the aqueous sludge produced by the groundwater treatment.

Revetment and Sea Outfalls

The existing rock armour in the revetment will be completely removed from crest to toe using excavators. Upon removal, the rock armour will be temporarily stored in a designated place within the site where it would be classified and sorted into suitable material for reuse and material to be transported offsite. An estimated 42,000 tonnes of existing rock armour will require removal from site. An estimated 32,000 tonnes of excavated seabed material will be reused within the scheme. There is also a requirement to remove 50,000 tonnes of excavated seabed material from the site. Any material unsuitable for reuse will be removed from the site by trucks and transported to an authorised recovery/ disposal facility.

Summary

Approximately 220,000 tonnes of excavated material will be generated during construction of the proposed development.

Of this it is estimated that 35,000 tonnes of excavated material from the Old Wallboard Site will be categorised as non-hazardous or hazardous in accordance with *Council Directive 99/31/EC of 26 April 1999 on the landfill of waste* and will require removal from site to authorised facilities in Ireland or abroad.

An estimated 185,000 tonnes of surplus excavation material will require removal from site during the construction phase of the proposed development.

The duration of the construction phase is estimated to be 3.5 - 4 years, however as a reasonable worst case given the programme in Appendix 5.2, it has been assumed that excavation and demolition activities may occur over a two year period.

Therefore, an average of approximately 90,000 tonnes of this surplus excavation material per year will require removal from site over this two year period. A significant proportion of this material is likely to consist of soil and stones.

The contractor will ensure excavation waste generated from the proposed development is tested prior to reuse on site, and removal from site to ensure to ensure material and waste is correctly classified and delivered to the appropriate authorised waste facility. Where waste is delivered off site for storage, reuse or recovery the contractor will ensure that the appropriate waste authorisation is in place for all facilities including storage facilities (i.e. EPA Licence, Waste Facility Permit or Certificate of Registration).

16.4.2.3 General Construction Waste

Construction works, site offices and temporary works facilities are also likely to generate waste. Construction waste can vary significantly from site to site but typically may include the following non- hazardous fractions:

- Soil and stone;
- Concrete, brick, tiles and ceramics;
- Asphalt/tar;
- Metals;
- Wood; and
- Other.

The hazardous waste streams which could arise from construction activities may include the following:

- Waste electrical and electronic components;
- Batteries;
- Asbestos;
- Wood preservatives;
- Liquid fuels; and
- Contaminated soil.

Also included within the definition are surplus and damaged products and materials arising in the course of construction work or used temporarily during the course of on-site activities.

In the case of the proposed development, the most likely type of construction waste will be surplus concrete, unusable or damaged pipe segments which may arise on site and drilling waste containing bentonite.

16.4.2.4 Removal of Temporary Works

Following completion of construction, temporary sheet piles may be extracted and removed.

As mentioned previously, a temporary causeway will be installed in the Avoca River to enable sheet piles to be installed herein. This temporary causeway will be constructed of coarse granular material and removed on completion of construction. An estimated 17,000 tonnes of material will require removal from site upon removal of the causeway. This material will be delivered for recovery or disposal at licensed and/or permitted facilities in respect of which a waste permit or a waste licence is granted.

16.4.2.5 Decommissioning of Existing Sewers

On commissioning of the proposed development, a number of the existing sewer pipework on River Walk, South Quay and North Quay will be abandoned and pumped with concrete to seal both ends as detailed in **Chapter 5**.

16.4.2.6 Construction Waste and the Waste Hierarchy

Irish Water is committed to sustainable waste management and the waste management hierarchy set out in the EU Waste Framework Directive (Directive 2008/98/EC) (see also **Section 16.2).** The construction of the proposed development is reviewed below in the context of the waste hierarchy

Prevention

Waste prevention and minimisation is the most environmentally sustainable means of managing excavated material and construction wastes. Prevention and minimisation of waste is inherent in the design of the proposed development.

As mentioned previously, where naturally occurring material is used for the purpose of construction in its natural state within the proposed development this material is not deemed to be a waste in accordance with Article 2 of the Waste Directive 2008/98/EC, the European Communities (Waste Directive) Regulations, 2011 and Section 3 of the Waste Management Acts, 1996-2011 as amended.

Preparing for reuse

The next preferable option in the waste hierarchy is beneficial re-use of surplus excavation spoil as engineering and landscaping material within the proposed development and on other projects requiring the types of materials generated. Reuse of topsoil and excavated material within the proposed development is proposed subject to availability of temporary storage space during the construction phase. The material is also subject to testing to ensure it is suitable for its proposed end use.

Where construction by-products are proposed to be further used on or off site this will take place in compliance with Article 27 of the European Communities (Waste Directive) Regulations, 2011. The contractor will be responsible for ensuring compliance with these Regulations where appropriate.

Recycling, Recovery and Disposal

A significant proportion of surplus excavation material from the proposed development will consist of soil and stones which can be accepted for recovery and recycling at EPA licensed and permitted facilities. Recycling/ recovery activities include:

- Processing of stone to produce construction aggregate;
- Backfilling of quarries; and
- Raising land for site improvement or development.

The option of delivery of inert uncontaminated material for disposal to landfill is the least desirable destination for surplus material generated by the proposed development and will only be considered where sufficient void capacity cannot be secured at appropriately licensed/permitted facilities for recovery purposes. It is unavoidable that a small percentage of excavation material, due to the presence of contaminants will have to be disposed of off-site. All material presented for disposal will have to meet the receiving sites waste acceptance criteria.

Where material for reuse within the proposed development will be processed through crushing and screening to achieve required specifications for end use the contractor will obtain the appropriate permit or licence from Wicklow County Council or the EPA prior to commencement of these activities.

Where removal of waste from site is required this will be delivered for recovery or recycling at facilities holding a Certificate of Registration, Waste Facility Permit or EPA Waste Licence.

The most significant waste generated from the proposed development will be excavation soil and stones with an estimated 49,400t per year likely to be generated during the construction phase. Research was undertaken to determine if licensed capacity is likely to exist at authorised and regulated facilities for acceptance of surplus excavation material generated from the proposed development. The case studies presented in **Appendix 16.2** identify a number of named facilities. The identified facilities merely represent a subset of the total number of facilities available in the region. The review shows that there is adequate authorised capacity in the region to receive the excavation soil and stones likely to be generated by the construction of the proposed development. The case studies are provided for demonstrative purposes and it will be the responsibility of the Contractor to secure agreements for acceptance of the surplus spoil in similar authorised and regulated facilities, in accordance with waste management legislation and requirements.

16.4.2.7 Cumulative

A number of other development proposals are currently permitted or proposed in Arklow town as discussed in **Sections 2.6.6 of Chapter 2**. The nature and scale of these developments are such that construction of these projects at the same time as the proposed development, would not give rise to significant resource and waste management effects.

The proposed Arklow Flood Relief Scheme has also been considered during this assessment. It is likely that the proposed Arklow Flood Relief Scheme (which would be subject to its own EIAR in due course), may include dredging of the river channel, placement of a flood embankment at the eastern edge of Arklow Town Marsh, removal of an area of land at South Quay and construction of flood walls along the river on its southern side.

Design coordination between the proposed development and the design of the proposed Arklow Flood Relief Scheme to date is such that the detail of the proposed development anticipates the proposed Arklow Flood Relief Scheme in so far as is possible. For the purposes of this assessment, it has been assumed that both infrastructure schemes could proceed in parallel or overlap to a degree.

Cumulative construction effects of the other development proposal with the proposed development could give rise to short-term moderate negative resource and waste management effects.

16.4.3 Assessment of Effects during Operation

The sludge produced by the proposed development will be thickened and dewatered to a minimum 18% dry solids, with the dewatered sludge being transported to one or a number of sludge hub centres for further treatment and appropriate disposal in accordance with the Irish Water National Wastewater Sludge Management Plan (NWSMP). The anticipated volume of dewatered sludge cake which will be produced is estimated at 14 m^3 per day. This is equivalent to approximately one truck removing sludge cake from the WwTP per day.

While, as set out in the NWSMP, it is likely that the majority of wastewater sludge will continue to be treated to produce a biosolids product for reuse in agriculture in the medium term, the use of a sludge hub centre allows for economies of scale and greater flexibility in the development and selection of new treatment processes in the future, particularly energy recovery. The reuse of the treated Arklow WwTP sludge in agriculture is subject to a separate regulatory regime and will be in accordance with an appropriate Nutrient Management Plan and regulated in line with statutory requirements, including those under the European Union (Good Agricultural Practice for Protection of Waters) Regulations 2017.

Screenings and grit from the inlet works and SWOs' screening and/or grit removal operations will be collected by suitably permitted contractors and disposed of at an appropriately licensed facility in accordance with the *Waste Management Acts, 1996 to 2011*. Grit and screenings will be produced during operation of the wastewater treatment plant. It is estimated that approximately 1.62 m^3 of screenings will typically be produced per day.

Waste resulting from administrative offices and maintenance requirements is currently categorised as non-household municipal waste. In relation to baseline waste generation for this type of waste in Ireland statistics are reported at a national level. The most recently published EPA statistics relate to 2014 and note that 1,181,554 tonnes of non-household municipal waste was generated in Ireland.

In 2012, 568,873 tonnes of commercial waste was collected in the Eastern Midlands Region, while 390,403 tonnes of non- household municipal waste was collected in the Southern Region. Municipal office and food waste is likely to be generated from the Administration Building. This will be collected by an authorised commercial waste collector as part of their weekly waste collection service in Arklow town.

Maintenance waste will be generated during maintenance of the sewer network and the wastewater treatment plant. Maintenance contractors will remove maintenance waste generated during the course of their work.

16.4.3.1 Cumulative

As outlined in **Section 2.6.6 of Chapter 2**, a number of other development proposals are currently permitted or proposed in Arklow. The nature and scale of these developments are such that development of these projects in combination with the proposed development would not give rise to significant resource and waste management effects.

16.4.4 Assessment of Effects during Decommissioning

Irish Water considers that the proposed development will be a key strategic asset in the Irish Water portfolio and as such it will be maintained and upgraded as required in line with all of its other strategic assets. The design life for the proposed development is 50 years.

In the event of decommissioning, the following measures would be undertaken by Irish Water to ensure that there will be no likely significant effects associated with the decommissioning of the proposed development:

- All raw materials, chemicals, oils, fuel etc. on site at the time of closure will be returned to the supplier, or collected and recycled or disposed of by an authorised waste contractor and at an authorised facility, as appropriate;
- All WwTP buildings and process equipment would be decontaminated and decommissioned in an appropriate manner;
- Infrastructure and underground pipelines are not anticipated to be removed. If removed these will be recycled or disposed of by an authorised waste contractor and at an authorised facility. Generally, specialist equipment would be sold for reuse, where possible, or disposed of off-site;
- All buildings, structures and pipelines would be decommissioned; and
- Roads, hard-standing and site fencing would be retained.

Decommissioning measures would have to be implemented to the satisfaction of the Environmental Protection Agency in relation to the WWDA and the planning authority in relation to any planning permission granted or required. The WWDA would be surrendered in accordance with the relevant requirements. Therefore the effect on resources and waste management, should the proposed development be decommissioned, is expected to be moderate, negative and short term.

16.5 Mitigation Measures and Monitoring

16.5.1 Mitigation

16.5.1.1 Mitigation During Construction

An outline Construction and Demolition Waste Management Plan (CDWMP) is described below. This Outline CDWMP plan will be required to be developed into a Detailed CDWMP by the Contractor(s) following appointment and prior to commencing works on site. The CDWMP addresses waste generation and arrangements made for prevention, reuse, recycling, disposal and collection of recyclables and wastes.

The Outline CDWMP was prepared in line with the guidance[4]. The following is an indicative summary of the content of a CDWMP:

- Description of the project (Refer to **Chapters 4 and 5)**;
- Wastes arising including procedures for minimisation/reuse/recycling;
- Estimated cost of waste management;
- Roles including training and responsibilities for C&D waste;
- Procedures for education of workforce and plan dissemination programme.
- Record keeping procedures;
- Waste collectors, recycling and disposal sites including copies of relavant permits or licences; and
- Waste auditing protocols.

Using the information identified in this section the contractor will be required to develop, implement and maintain a CDWMP during the construction of the proposed development.

Construction – All Phases

In addition to the inherent design measures which will be implemented during construction, the following mitigation measures will also be implemented:

- A pre-demolition audit will be undertaken in order to facilitate selective demolition. Selective demolition will be undertaken in order to enable removal and safe handling of hazardous substances and to facilitate re-use and high quality recycling. The Institution of Civil Engineers (ICE) Demolition Protocol, 2008 provides a robust methodology to assess the quantities of materials present in buildings and structures and their waste management options considering the waste hierarchy principle, when reaching the end of their lives. This guidance should be used to inform the demolition audit of the project.

[4] DoEHLG (2006) Best Practice Guidelines on the Preparation of Waste Management Plans for Construction & Demolition Projects

- The contractor will minimise waste disposal so far as is reasonably practicable. Opportunities for reuse of materials, by products and wastes will be sought throughout the construction stage of the proposed development.
- Possibilities for re-use of clean non-hazardous excavation material as fill on the site or in landscaping works will be considered following appropriate testing to ensure material is suitable for its proposed end use. Where excavated material may not be re-used within the proposed works the Contractor will endeavour to send material for recovery or recycling so far as is reasonably practicable.
- Waste from the proposed development will be transported by authorised waste collectors in accordance with the Waste Management (Collection Permit) Regulations, 2007 as amended.
- Waste from the proposed development will be delivered to authorised waste facilities in accordance with the Waste Management Acts 1996-2016 as amended.
- Source segregation: Where possible metal, timber, glass and other recyclable material will be segregated during construction works and removed off site to a permitted/licensed facility for recycling. Waste stream colour coding, and photographs of wastes to be placed in each container as required, will be used to facilitate segregation. Where waste generation cannot be avoided this will maximise the quantity and quality of waste delivered for recycling and facilitate its movement up the waste hierarchy away from landfill disposal and reduce its environmental impact.
- Material management: 'Just-in-time' delivery will be used so far as is reasonably practicable to minimise material wastage.
- Supply chain partners: The Contractor will engage with the supply chain to supply products and materials that use minimal packaging, and segregate packaging for reuse.
- Waste Auditing: The Contractor will record the quantity in tonnes and types of waste and materials leaving site during the construction phase.
- Waste fuels/oils may be generated from equipment used on-site during construction and may be classified as hazardous waste. Such wastes will be stored in a secure, bunded area on-site prior to collection by a contractor who holds the appropriate waste collection permit.
- The name, address and authorisation details of all facilities and locations to which waste and materials are delivered will be recorded along with the quantity of waste in tonnes delivered to each facility. Records will show material which is recovered and which is disposed of.
- The contractor(s) will ensure that any off site interim storage or waste management facilities for excavated material have the appropriate waste licences or waste facility permits in place.

16.5.1.2 Mitigation during Operation

As the impact of operational waste is predicted to be imperceptible no specific mitigation is considered necessary.

16.5.2 Monitoring

16.5.2.1 Monitoring During Construction

Monitoring required as part of the CDWMP and/or CEMP as set out in sections 16.5.1 and Appendix 5.1 in relation to wastes will be undertaken and recorded by the Contractor(s).

16.5.2.2 Monitoring During Operation

Monitoring of sludge generation and management will be undertaken in accordance with the provisions of operational procedures for the WwTP and the NWSMP.

No additional monitoring is considered necessary with respect to effects from other operational wastes from the proposed development.

16.6 Residual Effects

Following implementation of the mitigation described in **Section 16.5** the residual effects are as follows:

16.6.1 Residual Effects during Construction

The residual effect of excavation waste is expected to be slight, negative and short-term.

The residual effect of demolition waste is expected to be slight, negative and short-term.

The impact of general construction waste is expected to be imperceptible and short term.

16.6.2 Residual Effects during Operation

The residual effect of operational waste is expected to be imperceptible and long term.

16.6.3 Residual Effects during Decommissioning

The residual effect of decommissioning waste is expected to be slight negative and short term.

16.7 References

CAAS (2003). *Advice Notes on Current Practice in the Preparation of Environmental Impact Statements*. EPA, Johnstown Castle Estate, Wexford, Ireland.

Conservation and Amenity Advice Service (CAAS) (2002). *Guidelines on the Information to be contained in Environmental Impact Statements*. Environmental Protection Agency (EPA), Johnstown Castle Estate, Wexford, Ireland.

Department of Environment Community and Local Government (2006). *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects*. DoECLG, Dublin, Ireland.

Eastern Midlands Waste Region (2015). *Eastern Midlands Region Waste Management Plan 2015-2021*. Eastern Midlands Waste Regional Authority, Dublin, Ireland.

EPA (2015). *Waste Classification – List of Waste and Determining if Waste is hazardous or Non Hazardous*. Johnstown Castle, Wexford, Ireland.

EPA (2016) *Ireland's Environment – An Assessment 2016*. EPA, Johnstown Castle Estate, Wexford, Ireland.

EPA (2018) *Construction & Demolition Waste Statistics for Ireland* http://www.epa.ie/nationalwastestatistics/constructiondemolition/

EPA (2017) *Hazardous Waste Statistics for Ireland.* http://www.epa.ie/nationalwastestatistics/hazardous/

EPA (2017) *Municipal Waste Statistics for Ireland*. Latest Reference Year 2014. www.epa.ie/nationalwastestatistics/municipal/

EPA (2017) *Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR)*

European Union (2017). *Environmental Impact Assessment of Projects. Guidance on the Preparation of the Environmental Impact Assessment Report*. EU Publications Office, Luxembourg.

Institution of Civil Engineers (ICE) (2008). *Demolition Protocol, 2008*. ICE, London.

Southern Waste Region (2015). *Southern Region Waste Management Plan 2015-2021*. Southern Waste Regional Authority, Limerick, Ireland.

17 Population and Human Health

17.1 Introduction

This chapter describes the likely significant effects of the proposed development on population and human health (i.e. socio-economic and public health aspects respectively) during construction and operation. It should be noted that **Chapter 19** separately addresses likely significant effects of possible unplanned events (i.e. accidents or disasters).

Chapter 4 provides a description of the proposed development whilst **Chapter 5** provides a full description of the strategy for construction. The following aspects are particularly relevant to the population and human health assessment:

- Design:
  - Aspects relating particularly to the design and location of the Alps SWO and stormwater storage, interceptor sewers and WwTP where these facilities are in proximity to residential and commercial properties or in areas publicly accessible in Arklow town.
- Construction:
  - Construction of all infrastructure, including the interceptor sewers and removal of existing sewers, especially along the Avoca River and in the centre of Arklow town.
  - Potential disturbance to local community, tourism and economy due to construction works, including associated effects on traffic (i.e. pedestrian, cyclist and vehicle movement) and amenity associated with visual, air quality, noise and vibration effects.
  - Likely significant effects on human health including the effects of emissions including noise and emissions to air and water from plant and equipment.
  - Likely significant effects on human health associated with disturbance and annoyance, including construction traffic and how that may interact with human health.
- Operation:
  - Likely significant effects of the proposed development on community, tourism and future development in Arklow town.
  - Operation of the long sea outfall and SWOs, including during periods following heavy rainfall or storm conditions, and associated amenity.
  - Operation of the WwTP including emissions to air from the vent stacks and movement of operational vehicles to the WwTP site.
  - Likely significant effects on human health including potential positive effects associated with improved water quality and consideration of the health consequences of a do nothing or a do minimum scenario.

17.2 Assessment Methodology

17.2.1 General

Population aspects of relevance to this assessment include journey patterns, amenity and community severance, business, tourism and employment opportunities. Other aspects relevant to the local community such as unplanned events, natural amenity, built and natural heritage, material assets and nuisance are dealt with in other chapters of this EIAR.

Human health aspects are primarily considered through an assessment of the environmental pathways by which health may be affected (i.e. the determinants of health) such as air, noise, water or soil. The assessment on human health therefore draws on the findings of other sections of the EIAR as necessary to ensure that the likely significant effects that have the potential for significant effects on human health are considered herein.

17.2.2 Guidance and Legislation

17.2.2.1 Population

This assessment has been undertaken with due regard to the overarching EIA guidance (described in **Section 1.4.3 of Chapter 1**) and Fáilte Ireland guidance[1].

The assessment of effects relevant to human beings in the local area (i.e. the local population) has been undertaken in line with these guidelines. Specifically, the EPA Guidelines[2] advise on types of effects including cumulative and in-combination effects which are particularly important for socio-economic aspects of effects on people, for instance between wastewater collection network capacity and the nature and extent of existing and proposed residential and non-residential development.

17.2.2.2 Human Health

No specific guidance on the definition for human health has been defined to date and in addition, no specific guidance on the assessment of human health in the context of EIA has been issued to date. The relevant topic-specific guidance that has been considered includes the following:

- The World Health Organisation (WHO) (2009) Night time Noise Guidelines for Europe;
- US EPA (2016) Health Impact Assessment Resource and Tool Compilation;
- WHO (1999) Guidelines for Community Noise;
- IEMA (2017) Health in Environmental Impact Assessment - A Primer for a Proportionate Approach;

[1] Fáilte Ireland (2011) Guidelines on the Treatment of Tourism in an EIS
[2] Environmental Protection Agency (2017) Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft August 2017)

- Institute of Public Health Ireland (2009) Health Impact Assessment Guidance;
- WHO (2005) WHO Air Quality Guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide;
- British Standards Institution (2014) 5228-1 and 2:2009+A1:2014. Code of practice for noise and vibration control on construction and open sites. Noise and Vibration[3];
- EPA (2016) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4);
- Air Quality Standards Regulations 2011;
- European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI No 272 of 2009) as amended by the European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2012 (S.I. No. 327 of 2012); and the European Communities Environmental Objectives (Surface Water) (Amendment) Regulations 2015 (SI No. 386 of 2015); and
- Bathing Water Quality Regulations 2008 (SI No 79 of 2008) as amended by Bathing Water Quality (Amendment) Regulations 2011 (SI No 351 of 2011) and Bathing Water Quality (Amendment) Regulations 2016 (SI No 163 of 2016)

Specific Guidance on the Human Health is discussed further in **Section 17.2.7.3**.

17.2.3 Study Area

The principal study area has been determined as the site (i.e. all areas within the planning boundary for the proposed development), specifically residential, commercial and industrial areas adjacent to the Avoca River such as Main Street and the Bridgewater Shopping Centre. The wider study area is the greater Arklow urban area, i.e. the settlement of Arklow and its environs as defined by the Arklow LAP.

For the assessment of effects during construction, the relevant study area includes those areas frequented by people in the immediate environs of the working areas as well as those receptors who might be impacted by ancillary activities such as construction traffic.

For the assessment of effects during operation, the wider study area includes all receptors that may be impacted by the proposed development including primarily, those who live and work in the Arklow town, as well as those who may come in contact with the proposed development, including recreational users around the Avoca River and the coastal and offshore areas within the Irish Sea.

[3] 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

17.2.4 Site Visits

Site visits were undertaken on 2 May 2018 and 10 July 2018 to examine the nature of existing land use in the study area, the principal areas of pedestrian and traffic movement and to witness the extent and nature of leisure activities in Arklow town.

17.2.5 Consultation

Informal meetings took place on the above dates with local businesses, the marina, sailing club, rowing club and sea scouts to discuss the interaction with the existing environment and the likely significant effects of the proposed development.

17.2.6 Categorisation of the Baseline Environment

An assessment of population and human health requires that an understanding of the baseline environment and local community is acquired through background research, site visits, and discussions with local people and community representatives where necessary. Specifically, data has been collected by means of:

- Primary data sources (e.g. demographic data from Census 2016 and preceding Census data produced by the Central Statistics Office [CSO][4]);
- Design drawings of the proposed development (Refer to Volume 3);
- Street maps of the study area[5] obtained in May – July 2018;
- Other relevant environmental baseline data gathered and considered as part of this EIAR, especially traffic and air quality, noise, landscape and visual assessments;
- A review of relevant planning documentation including the Wicklow County Development Plan and the Arklow LAP (Refer to **Chapter 6** for further detail);
- Observation of local settlement, travel patterns and amenity activity along with identification of community facilities; and
- Available community health profiles including the Health Profile completed by Lenus and the HSE6 for the area.

[4] CSO 2016 Census results (2018, and 2011 Census results (2012). Available from: https://www.cso.ie/en/census/ [Accessed 3 May 2018]
[5] For example Bing Maps, Google Maps and Tourist Office Map and Guide
[6] http://www.lenus.ie/hse/bitstream/10147/584031/1/Wicklow.pdf

17.2.7 Impact Assessment Methodology

17.2.7.1 Sensitive Receptors

The EPA guidance7 indicates that the neighbouring occupied premises and land uses that should be considered as 'sensitive receptors' include the following:

- Homes;
- Hospitals;
- Hotels and holiday accommodation;
- Schools and rehabilitation workshops;
- Tourism and recreational facilities; and
- Economic facilities such as visitor attractions based on cultural/historic or natural assets.

17.2.7.2 Population Assessment

This section sets out the methodology that has been used to assess the likely significant effects of the proposed development on population. The purpose of the assessment is to identify the likely significant effects on the local community and users of the proposed development during construction and operation, along with the likely economic significant effects at the local and regional level.

Likely significant effects are categorised in accordance with the EPA Guidelines8. Significant effects are compared between the Do-Nothing and the Do-Something scenarios and arise from direct, indirect, secondary and cumulative effects on environmental conditions. Significant effects can be positive, neutral or negative. It usually follows that the significance of an effect depends, among other considerations, on:

- The location and character of the local environment;
- The sensitivity of the local population and its capacity to absorb change;
- The nature of the environmental effect;
- The timing and duration of an effect;
- The scale or extent of the effect in terms of area or population affected;
- The duration, frequency and reversibility of an effect; and
- The probability of an effect's occurrence.

Effects may be short term, medium term or long term. Construction effects relevant to the assessment are by their nature temporary.

[7] EPA Advice Notes for Preparing Environmental Impact Statement (Draft Sept. 2015)
[8] EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (Draft Sept 2015).

The rationale for applying a particular level of significance to an effect as it would affect the worst hit subset of the population is summarised in **Tables 17.11 and 17.12**. The tables summarise:

- The nature of an effect;
- Location and the population subgroup affected;
- The current character of the local environment;
- The likely significant effects due to the proposed development;
- Significance of an effect;
- Duration of an effect (i.e. temporary, short, medium or long term);
- Receptor extent;
- Proposed mitigation; and
- The residual effect.

Receptor extent qualifies the preceding assessment of significance by identifying the number of receptor types, i.e. people or businesses, likely to be affected as an approximate proportion of the local population or the total number of businesses. Receptor extent is assessed qualitatively as: few; medium; many; or very many. For instance, an impact may be significant for a particular population subset, but the number of people impacted could be few in number.

The methodology includes for the assessment of likely significant effects on:

- Journey patterns;
- Amenity;
- Accessibility and community severance; and
- Business, tourism and employment.

Journey patterns

For a development of this nature and scale, effects on journey patterns may arise due to traffic movements from the proposed development that are additional to normal traffic volumes on the existing network or due to road closures or diversions as they affect traffic movement. Effects can also extend to changes in journey time reliability on the local network.

Amenity

Amenity effects arise from the proximity to construction works or disturbance during operation as it affects the pleasantness and perceived safety of the environment for walking, cycling or driving. General amenity effects can arise due to any effect that the proposed development may have on residential quality of life, amenity or recreation due to environmental effects such as noise or visual intrusion, for which specific significance levels are identified in the respective chapters of the EIAR. There are also links between effects on amenity and tourism.

Accessibility and community severance

Accessibility or community severance refers to people's access or use of community facilities from their home or place of work, particularly as it affects facilities used by older people, children or other vulnerable groups such as those with limited mobility and/or disabilities.

Business, tourism and employment

Economic effects can arise during construction from local employment opportunities and purchasing of local inputs, or from the impact of construction works on local economic activity or businesses.

During operation, significant effects (positive or negative) can arise due to changes in the local environment due to a project or displacement of existing economic activity, or from local employment opportunities or inputs to the local economy. There are also potential interactions with other economic activities in the local area as well as with regard to settlement patterns, population change and tourism.

17.2.7.3 Human Health

Overview

This section sets out the methodology that has been used to assess the likely significant effects of the proposed development on human health.

Directive 2014/52/EU of the European Parliament and of the Council referred to Population and Human Health instead of the Human Beings Chapter previously outlined in Council Directive 85/337/EEC which was repealed by Council Directive 2011/92/EEC'. As outlined in **Section 17.2.2.2**, no specific guidance on the meaning of the term Human Health has been issued and no specific guidance on the assessment of human health in the context of EIA has been issued to date.

The EPA guidelines[2] note that:

"*while no specific guidance on the meaning of the term Human Health has been issued in the context of Directive 2014/52/EU, the same term was used in the SEA Directive (2001/42/EC)*".

Section 5.26 of the Commission's SEA Implementation Guidance9 states the following whilst Paragraph (f) of Annex I of Council Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (SEA Directive) lists the environmental factors including soils, water, landscape, air etc.):

"*The notion of human health should be considered in the context of the other issues mentioned in paragraph (f) and thus environmentally related health issues such as exposure to traffic noise or air pollutants are obvious aspects to study*".

[9] European Commission (EC) Guidance (2003) Implementation of Directive 2001/42 on the assessment of the effects of certain plans and programmes on the environment.

The draft EPA guidelines2 note under Section 3.3.6 that the above health assessment approach is consistent with the approach set out in the 2002 EPA Guidelines where health was considered through assessment of the environmental pathways through which it could be affected, such as air, water or soil, viz:

"The evaluation of effects on these pathways is carried out by reference to accepted standards (usually international) of safety in dose, exposure or risk. These standards are in turn based upon medical and scientific investigation of the direct effects on health of the individual substance, effect or risk. This practice of reliance upon limits, doses and thresholds for environmental pathways, such as air, water or soil, provides robust and reliable health protectors [protection criteria] for analysis relating to the environment".

The draft EPA guidelines[2] also note under Section 3.3.6 that in an EIAR:

"the assessment of impacts on population & human health should refer to the assessments of those factors under which human health effects might occur, as addressed elsewhere in the EIAR e.g. under the environmental factors of air, water, soil etc and that "assessment of other health & safety issues are carried out under other EU Directives, as relevant. These may include reports prepared under the Integrated Pollution Prevention and Control, Industrial Emissions, Waste Framework, Landfill, Strategic Environmental Assessment, Seveso III, Floods or Nuclear Safety Directives. In keeping with the requirement of the amended Directive, an EIAR should take account of the results of such assessments without duplicating them".

The Institute of Environmental Management and Assessment (IEMA) is the largest professional body for environmental practitioners in the UK and worldwide, with nearly 15,000 members and as such it is an authoritative body on Environmental matters. IEMA issued a discussion document on the methodology of the assessment of Human Health in an Environmental Impact Assessment Report in 201710, which it describes as a primer for discussion on what a proportionate assessment of the impacts on health should be in EIA and is a useful document when considering what can and should be assessed in the context of this EIAR. Due regard has been had to the general approach advocated in this document when undertaking this assessment.

One of the messages in the IEMA document10 in terms of assessing health in EIA, is that there should be a greater emphasis on health outcomes, (that is the potential effects on human health), rather than simply the health determinants, (that is the agents or emissions which could have the potential to have health effects). The IEMA document noted that in EIA, there has previously been a strong focus on just the agents or emission levels (e.g. dust) rather than focusing on the effects of these agents/emission levels on human health. This change in emphasis does not mean a complete change in practice. For example, measurement and modelling of dust levels continues to be an essential part of the health assessment.

[10] IEMA (2017) Health in Environmental Impact Assessment - A Primer for a Proportionate Approach

The IEMA document[10] notes that:

"Public health is defined as the science and art of promoting and protecting health and well-being, preventing ill-health and prolonging life through the organised efforts of society and has three domains of practice: health protection, health improvement and improving services".

The IEMA document suggests that these three domains should be considered in the assessment of human health in EIA. Examples of health protection issues to be considered could include issues such as chemicals, radiation, health hazards, emergency response and infectious diseases whilst health improvement issues could include lifestyles, inequalities, housing, community and employment. Examples of improving services issues could include service planning, equity and efficiencies. This correlates well with EIA Directive.

The World Health Organization (WHO) defined health in its broader sense in its 1948 constitution as:

"*a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity".*

Therefore, whilst the draft EPA guidance2 is useful in terms of health protection, for a more holistic assessment as per the IEMA document10, it is also worthwhile to look at broader health effects in terms of opportunities for improvement of health and for improvement of access to services. While it is important to do this, it is also important not to attribute every conceivable event as being a health effect. To further rely on the WHO definition, a health effect would be something that would have a material impact on somebody's physical mental and social well-being be that positive or negative.

Therefore, *health protection, health improvement and improving services* are all considered in this assessment of human health effects. The methodology for assessing health protection is considered further below.

Health Impact Assessment and Environmental Impact Assessment

The IEMA document notes that Health Impact Assessment (HIA) and EIA are separate processes and that whilst a HIA can inform EIA practice in relation to human health, a HIA alone will not necessarily meet the requirements of the EIA Directive in relation to human health. Further, HIA is not routinely carried out for major infrastructure schemes in Ireland and it is typically a non-statutory document that is normally prepared on a voluntary basis by developers overseas, e.g. in the UK.

Guidance for performing HIAs has been issued by the Institute of Public Health in Ireland11 and they have outlined that there are considerable difficulties in performing a HIA for a project of this nature. Not least of these is the difficulty of getting baseline health data as it is quite difficult (due to patient confidentiality and other reasons) to accurately determine levels of even relatively common medical conditions in a relatively defined population that might be affected.

[11] Institute of Public Health (2009) Health Impact Assessment Guidance

Qualitative and quantitative baseline health data is a vitally important part of the HIA process.

This is because it is first important to determine the baseline health status of the community before it is possible to determine the quantitative impacts that a proposal might have on health. In the absence of accurate baseline data it is very difficult to assess qualitative and quantitative changes that might occur as a result of a project of this nature.

More useful generalised data that might exist for larger areas (such as a city or county) may be used, but these datasets would be at most an estimate of the local baseline and not accurate enough to allow for meaningful interpretation specific to the proposed development. Possible local effects, perhaps due to socio-economic variations or for other reasons would not be evident using data for larger population areas making the process inaccurate. This difficulty is not unique to the proposed development.

The IEMA document10, for example, notes that the WHO provides an overview of health in different types of impact assessment12 and presents the WHO perspective on the relationship of HIA to other types of impact assessment as follows:

"The health sector, by crafting and promoting HIA, can be regarded as contributing to fragmentation among impact assessments. Given the value of impact assessments from a societal perspective, this is a risk not to be taken lightly … The need … and justification for separate HIA cannot automatically be derived from the universally accepted significance of health; rather, it should be demonstrated whether and how HIA offers a comparative advantage in terms of societal benefits …

Health issues can, and need to, be included [in impact assessment] irrespective of levels of integration. At the same time, from a civic society perspective, it would be unacceptable for HIA to weaken other impact assessments. A prudent attitude suggests optimizing the coverage of health along all three avenues:

- *better consideration of health in existing impact assessments other than HIA;*
- *dedicated HIA; and*
- *integrated forms of impact assessment."*

It is clear therefore that the WHO does not support a stand-alone HIA unless it can be demonstrated to be of advantage over the assessment of population and human health in the EIAR. In this case no such advantage exists and indeed given the lack of baseline date a standalone HIA would add very little to the assessment process. It is for these reasons that this assessment of human health is part of this EIAR and that no stand-alone HIA has been prepared for the proposed development.

It is therefore important to note that this assessment on human health is provided as part of the overall EIAR rather than a stand-alone HIA.

[12] World Health Organization Regional Office for Europe. Health in impact assessments: opportunities not to be missed. 2014

The HIA is defined as a combination of procedures, methods and tools that systematically judges the potential, and sometimes unintended, effects of a policy, plan, programme or project on both the health of a population and the distribution of those effects within the population.

In contrast, the assessment of human health in the context of EIAR focuses the attention of the assessment on likely significant effects, i.e. on effects that are deemed likely to occur and, if they were to occur, would be expected to be significant (as per the requirements of the Directive 2014/52/EU of the European Parliament and of the Council). Conducting a HIA will not necessarily meet the population and human health requirements of the EIA Directive.

Health Protection

The assessment of human health for the proposed development, in terms of health protection, follows the approach set out in the EPA Guidelines2 , the IMEA guidelines10 referred to above and in Directive 2014/52/EU of the European Parliament and of the Council 9. It is also similar in nature to the US EPA guidance13. Human Health protection is considered through the assessment of the environmental factors (pathways) through which health could be affected such as air, noise, water and soils. The US EPA guidance13 includes a four-step approach which is represented graphically in Figure 17.1.

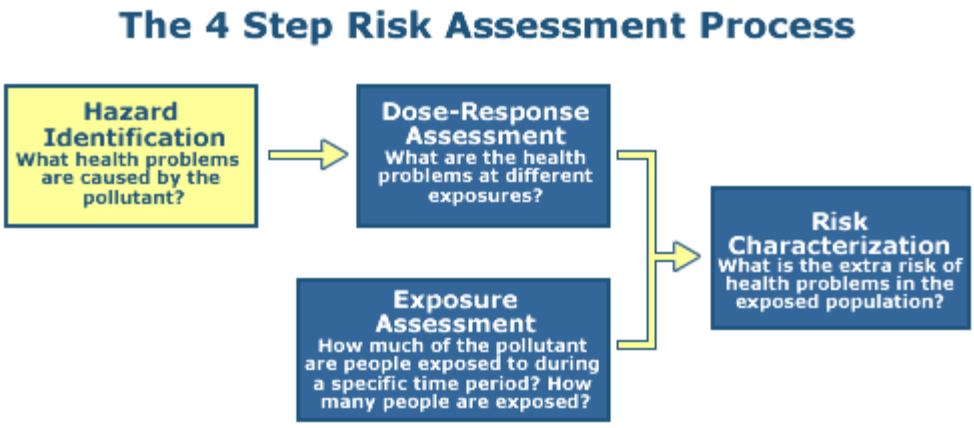

Figure 17.1: Four Step Human Risk Assessment Process

The likely significant effects associated with noise, air, soils and water that could affect human health were identified (Hazard Identification), the scale of these effects (Dose-Response Assessment) and their duration (Exposure Assessment) were assessed and the significance of the likely significant effect on human health was determined (Risk Characterisation).

When using a recognised Health Based Standard, such as one issued by the WHO14, the dose-response assessment is actually included in the standard.

[13] US EPA (2016) Health Impact Assessment Resource and Tool Compilation
[14] The World Health Organisation (WHO) (2009) Night time Noise Guidelines for Europe

In other words, the authorities or expert committees which recommended a specific threshold or parameter (i.e. a limit value) in a standard will have inherently taken into account the health problems at the different exposure levels and thus set the limit value within the standard to prevent these health problems (i.e. significant effects on human health) from occurring.

Health Improvement

Projects that have the potential to generate environmental benefits, protect the population from public health dangers as well as support regeneration, reduce unemployment and improve socio-economic circumstance, could contribute to improving the health and wellbeing of communities.

The assessment for the proposed development, in terms of health improvement, includes an assessment of the likely significant effects of the proposed development on the socio-economics of the community (refer to **Section 0** for further detail).

17.3 Baseline Conditions

17.3.1 Context

17.3.1.1 County Wicklow

County Wicklow is located within the Greater Dublin Area (GDA) and its proximity to County Dublin is central to its socio-economic development. Historically, the settlement patterns and economic development of County Wicklow have been heavily influenced by key infrastructure, notably the N11 and the Dublin-Rosslare railway which mainly follow the east coast.

The population in County Wicklow increased by 4.2% to 142,425 between 2011 and 2016 which was slightly above the national average growth of 3.8%. However, a reduction on the previous growth of 8.3% was evident, itself similar to the national average of 8.2%15. Just over 46% of the population of County Wicklow are under the age of 35 years, while 13% are aged over 65 years16.

17.3.1.2 Arklow Town

Arklow town is located in the southern part of County Wicklow. The Arklow Municipal District has a population of 26,18517 while the urban settlement had a population of 13,16318. Arklow serves a large area of rural County Wicklow, possessing commercial and retail facilities, a small hospital, primary schools, four secondary schools, leisure and cultural facilities.

[15] Central Statistics Office (www.cso.ie/en/statistics/population)
[16] Central Statistics Office (www.cso.ie/en/statistics/population)
[17] Arklow LAP
[18] Central Statistics Office (census.cso.ie/sapmap)

It has industrial infrastructure including a shipping and fishing port, is connected by the Dublin-Rosslare railway line and located close to the M11 motorway connecting Dublin with Gorey which is due to be extended beyond Enniscorthy with onward access to Wexford town and Rosslare.

Arklow town has no wastewater treatment at present and untreated wastewater is currently released from various discrete outfalls directly into the Avoca River. The town has also experienced significant flooding in recent decades due to combinations of heavy rainfall and high tides.

17.3.2 Character

Arklow town is bisected by the Avoca River. It has a natural setting on the coastline of the Irish Sea that is conducive to amenity, recreation and economic activities associated with fishing and the port. Much retail and other commercial activity in Arklow town is located along Main Street, including Upper and Lower Main Street, the latter extending east of Bridge Street.

Newer larger scale retail development and social facilities are located in and around the Bridgewater Shopping Centre on North Quay and Mill Road. Some port related industrial activity is found on North Quay and around the harbour area at the southern end of South Quay. Other industrial activity is found in industrial and business parks closer to the M11. Arklow Bridge has been widened in recent years to provide an improved pavement for pedestrian crossings on both sides of the bridge. Arklow Bridge is the only river crossing in Arklow connecting the two halves of the town.

Arklow town possesses a swimming pool, gyms, a tennis club, pitch and putt, playing fields and other facilities for exercise. There are also numerous opportunities for walking, along South and North Quays and along the seafront, including the northern seafront embankment and Seaview Avenue near where a public skate park and outside exercise equipment have been installed. Six walkways have been also designated around Arklow town taking in locations such as North Quay, South Quay and the harbour. River Walk is also a popular route which loops around a natural area west of the centre to Vale Road. Proposals have been put forward by local community groups to open paths alongside Arklow Marsh which would add to this amenity by providing access beside this proposed Natural Heritage Area.

Arklow South Beach, located to the south of the proposed development (to the south of the harbour mouth) is the principal destination for beach recreation in Arklow town. Water quality here is monitored by the EPA19 and has been judged to have been excellent for the period 2014 - 2017 based on 23 samples. The sandy section of the North Beach commences further north of Arklow town. No water quality samples have been taken here since 2008, although the beach is 2km north of the Avoca River.20

[19] EPA (2018) Bathing water quality map of Ireland for the 2017 bathing season. http://epa.ie/pubs/reports/water/bathing/bathingwaterqualitymapofirelandforthe2017bathingseason.html [Accessed 16 July 2018]
[20] Consultation with Water and Environmental Services of Wicklow County Council 24/5/18.

Water-based recreation includes sailing as evidenced by the boats berthed in the river, at the marina on North Quay and in the harbour. Some fishing boats and windfarm maintenance vessels also operate out of the harbour as does the lifeboat. Arklow Sea Scouts and the Rowing Club are active organisations and a Maritime Festival is held in Arklow each year usually in June/July.

The beach and Roadstone jetty are used for local sea fishing, mainly for flat fish (e.g. whiting, flounder) and dog fish. There is only occasional fishing on the Avoca River in the town due to the health issues presented by untreated wastewater, although the river as a whole is a designated salmonid river with high quality beats upstream as outlined in **Section 11.3 of Chapter 11**.

17.3.3 Significance

As discussed in detail in **Chapter 6**, Arklow town has been designated as a Level 3 - Large Growth Town II in the Regional Planning Guidelines and in the County Development Plan. National trends towards lower household size mean that more housing units are likely to be needed in the coming years. The LAP refers to proposals to support a large increase in population, ultimately to 23,000. Zoned land identified in the Arklow LAP already exists to accommodate up to 4,000 residential units. Since the opening of the N11 bypass in 1999, sequential built development has been permitted up to the road boundary. However, where local circumstances allow, Objective H3 of the LAP proposes that efficient use should be made of land resources by aiming for higher density development where appropriate. Infill development is expected to accommodate some of the proposed new residential development.

Relatively few people commute from Arklow town for employment in Dublin when compared with other settlements in County Wicklow which are closer to the capital. As part of the Wicklow/Arklow Core Economic Area, Arklow town is regarded as a major employment centre with a function to attract national and international investment. The focus of industrial development to date has been in the south of the town in the vicinity of the M11 interchange, but the Arklow LAP identifies opportunity sites for additional potential locations, including the Shelton Abbey site on the Avoca River to the west of the M11 flyover. The land use zoning in the Arklow LAP also identifies potential opportunities for development of the maritime sector given the existing infrastructure and services available in the port area through the Waterfront Zoning which applies also to the proposed WwTP site.

Wicklow County Council also plans to improve and widen the retail offering and town centre facilities. In recent years, some of the land on North Quay has been re-developed for mixed use, including apartments and retail facilities, namely the Bridgewater Shopping Centre which opened in 2007. There are remaining areas of derelict land along the waterfront available for new development in accordance with the relevant objectives outlined in the Arklow LAP.

Upstream of Arklow Bridge, along River Walk and within the ‘Alps’ site, there is a narrow corridor of green space that follows the river channel between the riverfront walkway and the town centre which contains an area identified as an opportunity site for redevelopment in the Arklow LAP.

Downstream of Arklow Bridge, the Avoca River is followed by roads on both sides alongside the waterfront area. The riverside includes the port to the south of the river, the marina to the north and former industrial areas behind these.

Designated waterfront areas are the subject of proposals to realise the potential amenity and tourism value of sites beside the Avoca River.

Arklow town's maritime heritage, built heritage, coastal golf course and beaches underpin this amenity and tourism potential. In addition, the nearby hinterland includes the Vale of Avoca and Brittas Bay for which Arklow could potentially be the gateway. Annual festivals celebrate the town's coastal location, maritime and musical heritage. Accommodation is provided by two small hotels in the centre of town along with the Arklow Bay Hotel on Sea Road, several local B&Bs and a caravan park which together cater for the existing modest flow of tourists visiting Arklow town.

Transport infrastructure includes connections to the M11. There are forward proposals to develop a Port Access Road to the south of Arklow to link the M11/R772 to the Roadstone jetty and South Quays to reduce the volume of heavy good vehicles in the centre of the town. A longer-term goal is the provision of a new bridge across the Avoca River to the west of the town. 21

17.3.4 Sensitivity

17.3.4.1 Community Profile

As of 2016, the settlement of Arklow had a population of 13,163. Most of this population is included within two Electoral Divisions (EDs), Arklow No. 1 Urban (Arklow ED No 1) which is located to the south of the Avoca River, and Arklow No. 2 Urban to the north of the Avoca River (Arklow ED No 2). These two urban EDs capture most of the built-up area for which the relevant population is 12,989 22, although the urban area has also extended into the Kilbride ED. Within the environs of Arklow town, Arklow Rural ED in located inland and to the south while Kilbride ED is located to the north.

As outlined in Table 17.1, the population has grown modestly between 2011 and 2016. Table 17.2 shows the age profile to be similar to the state with a slightly higher representation of younger people (under 17 years) and lower representation in the 17 - 25 year category (this is similar to nearby Wicklow town).

[21] Objective TR38 (Port Access Road) Wicklow County Development Plan. Both proposals referenced in Arklow LAP.

Table 17.1: Population within the study area (Source: CSO23)

Geographic region	2016	2011	Percent change
Arklow	13,163	13,009	1.2%
Arklow ED No 1	9,976	9,817	1.6%
Arklow ED No 2	3,013	2,953	2.0%
Arklow Rural ED	1,367	1,310	4.4%
Kilbride ED	889	909	-2.2%
Wicklow town	6,752	6,761	-0.1%
Co Wicklow	142,332	136,640	4.2%
State	4,757,976	4,588,252	3.7%

Table 17.2: Age profile within the study area: Census 2016 (Source: CSO24)

	0-16	17-25	26-35	36-45	46-55	56-65	65+
Male	1,729	565	797	1,067	869	662	736
Female	1,763	575	935	1,125	872	658	781
Total	**3,492**	**1,140**	**1,732**	**2,192**	**1,741**	**1,320**	**1,546**
% Arklow	26.5%	8.7%	13.2%	16.7%	13.2%	10.0%	15.5%
% Co Wicklow	25.4%	8.6%	11.9%	16.1%	14.1%	10.9%	17.5%
% State	23.7%	10.6%	14.4%	15.5%	12.9%	10.4%	12.5%

The total number of households in Arklow town is 4,788 and Table 17.3 reveals a similar proportion of numbers of persons per household in each of the two urban ED's.

Further, Table 17.4 shows that a large proportion of properties were built between 2001 and 2010. The proportions for each time period are similar for the two halves of the town, but slightly more construction was evident in Arklow ED No 2 between 1980 and 2000. Very little construction has occurred since 2010 due largely to the economic recession. Overall, the residential building stock is younger in Arklow town than for nearby Wicklow town where only 10.4% was built between 2001 and 2010.

[23] Central Statistics Office (www.cso.ie/en/statistics/population)
[24] Central Statistics Office (www.cso.ie/en/statistics/population)

Table 17.3: Numbers of persons in private households: Census 2016 (Source: CSO25)

	1	2	3	4	5	6	7+
Arklow ED No.1	892	1,001	678	688	301	91	45
Arklow ED No.2	264	309	200	193	89	26	11
Total	**1,156**	**1,310**	**878**	**881**	**390**	**117**	**56**
% Arklow	24.2%	27.4%	18.4%	18.5%	8.0%	2.5%	1.1%

Table 17.4: Private households by year built: Census 2016 (Source: CSO26)

	Pre-1971	1971-1991	1991-2000	2001-2010	2011 or later	Not stated
Arklow town	1,305	949	824	1,415	19	333
Arklow ED No 1	1,082	715	546	1,084	15	254
Arklow ED No 2	218	228	267	296	3	78
Total	**1,300**	**943**	**813**	**1,380**	**18**	**117**
% Arklow	26.9%	19.6%	17.0%	29.2%	0.4%	6.9%

Table 17.5 shows that the great majority of households are served by the public wastewater collection (sewerage) network, even though this wastewater is currently not treated. The proportions are again very similar for the two halves of Arklow town.

Table 17.5: Private households by sewerage facility: Census 2016 (Source: CSO27)

	Public scheme	Septic tank	Other individual treatment	Other treatment	No sewerage	Not stated
Arklow town	4,393	62	26	108	43	213
Arklow ED No 1	3,344	37	21	94	39	161
Arklow ED No.2	1,003	14	5	12	4	52
Total	**3,347**	**51**	**26**	**106**	**43**	**213**
% Arklow	90.7%	1.3%	0.5%	2.2%	0.9%	4.4%

Social class is indicated in Table 17.6. Although the town's traditional shipping and fishing industries have declined, the table indicates a relatively high proportion of skilled and semi-skilled workers supported by the presence of a strong industrial base.

[25] Central Statistics Office (census.cso.ie/sapmap)
[26] Central Statistics Office (census.cso.ie/sapmap)
[27] Central Statistics Office (census.cso.ie/sapmap)

There is a correspondingly lower proportion of people in the professional and managerial/technical subsets, although it should be noted that Arklow town retains boat building businesses, including vessels for the aquaculture sector and for maintenance of the offshore wind farm.

Table 17.6: Social class: Census 2016 (Source:CSO28)

	Professional	**Managerial / Technical**	**Non-manual**	**Skilled**	**Semi-skilled**	**Unskilled**	**Other**
Arklow town	628	3,027	2,331	2,218	1,917	491	2,596
% Arklow	4.8%	23.0%	17.7%	16.8%	14.6%	3.4%	19.7%
% Mid-East	7.9%	30.2%	18.1%	15.0%	10.3%	3.6%	15.0%

The Pobal Deprivation Index for Small Areas29 is based on census data where this indicates relevant population attributes and an absence of possessions or opportunities. Its value is in providing comparisons between locations and census years.
The latest assessment based on the 2016 Census reports that relatively high levels of disadvantage are to be found in small towns across Ireland, although some recovery is likely to have occurred since 2016 (as the economy has continued to grow). In this respect, the situation of Arklow town is characteristic of the fortunes of small towns across the country.

In 2016, Arklow ED No 1 and Arklow ED No 2 had absolute deprivation scores of -12.0 and -7.3 respectively. This indicates that the areas are defined as 'marginally below average' (i.e. more deprived) when compared against the national mean (4.2), but significantly above the national minimum value (-43.5). The highest levels of deprivation are recorded for the district of Sheephouse and around Abbey Street in Arklow ED No 1. The absolute deprivation scores for these two districts have improved on the values of -13.6 and -7.9 recorded for 2011, but are still well below the values of -5.6 and -1.6 recorded for 2006 indicating relatively slow economic recovery.

[28] Central Statistics Office (www.cso.ie/en/statistics/population)
[29] Haase, T. and Pratschke, J. (2017) The 2016 Pobal HP Deprivation Index. Available from: www.trutzhaase.ie [Accessed May 2018].

Table 17.7 indicates typical proportions of different types of occupancy in comparison to aggregate town areas nationally. County Wicklow as a whole has a high proportion of social housing when compared with the national average.

Table 17.7: Types of household occupancy: Census 2016 (Source: CSO30)

	Owner occupied	Rented from private landlord	Rented from local authority	Rented from voluntary body	Occupied free of rent	Not stated
Arklow	3,140	956	531	43	70	105
% Arklow	64.8%	19.7%	11.0%	0.9%	1.4%	2.2%
% Mid-East	71.6%	15.6%	7.2%	0.8%	1.5%	2.4%
Aggregate town area	61.4%	24.8%	11.2%	1.4%	1.2%	3.8%

Table 17.8 lists principal economic status in Arklow in 2016 and illustrates that there are lower levels of employment and higher levels of unemployment in the town when compared to the Mid-East Region and aggregate town areas nationally. Male and female unemployment rates31 as of 2016 were 25.1% and 19.7% above the national average respectively. Since this time the economy has grown and as of March 2018, the total number of people on the Live Register in the Southern and Eastern Region was 158,03432 compared with 215,607 for March 201633. In County Wicklow as a whole the unemployment figure has also fallen by 18% in the last year34. Further, the jobs ratio (full time employment to working age, i.e. 16-64 years) in County Wicklow has improved to 63% as the economy has recovered. This is a good indicator of economic activity and sustainability as full-time employment fosters higher income levels, promotes household formation and increased consumption.

Table 17.8: Principal Economic Status: Census 2016 (Source: CSO35)

	At work	Looking for first job	Unemployed	Student	Home duties	Retired	Unable to work	Other
Arklow	4,855	91	1,167	995	962	1,322	582	36
% Arklow	48.4%	0.9%	11.5%	9.9%	9.8%	13.2%	5.8%	0.4%
% Mid-East	55.0%	0.8%	7.1%	11.4%	8.8%	12.6%	3.9%	0.3%
Aggregate town area	53.4%	0.8%	7.1%	11.4%	8.1%	14.5%	4.2%	0.4%

[30] Central Statistics Office (www.cso.ie/))
[31] Central Statistics Office (www.cso.ie/en/statistics/population)
[32] Central Statistics Office (www.cso.ie/en/statistics/labourarket/liveregister)
[33] Central Statistics Office (www.cso.ie/en/statistics/labourarket/liveregister)
[34] Central Statistics Office (www.cso.ie/)
[35] Central Statistics Office (www.cso.ie/)

13% of County Wicklow residents have a disability36. Of the 19,244 people with a disability, one third are aged 65 years or older37. The number of people reporting disabilities (of all kinds) in Arklow is 15.4% compared with 12.8% for the Mid East Region38. Table 17.9 shows that self-perceptions of health in Arklow town were similar to the state as a whole (with the exception of slightly fewer people reporting their health to be very good). Numerous factors will inform these perceptions including age and living conditions.

Table 17.9: Perception of health: Census 2016 (Source: CSO39)

	very good	good	fair	bad	very bad	not stated
Total	**7,773**	**3,679**	**1,182**	**206**	**44**	**279**
% Arklow	59.1%	27.9%	9.0%	1.6%	0.3%	2.1%
% State	62.5%	26.2%	7.4%	1.1%	0.3%	2.5%

17.3.4.2 Interaction between Population and Environment

In the County Development Plan and Arklow LAP, Wicklow County Council target Arklow for a significant expansion in population up to 23,000 in addition to industrial, retail and tourism growth. However, this development has been held back by the current lack of wastewater treatment facilities (Refer to **Section 2.3** for further detail). The position is exacerbated by regular flooding, both fluvial and tidal, which has severely impacted properties adjacent to the river channel including the town centre (refer to **Section 15.3 of Chapter 15** for further detail). The combination of inadequate wastewater treatment and flood risk has restricted new development and compromised the town's ability to attract waterfront development and tourism.

The Avoca Estuary is the only waterbody in Ireland which fails to meet chemical WFD standards due to historic mining contamination40. Wastewater discharge into the river channel has exacerbated this situation in terms of the corresponding biological criteria. However, water quality is listed as "excellent" at Arklow South Beach in the EPA Report on Bathing Water Quality for 2016 and most recently at www.beaches.ie for July 2018. Wastewater currently enters the river at various locations on the north and south banks of the river.

In the context of population and human health, poor water quality presents a risk of diarrhoea or more acute gastroenteritis due to contamination from bacteria such as *E.coli* and Intestinal Enterococci. In practice, symptoms are most likely to arise in people who are in direct contact with contaminated bathing water, i.e. primarily those engaged in water-based recreation either on the Avoca River or offshore. Arklow is popular for sailing and Arklow South Beach is used for beach recreation and surfing.

[36] Central Statistics Office (census.cso.ie/sapmap)
[37] Central Statistics Office (census.cso.ie/sapmap)
[38] Central Statistics Office (www.cso.ie/)
[39] Central Statistics Office (www.cso.ie/)
[40] (Water Quality in Ireland 2010-2015 (EPA, 2016)

Indeed, the sailing and rowing clubs, and the marina, each report problems with floating wastewater and sanitary products, odour, soiling of hulls and, most seriously, infections of cuts due to untreated wastewater. Potentially, symptoms can be exacerbated if untreated wastewater becomes mixed with flood waters. This situation is most likely to occur in a combined sewer network (i.e. where the surface water is combined with the foul flows), where water storage capacity is limited or where wastewater is discharged frequently from overflow outlets following heavy rainfall – all of which are currently present in Arklow town. People who are in poor health or have compromised immune systems, are at higher risk in such events, especially if they reside in areas that are vulnerable to flooding.

Consequently, the poor quality of the water compromises the ability of Arklow town to sustain water-based recreation and presents a potential threat to the health of people coming into contact with the river or floodwaters. Furthermore, there is a risk associated with the consumption of fish caught in the vicinity of overflows and so the taking home of catches from the river is discouraged. Whilst South Beach currently has high water quality, this beach and the northern seafront are vulnerable to potential contamination from untreated wastewater under certain conditions.

17.3.5 Health Standards

17.3.5.1 Overview

As outlined in **Section 0**, a standards based approach has been used particularly in regard to health protection. Therefore, appropriate health standards have been chosen as outlined in **Sections 17.3.5.2 - 17.3.5.4** and justification for the particular standards chosen for each assessment from a human health perspective is provided therein. As stated in **Section 0**, it is important to bear in mind that it is not possible to use standards for all possible health effects.

17.3.5.2 Air Quality

Appropriate Standards

The starting point in selecting the appropriate standard to apply is Directive 2008/50/EC of the European Parliament and of the Council, as amended by Commission Directive (EU) 2015/1480 on ambient air quality and cleaner air for Europe (CAFE Directive). In Ireland, air quality is monitored by the EPA to ensure that the relevant limit values specified by EU directives (that set out the targets for specific air pollutants) are achieved. Limit values have been specified in the CAFE Directive for the following air pollutants (Refer to detail in Table 17.10):

- Sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter (PM_{10} and $PM_{2.5}$) and lead;
- Carbon monoxide and benzene;
- Ozone; and

- Arsenic, Cadmium, Nickel and Benzo(a)pyrene.

Table 17.10: Limit values as set out in the CAFE Directive

Pollutant	**Limit Value Objective**	**Averaging Period**	**Limit Value ug/m^3**	**Limit Value ppb**	**Basis of Application of the Limit Value**	**Limit Value Attainment Date**
SO_2	Protection of human health	1 hour	350	132	Not to be exceeded more than 24 times in a calendar year	1 Jan 2005
SO_2	Protection of human health	24 hours	125	47	Not to be exceeded more than 3 times in a calendar year	1 Jan 2005
NO_2	Protection of human health	1 hour	200	105	Not to be exceeded more than 18 times in a calendar year	1 Jan 2010
NO_2	Protection of human health	calendar year	40	21	Annual mean	1 Jan 2010
PM_{10}	Protection of human health	24 hours	50		Not to be exceeded more than 35 times in a calendar year	1 Jan 2005
PM_{10}	Protection of human health	calendar year	40		Annual mean	1 Jan 2005
$PM_{2.5}$ - Stage 1	Protection of human health	calendar year	25		Annual mean	1 Jan 2015
$PM_{2.5}$ - Stage 2	Protection of human health	calendar year	20		Annual mean	1 Jan 2020
Lead	Protection of human health	calendar year	0.5		Annual mean	1 Jan 2005
Carbon Monoxide	Protection of human health	8 hours	10,000	8620	Not to be exceeded	1 Jan 2005
Benzene	Protection of human health	calendar year	5	1.5	Annual mean	1 Jan 2010

Additionally, it should be noted that provisions were also made for the inclusion of new ambient limit values relating to $PM_{2.5}$. These are clearly appropriate and robust standards.

Air quality standards protect the vulnerable including those with respiratory illnesses, the old, very young and infirm. Whilst slightly higher levels of oxides of nitrogen above the limit values may have no effect on the vast majority of the population, elevated levels of pollutants in ambient air may be significant for these vulnerable groups within the population. This assessment has relied on compliance with the limit values in the CAFE Directive to determine likely significant effects on human health. Therefore, adherence to these limit values is considered to represent that there will be no adverse effect on human health due to air quality emissions as Table 17.10 outlines that the levels set are primarily for the protection of human health.

Baseline conditions

Please refer to **Chapter 8** for a detailed description of the baseline conditions in relation to air quality.

17.3.5.3 Odour

Appropriate Standards

As outlined in **Chapter 9**, currently there is no general statutory odour standard in Ireland relating to industrial installations.

The odour limit used is based on the UK's Environment Agency Odour Management Guidance41 and the Institute of Air Quality Management (IAQM) Guidance42. These guidance documents recommend that odour standards should be between 1.5 and 6.0 OU/m^3 as a 98^{th} percentile of one-hour averaging periods at all receptors. This 98^{th} percentile limit allows for exceedances for 176 hours over a full year (8,760 hours).

This is the chosen standard used in this assessment as this 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. This is therefore considered an appropriate standard to apply for the purpose of the human health assessment.

Baseline conditions

Please refer to **Chapter 9** for a detailed description of the baseline conditions in relation to odour.

[41] Environment Agency (2011) H4 Odour Management How to comply with your environmental permit
[42] Institute of Air Quality Management (IAQM) (Version1.1 July 2018) Guidance on the assessment of odour for planning

17.3.5.4 Noise and Vibration

Appropriate Standards

As set out in **Chapter 10**, there is no specific legislation which sets out environmental noise limits that must be achieved. The noise assessment criteria are based on the Guidelines set out by regulatory bodies such as the EPA, the WHO and the Department of Communications, Climate Action and Environment (DCCAE) whose guidance and standards are based on international best practice.

Construction Noise Criteria

Construction noise is temporary in nature and usually experienced over a short to medium-term period. This characteristic requires it to be considered differently to other longer-term sources of noise. Construction activities on larger-scale developments of this nature will inevitably result in noise being generated temporarily.

There is no Irish guidance specifically published for the short to medium-term construction work such as that required for the proposed development. Construction noise is assessed in terms of the requirements of the relevant standard[43] and specifically Annex E details acceptable construction noise limits for differing scenarios. Annex E.2 of the standard43 looks at the significance of effects based on fixed noise limits and states:

"noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:

70 decibels (dBA) in rural, suburban and urban areas away from main road traffic and industrial noise;

75 decibels (dBA) in urban areas near main roads in heavy industrial areas."

International best practice dictates that noise limits ($L_{Aeq,1hr}$ equivalent) ranging between 65 - 75dB(A) are generally acceptable in the community during daytime construction. There are no specific health based guidelines applicable to time limited projects such as construction activities.

TII (formerly the NRA) is the only government body in Ireland to have specified and published construction noise limits[44]. The NRA guidelines are not mandatory but are recommended to achieve appropriate consistency with respect to the treatment of noise and vibration. The NRA guidelines emphasise that there is no published Irish guidance relating to the maximum permissible construction noise levels, however, they say that Local Authorities, where appropriate, should control noisy construction activities by imposing limits on the hours of operation and consider noise limits at their discretion. The guidelines[44] presents indicative noise levels that are typically deemed acceptable during the construction phase of road developments (Refer to **Table 10.5 in Chapter 10)**.

[43] British Standards (2014) BS 5228-1: Code of practice for noise and vibration control on construction and open sites
[44] NRA (2014) Guidelines for the Treatment of Noise and Vibration in National Road Schemes

In relation to human health specifically, the most applicable guidelines are those issued by the WHO in relation to community effects of noise and subsequent guidance on night time noise in Europe. In their guidance, the WHO state that in the two European countries studied (Switzerland and The Netherlands), almost 50% of the population are exposed to night time noise in excess of 45dB L_{night}45.

The WHO guidelines identify some health effects at quite low night time levels and proposed an ideal noise level of 40dB L_{night} outside residential properties. The WHO do however accept that this is essentially unachievable in the foreseeable future and therefore proposes an interim value as 55dB L_{night} instead. It should be noted that the effects detected at lower night time levels (below 55bB L_{night}) are relatively benign in terms of health effects as more significant health effects are linked to much higher noise levels, usually in excess of 70 dB L_{night}.

In most urban areas, ambient night time noise levels are typically at or above 55dB L_{night} and Arklow town is no different. In this context, any assessment of likely significant effects must take into account the baseline or existing noise levels in this urban area.

Vibration

The situation regarding Vibration standards outlined herein are as described in **Chapter 10**. These standards are:

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

The standards for vibration are primarily set to protect property such as buildings because the effects on buildings occur at considerably lower levels than on human health. Other than potential annoyance whole body vibration is not associated with human health effects until orders of magnitude levels higher than the limit values. This of course makes sense when one considers that we are all exposed regularly to higher levels of whole body vibration every time we get in a car, train or plane or indeed when we or others walk around our own houses. To put this in perspective the Occupational Exposure Limits for Whole Body Vibration are measured in units of metres per second per second (ms^{-2}). In contrast, the units in the TII and BSI standards are measured in millimetres instead of metres.

Baseline conditions

Please refer to **Chapter 10** for a detailed description of the baseline conditions in relation to noise and vibration.

[45] Note - The WHO night noise guidelines refer to Lnight parameter which relates specifically to noise levels over the night-time period.

17.4 Likely Significant Effects

17.4.1 Introduction

The following sections examine the significant effects of the proposed development that are likely to arise during the construction and operational phases.

For Population, these are effects of changes in journey patterns, amenity (journey, residential and general amenity), accessibility and community severance, and business, tourism and employment. A summary of Population effects' significance pre and post mitigation in provided in Table 17.11 and Table 17.12. For Human Health, these are the effects from environmental factors (pathways) through which health could be affected such as air, noise, water and soils.

For Human Health, these are the changes that may occur, during the do nothing scenario as well as construction and operation of the proposed development to human health as a result of emissions in the form of emissions to air, odour, noise and vibration, and to water. It will also consider potential health improvements and access to services.

17.4.2 Do-Nothing Scenario

In the event that the proposed development does not proceed, the absence of wastewater treatment is likely to continue to be a constraint on the economic and physical growth of Arklow town and on the redevelopment of the riverside and North Quay for residential or other development.

The eastern end of the North Quay in particular will remain substantially undeveloped in the short to medium term and the derelict character will continue to have a repressive effect on amenity use and tourism in the area.

The unsatisfactory water quality of the Avoca River will continue to present a potential health hazard to people using the river for water-based recreation and will deter growth or greater participation in these activities.

17.4.3 Assessment of Effects during Construction

17.4.3.1 Population

Journey patterns and journey amenity

It is proposed that construction traffic will use the existing road network, except where it is necessary to temporarily navigate around the working areas (see **Chapter 5**). As outlined in **Section 5.7 of Chapter 5**, the movements of materials will be restricted to daytime (7am-7pm) working hours. The construction phase is expected to increase traffic flows on the wider road network by less than 5% during peak-hours and less than 3% on a daily basis. **Chapter 7** provides more detailed information on traffic arrangements.

In Stages A-C (as defined in **Chapter 7**), construction traffic in the west of the study area will access River Walk (west) via the Town Council public car park entrance, exiting back onto Main Street via River Walk by use of a one-way system. Construction traffic accessing River Walk (central) will enter via Condren's Lane and exit using River Walk with this section becoming a one-way anticlockwise route for all traffic for the duration of the works. River Walk (east) will remain accessible to traffic and pedestrians. Approximately 25 public parking spaces will be unavailable on River Walk for the duration of individual works in these locations for up to 10 months. This will have some effect on local businesses (see below), but less so on journey patterns as alternative parking is available at the Arklow Town Centre Car Park.

At Arklow Bridge, open cut works for the interceptor sewer will be necessary below the first arch and underpinning of two arches will be undertaken (Stage D as defined in **Chapter 7**). Arklow Bridge is heavily used by pedestrians as well as by vehicular traffic and so works here may necessitate the closure of one lane of traffic for a finite period during which a signalised traffic counter-flow sequence will operate. This requirement has the potential for significant traffic congestion, but this effect will be moderated – by keeping closures to evening and night time hours.

Furthermore, a temporary causeway will be installed in the Arklow River. Construction traffic access to the temporary causeway will be from South Quay to avoid Arklow town centre and thus minimise the risk of congestion given existing traffic volumes. Where practicable, material used in the temporary causeway may be reprocessed for use elsewhere in the construction of the proposed development to minimise the need for additional deliveries and additional effects on traffic.

Between Doyle's Lane and South Green, a one-way traffic system will be temporarily installed during construction works operating in a westward direction. This arrangement will have only a slight negative effect on local traffic movement, albeit for around 9 months. East of South Green, there will be a temporary closure of South Quay to through traffic once construction works commence in this area and alternative access will be provided for local residents. In the first instance (Stage E as defined in **Chapter 7**) access will be from Harbour Road for around 2 months after which access will be provided from South Green (Stage F as defined in **Chapter 7**). These access arrangements will have a moderate negative temporary effect on residential access (prior to mitigation) for up to 7 months. At Working Area 15A and 15B a temporary access road will be needed to serve two properties and the enabling works will remove a dividing garden wall. Access to the harbour would be from Harbour Road, although as most traffic already uses this route this restriction presents no significant effect. Works here are anticipated to take 12 months.

At North Quay, access to all properties and businesses will be maintained for the duration of the construction works. However, North Quay will cease to operate as a through road for approximately 12 months due to rolling closures of short sections, requiring varying alternative construction and other access, including to the Bridgewater Shopping Centre, Aldi, Arklow Sailing Club and Arklow Shipping, (Refer to **Chapter 5** and **Chapter 7** for further detail).

A temporary closure of a short section of North Quay will be required immediately east of Arklow Bridge (Stages G-I) necessitating a diversion for vehicles via a temporary paved area linking with Seaview Avenue. This diversion will add to journey times for shoppers and deliveries and also to journeys by residents of Seaview Avenue presenting a significant negative temporary effect on journey times at peak times (prior to mitigation) for around 2 months. Pedestrian access will be retained during this time. The area will be reinstated on completion of the construction works.

Two other sections of North Quay will also be closed during works predicted to last up to 6 months (Stage J and Stage K as defined in **Chapter 7**). These closures will require diversions to Marina Village via Mill Road, presenting a moderate negative temporary effect for residents prior to mitigation (see also Severance below). This alternative access to the marina and businesses to the east will continue for up to 4.5 months (Stage L and Stage M as defined in **Chapter 7**). Pedestrian access will be retained during this time.

Within the working areas as described above, construction equipment and materials will need to be transported to or from the working areas using the sewer pipeline wayleaves, including the proposed temporary causeway, or local riverside roads, connecting with the construction compounds at the treatment plant location and at the rear of Arklow Harbour (Working Area S19). During the period of peak construction, it is anticipated that deliveries will amount to around 388 passenger car units (pcu) daily, with most activity being generated by the WwTP and revetment works.

Construction access to the WwTP site is proposed to use Mill Road along which current traffic volumes are light. However, Mill Road links with the busier North Quay (west) and will, for 2 months, be connected with Seaview Avenue.

Amenity

The construction works are estimated to last for between approximately 3.5 and 4 years. Two construction compounds will be required, but neither is located beside residential properties.

A Storm Water Overflow (SWO) and Stormwater tank will be constructed at the Alps. The structure will connect with the interceptor sewer at the foot of a short wooded valley beside the south bank of the Avoca River. Construction works will be modest in intensity, but a haulage route will be needed along the southern bank of the river channel between Châteaudune Promenade and River Walk to allow construction vehicles to access the site. For safety, construction will necessitate the temporary closure of this footpath from River Walk and Coomie Lane for the duration of the works in this area (Approximately 6 months). Continued access to the western section of the walkway will be possible during this time from Vale Road. There are other outdoor areas available for walking in the town, although the riverside at the Alps is the only natural section of the river that is accessible by foot from the town centre. It has been improved in recent years with ongoing maintenance by the community and is an amenity of value to the people of Arklow town. Subject to proposed mitigation, construction here will have a temporary significant negative effect on amenity (prior to mitigation) even though access will remain from the west.

Open cut construction of the interceptor sewer along Châteaudune Promenade and River Walk will entail cutting of a trench and removal of spoil, requiring digging machinery and some vehicle movement presenting noise and visual effects **(see Chapters 10 and 13** for further detail on noise and vibration and landscape and visual respectively). Mitigation will take the form of the erection of 2.4m high hoarding/fencing and the restriction of works to within daytime (7am - 7pm) noise limits. This is a sensitive area given amenity use and the presence of small businesses, construction works in front of the commercial properties on River Walk would be timed for October to March which will minimise significant effects on riverside amenity, the residential amenity of apartments and adjacent businesses during the summer months.

Downstream of Arklow Bridge, the in-river construction of the interceptor sewer will be open cut for approximately 300m from a point shortly upstream of the first arch of Arklow Bridge as far as the junction between South Quay and South Green. Along this section, the laying and removal of the temporary causeway will have to be undertaken between July and September to accommodate Inland Fisheries seasonality restrictions and this timing is likely to have a significant effect on amenity and tourism during the summer months (prior mitigation). The temporary causeway will likely be in place for one year, but with varying intensity of works during this time.

The open cut construction works for the interceptor sewer would extend along South Quay. Shortly after the commencement of South Quay there is a row of 4 terraced houses followed by the Brookview Court apartment complex in which 22 properties face onto South Quay and the Avoca River. These apartments are followed in turn by a further 7 terraced houses. A negative effect due to noise, vibration and visual intrusion will apply here due to open cut works, amounting to a significant negative effect (prior to mitigation) for two of the private houses that are closest to the working areas.

Downstream at South Green junction, the interceptor sewer will return to the landward side and be tunnelled. At the start of this tunnelling, two houses adjoining the tunnel shaft (TSS2) will be affected as their main entrances will be very close to the working area and temporary diversions will be needed to maintain access to these properties.

The green space fronting onto the following 10 properties on South Quay is publicly owned and separated from private front gardens by a low wall. However, the green space is also divided by residential driveways giving the appearance of individual plots. Consequently, construction works in this area will present potentially significant temporary effects (prior to mitigation), including noise, vibration and visual intrusion, on the amenity of nearby residents and pedestrians (Refer to **Chapters 10 and 13** for further detail). For four of these properties, the working area will extend into private gardens requiring a temporary CPO.

The tunnelling of the interceptor sewer will then extend in front of the entrance to the housing estate of Anchor Mews and a further 12 apartments and terraced properties facing onto South Quay and then to the rear of a further 4 properties on the west side of Harbour Road. Several properties on the east side of Harbour Road are set back from the road, but will face the tunnelling works. A small business is also located here (Farrell’s Fireplaces).

At this point, the river crossing will be constructed by tunnelling methods in the river channel. Construction will require tunnelling 24 hours per day for efficient completion and involve the use of a tunnel boring machine, jacking frame and a water/slurry flow system. This work will need to conform with noise standards, although there will be up to a significant temporary effect from noise and visual effects affecting the amenity of local residents inhabiting properties commencing on South Quay and continuing up Harbour Road (Refer to **Chapter 10**).

Along North Quay, the sewer will be constructed entirely using tunnelling methods. Construction works will be managed to allow continued access to the river by members of Arklow Sailing Club. The diversion of traffic to the Bridgewater Shopping Centre via Seaview Avenue for around 2 months, including some construction traffic, will have an effect on access for local residents (see Journey Patterns) and also a temporary significant effect on the residential amenity of households fronting the road. To the east, the proposed interceptor sewer will run behind a marina with berths for 35 boats without impacting significantly on access. Noise and visual intrusion from the working areas will, however, have an impact on the amenity of people using the riverside, business employees, boat owners and residents of Marina Village, most particularly for those apartments closest to, or facing, the working areas. These effects will amount to a significant negative effect prior to noise and visual mitigation (Refer to **Chapters 10 and 13** for further detail).

Overall, the construction works are likely to have a negative effect on the attractiveness of the riverside environment for the amenity of local residents and tourists. This can be mitigated by staggering the erection of hoarding to those working areas where it is most needed at any one time so that the riverfront views are not lost for the entire construction period (Refer also to **Chapter 13**). At the WwTP site, noise and other environmental effects are likely, but amenity associated with this area is currently very low with these affects being more relevant to local businesses nearby. However, significant cumulative noise effects are anticipated, mainly affecting typically modest numbers of walkers using the southern-most section of the existing embankment adjoining the Irish Sea.

Accessibility and community severance

Construction access to the Alps SWO and stormwater tank will be via Condren's Lane and the existing one-way systems serving the public car park behind the band stand on Main Street, exiting via River Lane (East) which forms the existing exit to the car park. Although most pedestrians will be familiar with this exit point, it is narrow with limited sightlines so a moderate severance effect is likely (prior to mitigation).

Temporary night-time closures of one lane of Arklow Bridge may be needed during which a signalised counter-flow sequence would operate. Arklow Bridge provides the only connection between the north and south of the town and carries high volumes of traffic at peak times and a reasonably high volume at other daytime hours as well as significant pedestrian traffic. Some delays are inevitable and will represent a negative effect on journey patterns and amenity as discussed above and this, in turn, will create a degree of severance in that some people will be deterred from making journeys by car or foot.

The temporary closure of sections of South Quay and North Quay, particularly the latter, and the diversion of traffic around working areas will have a severance effect on local residents, employees of local businesses and other people using the riverfront for leisure. Temporary road closures may require diversions to Marina Village via Mill Road, presenting a negative severance effect for residents. Block 7 of the apartments (separated from the others by the existing road) will be most affected by severance due to the movement of construction vehicles and the need for temporary access arrangements in this area.

There will also be a severance effect at Seaview Avenue for the period when this road is used for diverted traffic accessing the Bridgewater Shopping Centre, although this is moderated by the fact that community facilities are located on the north or eastern side of the road and of the proposed diversion. These facilities include a playground, swimming pool, leisure centre, running track and green space. The Bridgewater Shopping Centre itself is the only community facility for which a severance effect will apply with this being slight as regards pedestrian access from Seaview Avenue residential area.

Business, tourism and employment.

Along River Walk, the interceptor sewer and associated working areas adjoin the river channel as it approaches Arklow Bridge. A restaurant, tanning salon and two cafes are located along this section of River Walk, of which the latter both have outdoor seating and with one situated somewhat closer to the river. Other businesses on Main Street have rear access from River Walk, including a pub with limited outdoor seating. Approximately 25 parking spaces along River Walk will be unavailable during construction and this will have at least a negative effect on businesses. For the café and restaurant businesses, an overall significant negative temporary effect is anticipated prior to mitigation due to temporary loss of some parking, loss of some outdoor seating, noise and visual effects (Refer to **Chapters 10 and 13** for further detail). The effects will, however, be moderated by the duration of the works (around 2 months) and their proposed timing between October and March outside of the period when people may be more inclined to sit outside or enjoy the riverfront walk.

However, the negative effect will be greater for the café business nearest Arklow Bridge where the duration of works will be longer, i.e. around 9 months. A negative effect is also likely for the Bridge Hotel which, although it does not face directly onto the proposed development, has guest accommodation which may be affected by noise, including from short duration night-time works.

Three businesses are also located close to the proposed open cut works at the start of South Quay on the far side of Arklow Bridge. These include a Chinese restaurant, creche access and a carpet installer. Only a slight negative effect is anticipated for these businesses.

On North Quay, the interceptor sewer will be constructed close to a homeopathy centre/sports clinic, the entrance of Bridgewater Shopping Centre and an Aldi supermarket. Three cafes/restaurants are located in the Bridgewater Shopping Centre which face onto the Avoca River with some outdoor seating. The businesses are not highly dependent on this riverside view, although this is clearly an asset.

The interceptor sewer will be tunnelled at this location, although access will be constructed in front of the shopping centre. Consequently, there will be a moderate negative effect (prior to mitigation) on these businesses for the duration of the works.

The temporary diversion of traffic for the Bridgewater Shopping Centre could deter some shoppers and patronage of retail outlets despite the absence of alternative shopping centres in Arklow town. If so, this would have a negative, if temporary economic effect on some retailers.

North Quay is also the home of the Maritime Museum, although the effect of the works on visits to the museum and tourism will be slight. The construction works will also occur in front of the entrance to Arklow Shipping. For these premises a moderate negative construction effect is likely (prior to mitigation) due mainly from noise and the proposed diversions of traffic discussed above.

Downstream, tunnel shafts are not proposed for locations in front of business entrances or apartments. However, tunnelling works will occur in the vicinity of three further businesses at North Quay/Mill Road. The effect of noise from these works will represent a moderate negative effect (prior to mitigation) for two businesses opposite the river crossing, but slight negative with respect to noise from works on the interceptor sewer and the construction work on the WwTP site.

At an aggregate level, construction of the proposed development is anticipated to have only a slight and temporary negative effect on tourism numbers or length of stay prior to proposed mitigation being in place. Any effects on tourism will have a knock-on impact on local businesses such as hotels, guest houses and restaurants. Tourism currently makes a modest contribution to the economy of Arklow and most hotels are located away from the working areas with the exception of the Bridge Hotel.

17.4.3.2 Human Health

Traffic

As outlined in **Chapter 7,** some moderate adverse effects are predicted in some locations around the eastern end of River Walk, Arklow Bridge, South Quay and North Quay on traffic operations during construction associated with increased traffic flows on the network and diversions. This has potential to lead to some annoyance in drivers, pedestrians and cyclists as well as properties adjoining traffic routes.

Annoyance however is not in itself a health effect. Further, given the defined duration of the construction phase, and the extensive mitigation outlined in **Chapter 7** the likely significant effect on human health associated with traffic is negligible.

Air Quality

As outlined in **Chapter 8,** no likely significant effects are predicted on air quality during construction. Further, extensive mitigation including a dust monitoring programme is outlined in **Section 8.7 of Chapter 8**.

On the basis of complying with the limit values outlined in the CAFE Directive, the likely significant effects on human health associated with air quality are imperceptible during construction.

Odour

As outlined in **Chapter 9,** no significant negative effects on odour are predicted during construction. On the basis of complying with the relevant standards, the likely significant effects on human health associated with odour are imperceptible during construction.

Noise

As outlined in **Chapter 10**, the assessment of likely significant noise and vibration effects during construction generally indicates that compliance with noise limit values can be achieved at the nearest sensitive receptors to the WwTP site during construction of the WwTP, outfalls and revetment.

However, as outlined in **Chapter 10**, noise limit values will be exceeded at some of the nearest sensitive receptors along the alignment of the proposed interceptor sewer during some of the construction activities. Further, noise generated during tunnelling works may result in some exceedances of evening and night time limit values (tunnelling is intended to be undertaken on a 24-hour basis).

The implementation of the mitigation measures outlined in **Section 10.6** will assist in reducing effects on nearby sensitive receptors.

Vibration

As outlined above in relation to the Vibration, while no health affects as such are predicted, as outlined in **Chapter 10** tunnelling will be undertaken 24 hours per day. It will be continuously moving and any one location will have the potential for an effect for up to 20-25 days with some variation in intensity, the maximum time it will take the TBM to traverse 100 metres.

A susceptible individual, even if the only effect is annoyance, could still be affected over that period of time. However, the mitigation outlined in **Chapter 10** will ensure no adverse health effects.

Summary

Apart from mild annoyance due to traffic disruption and slight impact due to construction noise and vibration, significant effects on human health are not likely during construction.

17.4.3.3 Cumulative

Construction of the proposed development will have negative effects on aspects of accessibility and amenity for some receptors, including local residents, residents of Arklow town and visitors. There will also be related effects on some businesses due to amenity, for example loss of riverside views or noise. These effects can be mitigated, but not eliminated.

17.4.4 Assessment of effects during operation

17.4.4.1 Population

Journey patterns

The operation of the proposed development will have no significant effect on traffic or journey patterns. The WwTP is anticipated to produce approximately 14m^3 of dewatered sludge per day under normal conditions and this will need to be removed by road. It is not proposed that there will be sludge deliveries to the plant, therefore it is anticipated that there may be one vehicle movement per day to remove sludge. Other operational vehicle movements to/from the WwTP site will be limited to operational staff, routine maintenance of the interceptor sewer and will not represent a significant effect on traffic flow given the existing traffic volumes in Arklow town.

Amenity

Once complete, levels around the Alps SWO and stormwater storage tank will be raised by around 1m, covered with a 300mm layer of topsoil and landscaped. A c. 1.2m high fence will also be installed around the structure. New manholes would be visible (as discussed in **Chapter 5**), footpaths will be reinstated and occasional vehicle access will be needed for maintenance purposes. There should be no need for larger vehicle access in this area. The effect on amenity is anticipated to be imperceptible to slight negative.

All working areas affected temporarily during construction will be reinstated. Immediately downstream of Arklow Bridge, reclaimed land will be topped with approximately 300mm of top soil and grass seeded. It is currently understood that further public realm works may occur at a later date following the completion of the proposed Arklow Flood Relief Scheme that would allow for the introduction of new public realm permitting the introduction of a new footpath and linear green space along the riverfront.

In the short-term, the significant effect will be moderate positive, but with the potential to be a significant positive cumulative effect.

Once complete, the proposed WwTP will represent a sizeable structure. The area is zoned as waterfront for mixed use development and has a maritime industrial heritage that is part of the attraction of the area. New apartments will not be precluded by the presence of the WwTP and will continue to benefit from the associated amenity and views associated with the riverside/coastal location. The WwTP building design is of a high architectural standard and will replace an industrial site that has been derelict for some time. Consequently, a significant positive effect is anticipated.

Odour has potential to effect general amenity and human health at sensitive receptors, including people living or working in and for people recreating in odorous areas. Potential odour effects associated with the vent stacks adjacent to sensitive receptors are addressed in detail in **Chapter 9** and odour in the vicinity of the proposed development is predicted to be well below the limit values and thus will have no significant effect on amenity.

The revetment adjoining the WwTP site will be modified and improved, but will not be opened up for pedestrian access following completion of construction due to the health and safety risk that this would present in times of high tide or extreme weather. Planting and landscaping will be provided around the WwTP site perimeter. Altogether, the effect on amenity use of the area will be at least moderate positive compared with the Do-nothing Scenario.

Landscaping associated with the proposed development and subsequent public realm works that would be undertaken at a later date as part of the proposed Arklow Flood Relief Scheme, together with the provision of new or improved footpaths, is likely to have a significant positive cumulative effect on amenity use of the north bay and the riverside.

Business, Tourism and Employment.

By introducing new wastewater treatment facilities in compliance with the UWWT Directive, the proposed development will remove the existing restrictions on significant development and expansion in Arklow town, as it applies to both economic/industrial and population growth. This will have a positive effect on potential economic development and employment, and a possible indirect benefit in reducing the level of social disadvantage in Arklow town. In this respect, the proposed development will have a profoundly positive effect.

The proposed development will remove the sense of dereliction associated with the eastern waterfront at North Quay. As such, it will have a moderate positive effect on locational image of local businesses located in the area, most of which are associated with the town's maritime heritage. This, in turn may have a positive effect on the local economy by stimulating new riverside development in the waterfront area. It will also facilitate new development in town. In the same way by reintroducing the active use of land in the port and riverside area, the positive amenity effect of the proposed development will extend also to positive effect for tourism in the town.

17.4.4.2 Human Health

Traffic

As outlined in **Chapter 7**, likely significant effects on traffic and transportation are negligible during operation given existing traffic flows and the small number of operational vehicles. On this basis, the likely significant effects on human health associated with traffic will be imperceptible during operation of the proposed development.

Air Quality

As outlined in **Chapter 8**, likely significant effects on air quality are negligible during operation. On this basis, the likely significant effects on human health associated with air quality will be imperceptible during operation of the proposed development.

Odour

As outlined in **Chapter 9**, likely significant effects on odour are negligible during operation and odour will be monitored on an ongoing basis. On this basis, the likely significant effects on human health associated with odour will be imperceptible during operation of the proposed development.

Noise

As outlined in **Chapter 10**, likely significant effects on noise are negligible during operation and all equipment will be housed within buildings/chambers which will limit noise breakout to atmosphere. On this basis, the likely significant effects on human health associated with noise will be imperceptible during operation of the proposed development.

17.4.4.3 Cumulative

The proposed development will have a profound positive effect on the economic development and population growth as well as a significant positive effect on public health due to the improved water quality, particularly in the estuarine zone of the Avoca River associated with the removal of untreated wastewater discharging into the river channel.

The proposed development will reinstate the public realm and be completed with the provision of some landscaping that would facilitate further landscaping likely to be undertaken separately at a later date along River Walk and South Quay as part of the proposed Arklow Flood Relief Scheme. In combination with the proposed improvements to the revetment, a profound positive effect associated with the proposed development will be evident during operation.

17.5 Mitigation Measures and Monitoring

17.5.1 Mitigation

17.5.1.1 Mitigation during Construction

Population

Mitigation during construction is proposed throughout **Chapters 7 - 19**. The use of hoarding and management of the timing and duration of works will, in most cases have the effect of reducing the level of pre-mitigation significance of effects on Population by at least one level (see Table 17.1). One limitation is the required July-September timing of works at Arklow Bridge to conform to Inland Fisheries seasonal regulations. In addition, it is proposed in this section of the report that construction activities at key locations in Arklow town, such as locations adjacent to businesses on River Walk and North Quay, and close to residential properties along River Walk, South Quay and at the Marina Village, be completed as swiftly as possible and on a rolling basis.

Although it is intended that the construction will be completed swiftly, the avoidance of having simultaneous work and hoarding at all locations throughout construction will greatly mitigate the overall cumulative effect on traffic flow, journey patterns, amenity, tourism and consumer businesses. Specific proposed mitigation includes:

- Provide for safe pedestrian access at points of entry and exit of construction vehicles accessing River Walk and Châteaudune Promenade from Main Street;
- Ensure provision of a safe surface for the existing eastern footpath (currently gravel) from Vale Road for use of the walk by more vulnerable older age groups as an alternative to the temporary closure of surfaced section from River Walk;
- Provide continued access to boat moorings on North Quay during open cut works;
- Where practicable, use short sections of transparent hoarding or include viewing windows in the hoarding at locations popular for amenity such as in front of the cafes on River Walk and at the Bridgewater Shopping Centre;
- Stagger works wherever possible and remove hoarding as soon as it is no longer needed to mitigate against severance;
- Avoid works that could involve high noise or visual intrusion during major social events around the Avoca River, notably any sites used by the annual Arklow Maritime Festival or other public events.
- Provide temporary signalling or manning of junction between Ferrybank and Seaview Avenue while diversion to Bridgewater Shopping Centre is in effect;
- Maintain regular proactive consultation with local residents and businesses, particularly along River Walk, South Green, Harbour Road, Bridgewater Shopping Centre, Aldi and Marine Village, but also with all living or working along South Quay, North Quay and Ferrybank.

Human Health

Other than the mitigation outlined in the respective **Chapters 7 - 10**, no further mitigation has been proposed with respect to human health effects during construction of the proposed development. This is because, in accordance with the best scientific evidence no significant health effects are predicted with the mitigation already proposed.

Cumulative

Other than the mitigation outlined in the respective **Chapters 7 - 10**, no further mitigation measures have been proposed with respect to cumulative effects during the construction of the proposed development.

17.5.1 Mitigation during Operation

Population

Other than the mitigation outlined in the respective **Chapters 7 - 19**, no further mitigation measures have been proposed with population respect to effects from operation of the proposed development.

Human Health

Other than the mitigation outlined in the respective **Chapters 7 - 10**, no further mitigation have been proposed with respect to human health effects during operation of the proposed development. This is because, in accordance with the best scientific evidence no significant health effects are predicted with the mitigation already proposed.

Cumulative

Other than the mitigation outlined in the respective **Chapters 7 - 19**, no further mitigation measures have been proposed with respect to cumulative effects during the operation of the proposed development.

17.5.2 Monitoring

17.5.1 Monitoring during Construction

Population

Traffic flows should be monitored to ensure that significant delays or congestion are not occurring in Arklow town due to diversions or construction traffic.

Regular proactive consultation should be undertaken with local businesses and a log of complaints/issues raised by stakeholders should be maintained and monitored throughout construction. Where practicable, residents and local businesses should be advised in advance on the timing of works to understand the effect on business turnover or population amenity.

Human Health

Other than the monitoring outlined in the respective **Chapters 7 - 10**, no further monitoring has been proposed with respect to human health effects during operation of the proposed development.

Cumulative

No monitoring has been proposed with respect to cumulative effects from construction of the proposed development.

17.5.2 Monitoring during Operation

Population

Monitoring of the volume of HGV movements to and from the WwTP is proposed. In other respects, the positive effect of the proposed development mitigates the need for further monitoring with regard to population effects from operation of the proposed development.

Human Health

No monitoring has been proposed with respect to human health effects from operation of the proposed development.

Cumulative

No monitoring has been proposed with respect to cumulative effects from operation of the proposed development.

17.6 Residual Effects

17.6.1 Residual Effects during Construction

17.6.1.1 Population

There will be a significant residual effect on local businesses such as cafes and restaurants that have a partial dependence on views of the river and amenity use.

In addition, residual effects on the amenity of people living beside the river and the proposed interceptor sewer is inevitable. These effects will be temporary in nature and will have been moderated by the implementation of the proposed mitigation.

17.6.1.2 Human Health

Other than some annoyance possible as a result of traffic disruption during the construction phase, which will be mitigated by the traffic management plan and some slight negative impact on the closest sensitive receptors due to construction noise, no likely residual effects on human health have been identified.

17.6.2 Residual Effects during Operation

17.6.2.1 Population

The provision of wastewater treatment in Arklow town will reactivate the potential for the economic and residential development providing a profound positive effect for the community and local economy.

The elimination, in so far as possible, of the discharge of untreated wastewater into the Avoca River will have a significant positive effect on water quality and recreational activities associated with the Avoca River, including general tourism and water sports. However, use of the river for direct contact recreation such as swimming may still be compromised by legacy contamination from historical mining that was undertaken in the upper catchment.

17.6.2.2 Human Health

No adverse effect during the construction phase on human health is predicted. Significant positive impacts in terms of public health and socio-economic benefits with resultant benefits for human health are predicted on the basis of having an efficient and adequate wastewater treatment facility.

17.7 References

Air Quality Standards Regulations 2011;

Bathing Water Quality Regulations 2008 (SI No 79 of 2008) as amended by Bathing Water Quality (Amendment) Regulations 2011 (SI No 351 of 2011) and Bathing Water Quality (Amendment) Regulations 2016 (SI No 163 of 2016)

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;

CSO (2016) *Central Statistics Office – Census 2016 Small Area Population Statistics.* Available at: http://census.cso.ie/sapmap/

CSO (2018) *Central Statistics Office* Available at: https://www.cso.ie/en/census/

CSO (2016) Population [Online] Available at: https://www.cso.ie/en/statistics/population/

Environmental Agency (2011) *H4 Odour Management How to comply with your environmental permit*

EPA (2017) *Advice Notes for Preparing Environmental Impact Statement (Draft August 2017)* Accessed at: http://www.lenus.ie/hse/bitstream/10147/584031/1/Wicklow.pdf

EPA (2015) *Advice Notes for Preparing Environmental Impact Statement Draft Sept.2015*

EPA. (2017). *Bathing Water Quality Map of Ireland for the 2017 Bathing Season*. Retrieved July 16, 2018, from http://epa.ie/pubs/reports/water/bathing/bathingwaterqualitymapofirelandforthe2017bathingseason.html

EPA (2016) *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4*);

EPA (2015) *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (Draft Sept. 2015)*

EPA (2016) *Water Quality in Ireland 2010-2015*. EPA Johnstown Castle, County Wexford.

European Commission (2003) *Implementation of Directive 2001/42 on the assessment of the effects of certain plans and programmes on the environment*.

European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI No 272 of 2009) as amended by the European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2012 (S.I. No. 327 of 2012); and the European Communities Environmental Objectives (Surface Water) (Amendment) Regulations 2015 (SI No. 386 of 2015TII (2004) *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*;

Fáilte Ireland (2011) *Guidelines on the Treatment of Tourism in an EIS*

Haase, T. and Pratschke, J. (2017) *The 2016 Pobal HP Deprivation Index.* Accessed at www.trutzhaase.ie. [May 2018].

IEMA (2017) *Health in Environmental Impact Assessment - A Primer for a Proportionate Approach;*

Institute of Air Quality Management (IAQM) (2018) *Guidance on the assessment of odour for planning*

Institute of Public Health Ireland (2009) *Health Impact Assessment Guidance*;

NRA (2014) *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*

WHO (1999) *Guidelines for Community N*oise;

WHO (2009) *Night time Noise Guidelines for Europe*;

WHO (2005) *WHO Air Quality Guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide;*

Wicklow County Council (2018) *Arklow and Environs Local Area Plan 2018-2024;*

Wicklow County Council (2011) *Wicklow County Development Plan 2011-2017*

US EPA (2016) *Health Impact Assessment Resource and Tool Compilation*

18 Material Assets

18.1 Introduction

This section describes the likely significant effects of the proposed development on material assets. Material assets are defined[1] as:

"*Resources that are valued and that are intrinsic to specific places"*

Whilst the current draft EPA Guidelines[2] state that Material Assets:

"Can now be taken to mean built services and infrastructure."

The purpose of this assessment is therefore to consider the likely significant effects of the proposed development on existing services and infrastructure, including:

- Land Use and Properties;
- Electricity;
- Telecommunications;
- Gas;
- Water Supply Infrastructure; and
- Foul and Surface Water Drainage.

Material assets of natural origin are addressed separately in other chapters of this EIAR, such as **Chapter 8** (air quality), **Chapter 11** (biodiversity), **Chapter 14** (land and soils) **Chapter 15** (water), and traffic and transport assets are considered in **Chapter 7**.

Chapter 4 provides a full description of the proposed development and **Chapter 5** describes the construction strategy for the proposed development. The following aspects are particularly relevant to the material assets assessment:

- Design:
  - Proximity of the proposed development to existing material assets;
- Construction:
  - Diversions required to undertake construction activities in the vicinity of existing material assets; and
  - Intrusive construction activities occurring in proximity to existing material assets.
- Operation:
  - Operational demand requirements of the proposed development;

[1] EPA (2015) Advice Notes for Preparing Environmental Impact Statements.
[2] EPA (2017) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports: Draft August 2017.

18.2 Assessment Methodology

18.2.1 General

This chapter has been prepared having regard to the overarching EIA guidance as described in **Section 1.4.3 of Chapter 1**. The significance of effects has been determined based on the severity of potential disturbance to existing material assets.

18.2.2 Guidance and Legislation

The significance criteria used to categorise significant effects on material assets is set out in Table 18.1 and has been developed based on the description of significant effects as outlined in the guidance[2].

Table 18.1: Significance criteria for likely significant effects on material assets

Significance Level	Criteria
Imperceptible	An effect capable of measurement but without significant consequences.
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound Effects	An effect which obliterates sensitive characteristics

For the purpose of this assessment, likely significant effects on material assets are considered to be those effects that are categorised as significant, very significant or profound.

18.2.3 Categorisation of the Baseline Environment

In order to determine the existing utilities and services within the proposed development site, utility investigations have been undertaken to support the design development. A desk study, site visits and site-specific investigations were undertaken in August 2016 to provide the data to compile the description of the existing material assets. These survey findings reconciled with the relevant utility records at the time.

In early 2018 the design team reverted to utilities contacts for updated records on the following dates, with no further updates highlighted at that stage:

- Eir - maps downloaded from website 24 January 2018.
- ESB Networks – maps received 23 January 2018, 26 January 2018 and 26 February 2018.
- Gas Networks – maps received 23 January 2018.
- Virgin Media – maps received 20 March 2018.

Consultation with utility providers has also been undertaken where applicable to determine the location and details of existing utilities including ESB, gas, surface and wastewater sewers, telecommunications, public lighting and infrastructure within the site.

18.2.4 Impact Assessment Methodology

A desk study has been carried out to identify the existing material assets associated within the site and determine the likely significant effects of the construction and operation of the proposed development on those material assets.

Having regard to Chapters 4 and 5, the likely significant effects of the proposed development on existing material assets have been assessed in the context of the significance criteria set out in Table 18.1.

18.3 Baseline Conditions

18.3.1 Land-use and Property

The existing land use and property is described in detail in **Section 2.6 of Chapter 2.** The proposed development is concentrated in the waterfront area of Arklow, with the proposed interceptor sewers located along the north and south quays and the WwTP located at the Old Wallboard site at Ferrybank. The WwTP site is bounded to the east by Arklow Bay and to the south by the Arklow River, in a prominent location on the waterfront at the mouth of the estuary.

18.3.2 Electricity

ESB maintains both underground and overhead power lines within and around the site. ESB's infrastructure of relevance to the proposed development includes the following:

- Overhead ESB cables running from a central point at the Alps that cross the Avoca River in a north-easterly direction, travel west across the Alps site and south-east to the Arklow Court House;
- Underground ESB ducting running along a section of the riverfront, between the Alps site and River Walk;
- Underground ESB ducting running along River Walk to Arklow Bridge;

- Overhead ESB cable running along South Quay, from Arklow Bridge to the Anchor Mews residential estate. Additional ESB overhead cables from the town centre meet this cable at a number of points along South Quay;
- Underground ESB ducting running along the South Quay, from Arklow Bridge to Doyle's Lane;
- Underground ESB ducting traversing the WwTP site;
- Underground GE Energy cable running under the existing revetment;
- Underground ESB ducting running along Mill Road;
- Underground ESB ducting running along North Quay; and
- Overhead ESB cables running along North Quay, from Arklow Bridge to the Bridgewater Shopping Centre.

18.3.3 Telecommunications

There are telecommunication cables of relevance to the proposed development at the following locations within and around the site:

- Telecommunication cables running between River Walk and Arklow Bridge. Additional telecommunication cables from the town centre meet this cable at a number of points along River Walk;
- Telecommunication cables running across Arklow Bridge;
- Telecommunication cables running along Mill Road;
- Telecommunication cables running along North Quay, between Arklow Bridge and the Marina; and
- Telecommunication cables running across Arklow Bridge, from Ferrybank to Bridge Street.

18.3.4 Gas

There are gas mains of relevance to the proposed development at the following locations within and around the site:

- A 355mm diameter gas main running across Arklow Bridge which enters underground approximately 10m upstream of the River Walk – Arklow Bridge tie-in. This gas main supplies those parts of Arklow town to the south of the river channel;
- Gas main running along South Quay between Arklow Bridge and the Harbour. At South Green there is an existing surface water outfall, therefore the gas main is manifolded into three lines that occupy the majority of the footprint of the road carriageway to pass over this outfall;
- Gas main running along North Quay between Arklow Bridge and Marina Village; and

- Gas main running across Arklow Bridge, connecting to those on the North and South Quays.

18.3.5 Water Supply Infrastructure

There is water supply infrastructure (that have transferred, or will transfer under the ministerial order to Irish Water) of relevance to the proposed development at the following locations within and around the site:

- A watermain running along River Walk to Arklow Bridge;
- Two watermains running across Arklow Bridge. Although relatively small (160mm and 100mm diameter pipelines), these are the only water supplies to those parts of Ferrybank to the north of the river channel;
- A watermain traversing the WwTP site;
- A watermain running along North Quay between the Marina and the WwTP site;
- A watermain running along Mill Road;
- A watermain running along North Quay between Arklow Bridge and Marina Village; and
- Two watermains running across Arklow Bridge.

18.3.6 Sewer Network and Drainage Infrastructure

There is an existing combined sewer network (including outfalls to the Avoca River) and drainage infrastructure of relevance to the proposed development at the following locations within the site:

- A sewer running to the east of the Alps site and between the Alps and carpark at River Walk and an outfall discharging to the Avoca River at this point;
- A sewer running River Walk that picks up perpendicular sewers and discharges via outfalls to the Avoca River;
- A sewer running along South Quay between Arklow Bridge and Doyle's Lane that picks up perpendicular sewers and discharges via outfalls to the Avoca River;
- At South Green, there are existing surface water outfalls;
- A sewer and outfall at the junction of South Quay and Harbour Road that discharges to the Avoca River
- A sewer running along the back of the properties adjacent to Arklow Town Marsh pNHA and the R7228 that discharges via an outfall to the Avoca River;
- Existing outfalls on North Quay that discharge to the Avoca River;
- A sewer traversing the North Quay near the marina, with an outfall discharging to the Avoca River; and

- A surface water sewer located in the vicinity of the Marina Village apartments, traversing the North Quays, with an outfall to the Avoca River.
- Sewers along Mill Road that discharge to the Avoca River and an additional outfall to the marina.

18.4 Likely Significant Effects

18.4.1 Do-Nothing Scenario

In the scenario where the proposed development does not proceed as planned, the existing land and material assets in the study area will remain as currently identified in the desk study, site visits and site-specific investigations.

The existing sewer network and drainage infrastructure associated with the current practise of discharging untreated wastewater to the Avoca River will remain as currently identified.

As previously outlined in **Chapters 1 and 2**, the European Commission is currently taking a case against Ireland at the Court of Justice of the European Union for its failure to ensure that urban wastewater in 38 agglomerations (of which Arklow is one such named agglomeration) is adequately collected and treated to prevent serious risks to human health and the environment.

It is clear therefore, that from a legislative perspective alone, the 'do-nothing' scenario is not a reasonable alternative in the context of the proposed development. In any case, the do nothing scenario will result in no significant effects on material assets.

18.4.2 Assessment of effects during construction

18.4.2.1 Land-Use and Property

Overview

Construction of the proposed development will require temporary land take to accommodate construction activities and permanent land take to accommodate specific above ground elements of the proposed development. (as described in detail in **Chapter 4**).

The Compulsory Purchase Order (CPO) accompanying the planning application outlines the extent of:

- Lands to be acquired (purchased);
- Permanent wayleaves;
- Temporary working areas;
- Permanent rights of way.

Supporting documentation is provided as part of the planning application submission, in the form of an Engineer's Report, CPO drawings and land schedules.

Land which will be temporarily acquired to facilitate working areas during the construction phase of the proposed development include lands within the planning boundary at the Alps, lands along River Walk, lands north of the WwTP site and lands along the North and South Quays. The temporary acquisition of lands to facilitate temporary working areas or temporary rights of way during the construction of the proposed development is predicted to result in a slight, negative and short-term effect on land-use. On completion of the construction phase, the contractor will be obliged to return these lands to their original land-use classifications.

Land which will be permanently acquired in order to facilitate the proposed development includes the site of the existing overflow (SWO), located in the north-east corner of 'the Alps' development site, and the site of the proposed WwTP at Ferrybank.

The permanent acquisition of land is predicted to result in a slight, negative and long-term effect on the existing land-owner's due to the compulsory purchase of land. However, a significant, positive and long-term effect on land-use at these locations is predicted by means of physical improvements to the land in question and fulfilment of land-use zoning objectives and land-use classifications.

Land subject to permanent wayleaves and permanent rights of way in order to facilitate the proposed development include lands at the Alps, along River Walk, North Quay and South Quay. The requirement of permanent wayleaves and permanent rights of way is predicted to result in a slight, negative and long-term impact on land-use.

Foreshore License/Lease

As outlined in **Section 4.5.2 of Chapter 4**, the provisions of the Foreshore Act 1933 to 2014, as amended, require that a lease or licence must be obtained from the Minister for Housing, Planning and Local Government for development works on the State-owned foreshore. Foreshore consent applications will therefore be required for the following elements of the proposed development:

- The underpinning of Arklow Bridge;
- Construction works in the Avoca River to construct the interceptor sewer and sheet pile walls;
- The tunnelling of the interceptor sewer under the Avoca River from the South Quay to Mill Road;
- Construction works to construct the long sea outfall in the Irish Sea; and
- Construction works for the SWO and upgraded revetment at the WwTP site.

Foreshore consent application(s) for the above works are being submitted to the Department of Housing, Planning and Local Government in parallel to the application for consent that is being submitted to An Bord Pleanála.

A pre-application consultation meeting was held with the Foreshore Unit in the Department of Housing, Planning and Local Government on 20 June 2018.

18.4.2.2 Electricity

The interceptor sewer will interact with the underground electricity infrastructure in a number of locations along River Walk, hence local re-routing will be required prior to the commencement of construction.

On South Quay, the overhead ESB cable will have to be diverted prior to the commencement of construction. Tunnelling of the interceptor sewer along the downstream section of South Quay should minimise the risk of interaction with existing ESB overhead cables in this location.

Tunnelling of the interceptor sewer on North Quay and along Mill Road should minimise the risk of interaction with existing ESB ducting in this location.

The diversion of services along River Walk and South Quay may require planned power outages. Should the event of unplanned or prolonged disturbance occur, a negative, temporary effect is predicted. However, the contractor will be required to consult with ESB in advance of any works and it is anticipated that the service provider will arrange the diversion and consult with the relevant affected premises as required. The contractor will be obliged to put measures in place to ensure that there are no interruptions to existing utilities and services unless this has been agreed in advance with the relevant service provider.

It should be noted that there is an existing cable (owned by GE Energy) that runs under the existing revetment. The proposed development will encroach within the existing 50m cable buffer zone for this cable, however as agreed with GE, a 10m buffer zone around the cable will be adhered to and thus the proposed development will not directly affect the cable.

The proposed development will be connected to the existing ESB distribution network via a new 10kV connection at the WwTP site boundary on Mill Road (adjacent to the administration building). The maximum demand for the WwTP is currently estimated at 900kVA. The new 10kV connection will require a dedicated ESB substation room in the Process building. This substation room will house all ESB equipment and access will be restricted to ESB personnel only.

Therefore, the likely effect of the proposed development on existing electricity infrastructure will be slight, negative and temporary.

18.4.2.3 Telecommunications

The interceptor sewer will interact with the telecommunications infrastructure in a number of locations along River Walk, hence local rerouting will be required to facilitate the open-cut construction along this section.

In addition, the proposed underpinning of Arklow Bridge has the potential to interact with the Eir line running underneath the bridge deck.

Should the event of unplanned or prolonged disturbance occur, a negative, temporary effect is predicted. However, the contractor will be required to consult with the service provided in advance of any works and it is anticipated that the service provider will arrange the diversion and consult with the relevant affected premises as required. The contractor will be obliged to put measures in place to ensure that there are no interruptions to existing utilities and services unless this has been agreed in advance with the relevant service provider.

Tunnelling of the interceptor sewer should minimise the risk of interaction with existing underground telecommunication infrastructure on both North Quay and downstream on South Quay.

Therefore, the likely effect of the proposed development on existing telecommunications infrastructure will be slight, negative and temporary.

18.4.2.4 Gas

On South Quay and North Quay, tunnelling of the interceptor sewer should minimise the risk of interaction with existing services. On South Quay, all gas infrastructure is located in the road corridor.

The proposed underpinning of Arklow Bridge has the potential to interact with the gas main running underneath the bridge deck, as well as the connection at the southern, upstream tie-in on River Walk.

Should the event of unplanned or prolonged disturbance occur, a negative, temporary effect is predicted. However, the contractor will be obliged to put measures in place to ensure that there are no interruptions to existing utilities and services unless this has been agreed in advance with the relevant service provider.

Therefore, the likely effect of the proposed development on existing gas mains will be slight, negative and temporary.

18.4.2.5 Water Supply Infrastructure

Generally, the watermains adjacent to the Alps SWO and stormwater storage tank will not be impacted by the construction of the interceptor sewer as it will be undertaken ‘off line’ and appropriate diversions for water supply infrastructure will be put in place in advance of the commencement of construction as described in **Chapter 5**.

Along South Quay and North Quay, tunnelling should minimise the risk of interaction with existing water supply infrastructure.

The proposed underpinning of Arklow Bridge has the potential to interact with the two watermains running underneath the bridge deck.

Should the event of unplanned or prolonged disturbance occur, a negative, temporary effect is predicted. However, the contractor will be obliged to put measures in place to ensure that there are no interruptions to existing utilities and services unless this has been agreed in advance with the relevant service provider.

Therefore, the likely effect of the proposed development on existing water supply infrastructure will be slight, negative and temporary.

18.4.2.6 Sewer Network and Drainage Infrastructure

During the enabling works, sewer network diversions will be undertaken and temporary drainage infrastructure installed at working areas (as described in detail in **Chapter 5**) to maintain the operational sewer network in Arklow town throughout construction.

The sewer network and drainage infrastructure will be required to be functional throughout construction until the proposed development becomes operational. Upon completion of testing and commissioning, the existing wastewater sewers will be diverted to the interceptor sewers. Short sections of the existing sewers will then be abandoned, infilled with concrete and left insitu.

Therefore, the likely effect of the proposed development on the sewer network and drainage infrastructure will be long-term and neutral.

18.4.2.7 Cumulative

As outlined in **Section 2.6.6 and 2.6.7 of Chapter 2**, relevant developments have been considered in relation to cumulative effects.

Given the nature and scale of the developments identified, no cumulative effects on material assets is predicted to occur if any one, or all of these developments occur concurrent to the construction of the proposed development. However, there is the potential for physical and temporal overlap between the proposed development and the proposed Arklow Flood Relief Scheme.

Both proposals have been designed having regard to the existence of the other scheme and the potential for interaction, and the design and construction of the overlapping elements of each of the schemes will be implemented in an integrated manner in so far as possible. Further, it will be the responsibility of contractors to ensure effective coordination and communication throughout construction in relation to utilities and services diversions.

This approach therefore ensures that the cumulative effects on material assets arising from the construction of the proposed development and the proposed Arklow Flood Relief Scheme is mitigated and avoided in so far as possible.

18.4.3 Assessment of Effects during Operation

18.4.3.1 Land-Use and Property

As outlined in **Section 18.4.2.1**, some land within the planning boundary will be permanently acquired in order to facilitate the proposed development, including the site located in the north-east corner of the Alps and the site of the proposed WwTP at Ferrybank.

The permanent acquisition of land will occur during construction, but will remain in place throughout the operation of the proposed development. The permanent acquisition of land is predicted to result in a slight, negative and long-term effect on the existing land-owner's due to the compulsory purchase of land.

Similarly, and as outlined in **Section 18.4.2.1**, some land within the planning boundary will be subject to permanent wayleaves and permanent rights of way in order to facilitate the proposed development, including lands at the Alps, lands along River Walk, and lands along the North and South Quays.

The acquisition of permanent wayleaves and permanent rights of way will occur during construction, but will be maintained and enforced throughout the entire operation of the proposed development.

As previously outlined, a foreshore consent application is being submitted for the permanent infrastructure which will remain in place within the foreshore during the operation of the proposed development.

Therefore, a slight, negative and long-term effect on land-use at these locations is predicted during the operation of the proposed development.

18.4.3.2 Electricity

There will be no effect on existing underground ESB or GE cables during the operation of the proposed development.

The proposed development will be connected to the existing ESB distribution network via a new 10kV connection at the boundary of the WwTP site (i.e. on Mill Road as described in detail in **Section 4.3 of Chapter 4**). The maximum demand estimated for the WwTP is currently estimated at 900kVA.

The proposed development will therefore increase demand on the electricity network in Arklow town, however the demand will be offset through the provision of the PV installation on the Process building. Further, it is expected that the network has capacity to accommodate the proposed development. Therefore, the likely effect of the proposed development on the existing electricity network is considered to be permanent, but not significant.

18.4.3.3 Telecommunications

The proposed development will require a telecommunications connection to facilitate operational activities at the WwTP site. It is expected that the existing telecommunications network in the vicinity will have the capacity and thus be able to accommodate the connection.

The likely effect of the proposed development on the existing telecommunications network is therefore considered to be permanent, but imperceptible.

18.4.3.4 Gas

As there are no requirements for gas during operation of the proposed development, there will be a neutral effect on gas infrastructure during the operation of the proposed development.

18.4.3.5 Water Supply Infrastructure

A dedicated watermain, connected to the public water supply will be provided as part of the overall site infrastructure at the WwTP site. As outlined in **Section 4.3 of Chapter 4,** this incoming water main will be metered upon entry after which it will be distributed below ground to serve each of the individual buildings.

A complete water services installation including for the provision, as required, of mains, cold and hot water will service each building. The mains water will feed a number of mains water break tanks within the Inlet Works and Process buildings which will in turn service the respective cold-water service requirements such as safety showers, wash-down hose reels, process equipment etc. The mains water will also feed a 24hr cold water storage tank which will in turn service the cold-water service requirements of the Administration building. Point of use type electric water heaters will be provided to service any hot water service requirements of areas such as the sanitary accommodation.

The proposed development will therefore increase demand on the water supply network in Arklow town, however it is expected that the network has capacity to accommodate the proposed development.

Therefore, the likely effect of the proposed development on the existing water supply network is considered to be not significant.

18.4.3.6 Sewer Network and Drainage Infrastructure

Drainage infrastructure will be provided for all buildings on the WwTP site. This will include for the provision for drainage from all equipment, from all sanitary accommodation and from all items of equipment within ancillary spaces including workshop, laboratory, canteen etc. provided in the Administration building. Condensate drainage will also be provided as necessary from any HVAC equipment installations within each of the buildings. Further, appropriate drainage in the vicinity of the interceptor sewers will be maintained throughout Arklow town. Rainwater collection from the roofs of the various buildings will be discharged directly to drain.

Therefore, the likely effect of the proposed development on the existing drainage infrastructure is considered to be permanent, but not significant.

The nature of the proposed development will provide a robust wastewater network across Arklow town that is capable of accommodating population growth and will eliminate in as far as reasonable possible, the current practice of discharging untreated wastewater to the Avoca River. An appropriate WWDA will be obtained for the operation of the proposed development.

Therefore, there will be a significant, positive and long-term and permanent effect on the wastewater network during the operation of the proposed development.

18.4.3.7 Cumulative

There are no cumulative effects identified during the operation of the proposed development.

18.5 Mitigation Measures and Monitoring

18.5.1 Mitigation

18.5.1.1 Mitigation During Construction

Wherever possible, mitigation by avoidance of negative effects on property was a priority during the design development of the proposed development. Landowners will be compensated as appropriate for permanent and temporary land acquisition, in accordance with the relevant legislation. The details of any individual agreements will be private and confidential and therefore mitigation measures in the form of compensation are not specific or detailed herein.

A Property Protection Scheme will be put in place by Irish Water prior to works commencing on site. This will involve advance condition surveys prior to construction for all properties within the zone of influence of the proposed development. If it is determined that any reported minor cosmetic damage has been caused by construction of the proposed development, suitable remedial works will be undertaken to repair the damage to the properties with the use of the appropriate conservation technique.

Mitigation measures for all areas of temporary land acquisition will involve reinstatement to their original condition so far as is reasonably practicable.

Access to all existing properties will be maintained at all times during the construction of the proposed development. This may require temporary alternate access arrangements at some locations. All access will be reinstated upon completion of construction.

The contractor will be obliged to put measures in place to ensure that there are no interruptions to existing utilities and services unless this has been agreed in advance with the relevant service provider. As outlined in **Section 5.5.2 of Chapter 5**, all utilities and services diversions will be agreed and undertaken as part of the enabling works and in advance of the commencement of construction activities. All construction activities in the vicinity of existing services and utilities will be carried out in ongoing consultation with the relevant service provide and undertaken in compliance with any requirements or guidelines they may have.

Sewer diversions will be undertaken as part of the enabling works prior to the commencement of construction activities.

Upon commissioning, the older pipelines being abandoned will be sealed off and/or removed as described in **Chapter 5**.

Surface water management measures will be adopted along the entire site, as outlined in **Section 15.5 of Chapter 15**.

As described in **Chapter 5** and outlined in **Appendix 5.1**, the contractor will be required to prepare and maintain a detailed CEMP during the construction phase of the proposed development. The appointed contractor will be required to comply with the Outline CEMP. Effective implementation of the CEMP will ensure that disruption and nuisance are kept to a minimum throughout the construction of the proposed development. The detailed CEMP will be required to have regard to the guidance[3] and industry best practice. The CEMPs will be effective throughout construction and the contractor will be required to review and update the CEMP as construction progresses.

In addition to the CEMP, it is anticipated that the contractor will prepare relevant management plans and Works Method Statements in advance of any works commencing on site. Every effort will be made to ensure that any significant effects on material assets will be avoided, prevented or reduced during the construction of the proposed development.

18.5.1.2 Mitigation During Operation

Landowners will be compensated as appropriate for permanent land acquisition, in accordance with legislation. As noted in **Section 18.5.1.1**, the details of any individual agreements will be private and confidential and therefore mitigation measures in the form of compensation are not specific or detailed in this EIAR.

18.5.2 Monitoring

18.5.2.1 Monitoring During Construction

Construction phase mitigation measures have been proposed to ensure that significant negative effects on material assets will be avoided, prevented or reduced during the construction of the proposed development. As such, no monitoring measures are proposed during the construction phase.

18.5.2.2 Monitoring During Operation

As no significant, negative operational effects of the proposed development on material assets are identified, no operational monitoring measures have been proposed.

[3] CIRIA (2015) Environmental Good Practice on Site Guide, 4th Edition

18.6 Residual Effects

18.6.1 Residual Effects during Construction

A slight negative long-term effect on existing land-owner's is predicted where land will be permanently acquired to facilitate the proposed development.

For areas of temporary land acquisition where compensation will be agreed and which will be reinstated to their original condition as a minimum, it is concluded that there will be no residual significant effects. A slight negative long-term effect on land-use is predicted where land will subject to permanent wayleaves and permanent rights of way in order to facilitate the proposed development.

Following implementation of mitigation measures outlined in **Section 18.5.1.1**, it is anticipated that the residual effects of the proposed development on electricity, telecommunications, gas, water supply, sewer network and drainage infrastructure during construction is not considered to be significant.

18.6.2 Residual Effects during Operation

A slight negative long-term effect on existing land-owner's is predicted where land will be permanently acquired to facilitate the proposed development. However, once operational the proposed development is considered to be an improvement over the 'do-nothing' scenario as the re-development of a brownfield site at Ferrybank and the removal of dilapidated buildings by the provision of vital infrastructure for Arklow town is considered to be a significant positive long-term residual effect.

A slight negative long-term effect on land-use is predicted where land will be subject to permanent wayleaves and permanent rights of way in order to facilitate the proposed development. Following implementation of mitigation measures outlined above, it is anticipated that the residual effects of the proposed development on electricity, telecommunications, gas, water supply, sewer network and drainage infrastructure during operation are not considered to be significant.

The proposed development will result in a permanent, positive residual effect on the wastewater network by providing a robust, reliable collection network and treatment capacity that is capable of accommodating anticipated population growth in Arklow town.

18.7 References

CIRIA (2015) *Environmental Good Practice on Site Guide, 4th Edition*

EPA (2017) *Guidelines on Information to be contained in Environmental Impact Statements*

EPA (2015a) *Revised Guidelines on the information to be contained in Environmental Impact Statements Draft*

EPA (2015b) *Advice Notes for Preparing Environmental Impact Statements Draft.*

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

19 Major Accidents and Natural Disasters

19.1 Introduction

This chapter describes likely significant negative effects on the environment arising from the vulnerability of the proposed development to risks of major accidents and/or natural disasters.

The assessment of the vulnerability of the proposed development to major accidents and natural disasters is carried out in compliance with the EIA Directive which states the need to assess:

"*the expected significant adverse effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and/or natural disasters which are relevant to the project concerned*."

The underlying objective of this assessment is to ensure that appropriate precautionary actions are taken for those projects which *"because of their vulnerability to major accidents and/or natural disasters, are likely to have significant adverse effects on the environment".*

Based on the requirements of the EIA Directive, this chapter seeks to determine:

- The relevant major accidents and/or natural disasters, if any, that the proposed development could be vulnerable to;
- The potential for these major accidents and/or natural disasters to result in likely significant adverse environmental effect(s); and
- The measures that are in place, or need to be in place, to prevent or mitigate the likely significant adverse effects of such events on the environment.

19.2 Assessment Methodology

19.2.1 General

The scope and methodology of this assessment is centred on the understanding that the proposed development will be designed, built and operated in line with best international current practice. As such, major accidents resulting from the proposed development will be very unlikely.

The scope and methodology presented in the following sections is based on the provisions of the EIA Directive, the draft EPA Guidelines[1], EU Commission guidance[2] and other published risk assessment methodologies as described in **Section 19.2.4.2** and professional judgement.

[1] EPA (2017) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports: Draft, August 2017.
[2] European Commission (2017) Environmental Impact Assessment of Projects- Guidance on the preparation of the Environmental Impact Assessment Report

A risk analysis based methodology that covers the identification, likelihood and consequence of major accidents and/or natural disasters has been used for this assessment (Refer to **Section 19.2.4** for further detail on this approach).

Major accidents or natural disasters are hazards that have the potential to affect the proposed development. These include accidents during construction and operation caused by operational failure and/or natural hazards. The assessment of the risk of major accidents and/or disaster considers all factors defined in the EIA Directive that have been considered in this EIAR, i.e. population and human health, biodiversity, land, soil, water, air and climate and material assets, cultural heritage and the landscape.

19.2.2 Guidance and Legislation

19.2.2.1 Legislative Requirements

The following paragraphs set out the requirements of the EIA Directive in relation to major accidents and/or natural disasters.

Recital 15 of the EIA Directive states that:

"In order to ensure a high level of protection of the environment, precautionary actions need to be taken for certain projects which, because of their vulnerability to major accidents, and/or natural disasters (such as flooding, sea level rise, or earthquakes) are likely to have significant adverse effects on the environment. For such projects, it is important to consider their vulnerability (exposure and resilience) to major accidents and/or disasters, the risk of those accidents and/or disasters occurring and the implications for the likelihood of significant adverse effects on the environment. In order to avoid duplications, it should be possible to use any relevant information available and obtained through risk assessments carried out pursuant to Union legislation, such as Directive 2012/18/EU of the European Parliament and the Council[3] and Council Directive 2009/71/Euratom[4], or through relevant assessments carried out pursuant to national legislation provided that the requirements of this Directive are met."

It is clear from the EIA Directive that a major accident and/or natural disaster assessment should be mainly applied to 'Control of Major Accident Hazards involving Dangerous Substances' (COMAH)[5] sites or major industrial/energy installations. Notwithstanding, the assessment of major accidents and natural disasters for the proposed development has been carried out for completeness given the strategic nature and importance of the proposed development for Arklow town.

[3]Directive 2012/18/EU of the European Parliament and the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC (OJ L 197, 24.7.2012, p. 1).
[4] Council Directive 2009/71/Euratom of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations (OJ L 172, 2.7.2009, p. 18).
[5] Control of Major Accident Hazards Involving Dangerous Substances Regulations 2006, as amended (S.I. No. 209 of 2015), implementing the Seveso II Directive (96/82/EC)

Article 3 of the EIA Directive requires that the EIAR shall identify, describe and assess in the appropriate manner, the direct and indirect significant effects on population and human health, biodiversity, land, soil, water, air and climate, material assets, cultural heritage and landscape deriving from (amongst other things) the "*vulnerability of the project to risks of major accidents and/or disasters that are relevant to the project concerned"*.

The information relevant to major accidents and/or disasters to be included in the EIAR is set out in Section 8 of Annex IV of the EIA Directive as follows:

"(8) A description of the expected significant adverse effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and/or disasters which are relevant to the project concerned. Relevant information available and obtained through risk assessments pursuant to Union legislation such as Directive 2012/18/EU of the European Parliament and of the Council or Council Directive 2009/71/Euratom or relevant assessments carried out pursuant to national legislation may be used for this purpose provided that the requirements of this Directive are met. Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies".

19.2.2.2 Guidance Documents

A number of guidance documents and published plans have been reviewed and considered in order to inform this assessment, as described in the following sections.

Environmental Impact Assessment of Projects- Guidance on the preparation of the Environmental Impact Assessment Report

The European Commission Guidance[2] outlines the legislative requirements and key considerations which should be taken into account in the preparation of EIARs with respect to accident and disaster risks.

The Guidance lists the following issues which EIARs should address:

- What can go wrong with a Project?
- What adverse consequences might occur to human health and to the environment?
- How likely are these consequences?
- What is the Project's state of preparedness in case of an accident/disaster?
- Is there a plan for an emergency situation?

Draft EPA Guidelines

The draft EPA guidelines[1] refer to major accidents and/or disasters in a number of sections including:

- Characteristics of the Project – The draft EPA guidelines[1] state under Section 3.5.2 that the project characteristics should include "*a description of the Risk of Accidents – having regard to substances or technologies used."*
- Impact assessment - The draft EPA guidelines[1] state under Section 3.7.1 that the impact assessment should, in accordance with Annex IV(5) of the EIA Directive, include *"the risks to human health, cultural heritage or the environment (for example due to accidents or disasters)."*
- Likelihood of Impacts - The draft EPA guidelines[1] state the following under Section 3.7.3:

"To address unforeseen or unplanned effects the Directive further requires that the EIAR takes account of the vulnerability of the project to risk of major accidents and /or disasters relevant to the project concerned and that the EIAR therefore explicitly addresses this issue. The extent to which the effects of major accidents and / or disasters are examined in the EIAR should be guided by an assessment of the likelihood of their occurrence (risk). This may be supported by general risk assessment methods or by systematic risk assessments required under other regulations e.g. a COMAH (Control of Major Accident Hazards involving Dangerous Substances) assessment."

Guidance on Assessing and Costing Environmental Liabilities

The EPA guidance document[6] above presents a systematic approach for assessing and costing environmental liabilities associated with closure, restoration/aftercare and incidents. This guidance is targeted at activities falling under the various EPA authorisation regimes including the Industrial Emissions Directive (IED), Integrated Pollution Prevention and Control (IPPC), wastewater discharge authorisations (WWDA) and dumping at sea (DaS).

This document[6] provides guidance on the identification and quantification of risks, focusing on unplanned, but possible and plausible events that may occur during the construction and operational phases of licensed facilities and/or activities. Specifically, guidance is also provided on a range of risk assessment and evaluation techniques in Section 3.3 of the draft EPA guidance[6].

A Framework for Major Emergency Management Guidance Document 1-A Guide to Risk Assessment in Major Emergency Management

The Department of the Environment, Heritage and Local Government, as it then was, published a guidance note[7] in January 2010 on best practice in the area of risk assessment for major emergency management.

The document[7] provides guidance on the various stages of the risk assessment process and how it should be employed to inform mitigation and detailed planning during major emergency situations. Part 1 of the guidance[7] defines criteria for classifying impact and likelihood scenarios in order to support the risk assessment process, as well as a process for recording the risk assessment.

[6] EPA (2014) Guidance on Assessing and Costing Environmental Liabilities
[7] DoEHLG (2010) A Guide to Risk Assessment in Major Emergency Management

A National Risk Assessment for Ireland 2017

The most recent National Risk Assessment[8] forms a critical subset of the strategic process ('National Risk Assessment: Overview of Strategic Risks') undertaken by the Government on an annual basis to assess national risks. The purpose of the assessment is to identify national hazards across a broad range of emergencies, to assess the likelihood and impact of these risks and to inform actions at national level aimed at mitigating such risks, including the allocation of resources.

Major Emergency Plan for Wicklow

This plan[9] for Wicklow County Council has been prepared in accordance with the requirements of the Government and is consistent with the Government issued guidance[10].

The objective of this Plan[9] is to protect life and property, to minimize disruption to the County of Wicklow, and to provide immediate support for those affected. To achieve these objectives, the Plan[9] sets out the basis for a coordinated response to a major emergency and lays down the different roles and functions to be performed by Wicklow County Council and by the Principal Response Agencies (agencies designated by Government to respond to Major Emergencies).

19.2.3 Categorisation of the Baseline Environment

A desk-based study has been undertaken in order to establish the baseline environment on which the risk assessment is being carried out, as this will influence both the likelihood and the impact of a major accident and/or natural disaster.

As outlined in the guidance[7], establishing the local and regional context prior to completion of the risk assessment enables a better understanding of the vulnerability and resilience of the area to emergency situations. **Section 19.3** provides an overview of the baseline environment that has been considered for this assessment.

19.2.4 Impact Assessment Methodology

19.2.4.1 Current Practice

As discussed above, the scope and methodology of this assessment is centred on the understanding that the proposed development will be designed, built and operated in line with best international current practice and, as such, the vulnerability of the proposed development to risks of major accidents and/or natural disasters is considered low.

[8] Department of Defence (2017) A National Risk Assessment for Ireland 2017
[9] Wicklow County Council (2017) Major Emergency Plan
[10] Government of Ireland (2006) A Framework for Major Emergency Management

Current EIA practice already includes an assessment of some potential accidents and disaster scenarios such as pollution incidents to ground and watercourses as well as assessment of flooding events. These are described in detail in the relevant EIAR assessment chapters (Refer to **Chapters 14 and 15** for further detail).

19.2.4.2 Site-Specific Risk Assessment Methodology

Overview

A site-specific risk assessment identifies and quantifies risks focusing on: unplanned, but possible and plausible events occurring during the construction and operation of the proposed development. The approach to identifying and quantifying risks associated with the proposed development by means of a site specific risk assessment is derived from the EPA guidance[6].

The criteria for categorising impact is derived from the DoEHLG guidance[7] (Refer to Table 19.1 and Table 19.2).

The following steps were undertaken as part of the site-specific risk assessment:

- Risk identification;
- Risk classification, likelihood and consequence; and
- Risk evaluation.

Risk Identification

Risks have been reviewed through the identification of plausible risks in consultation with relevant specialists. The identification of risks has focused on non-standard but plausible incidents that could occur at the proposed development during construction and operation.

In accordance with the European Commission Guidance[2], risks are identified in respect of the projects:

(1) Potential vulnerability to disaster risks; and

(2) Potential to cause accidents and/or disasters.

Risk Classification

Classification of Likelihood

Having identified the potential risks, the likelihood of occurrence of each risk has been assessed. An analysis of safety procedures and proposed environmental controls was considered when estimating likelihood of identified potential risks occurring. Table 19.1 defines the likelihood ratings that have been applied.

The approach adopted has assumed a ‘risk likelihood’ where one or more aspects of the likelihood description are met, i.e. any risk to the proposed development less than extremely unlikely to occur has been excluded from the assessment.

Table 19.1: Risk Classification Table - Likelihood (Source DoEHLG7)

Ranking	Likelihood	Description
1	Extremely Unlikely	May occur only in exceptional circumstances; once every 500 or more years
2	Very Unlikely	Is not expected to occur; and/or no recorded incidents or anecdotal evidence; and/or very few incidents in associated organisations, facilities or communities; and / or little opportunity, reason or means to occur; may occur once every 100-500 years.
3	Unlikely	May occur at some time; and /or few, infrequent, random recorded incidents or little anecdotal evidence; some incidents in associated or comparable organisation's worldwide; some opportunity, reason or means to occur; may occur once per 10-100 years.
4	Likely	Likely to or may occur; regular recorded incidents and strong anecdotal evidence and will probably occur once per 1-10 years
5	Very Likely	Very likely to occur; high level of recorded incidents and/or strong anecdotal evidence. Will probably occur more than once a year.

Classification of Consequence

The consequence rating assigned to each risk has assumed that all proposed mitigation measures and/or safety procedures have failed to prevent the major accident and/or disaster. Further the Wicklow County Council Major Emergency Plan[9], if implemented as intended, would work to reduce the consequence of any major accident or disaster. The consequence of the impact if the event occurs has been assigned as described in Table 19.2.

The consequence of a risk to/from the proposed development has been determined where one or more aspects of the consequence description are met, i.e. risks that have no consequence have been excluded from the assessment.

Table 19.2: Risk Classification Table – Consequence (Source DoEHLG7)

Ranking	Consequence	Impact	Description
1	Minor	Life, Health, Welfare Environment Infrastructure Social	Small number of people affected; no fatalities and small number of minor injuries with first aid treatment. No contamination, localised effects <€0.5M Minor localised disruption to community services or infrastructure (<6 hours).
2	Limited	Life, Health, Welfare Environment Infrastructure Social	Single fatality; limited number of people affected; a few serious injuries with hospitalisation and medical treatment required. Localised displacement of a small number of people for 6-24 hours. Personal support satisfied through local arrangements. Simple contamination, localised effects of short duration €0.5-3M Normal community functioning with some inconvenience.
3	Serious	Life, Health, Welfare Environment Infrastructure Social	Significant number of people in affected area impacted with multiple fatalities (<5), multiple serious or extensive injuries (20), significant hospitalisation. Large number of people displaced for 6-24 hours or possibly beyond; up to 500 evacuated. External resources required for personal support. Simple contamination, widespread effects or extended duration €3-10M Community only partially functioning, some services available.
4	Very Serious	Life, Health, Welfare Environment Infrastructure Social	5 to 50 fatalities, up to 100 serious injuries, up to 2000 evacuated Heavy contamination, localised effects or extended duration €10-25M Community functioning poorly, minimal services available
5	Catastrophic	Life, Health, Welfare Environment Infrastructure Social	Large numbers of people impacted with significant numbers of fatalities (>50), injuries in the hundreds, more than 2000 evacuated. Very heavy contamination, widespread effects of extended duration. >€25M Serious damage to infrastructure causing significant disruption to, or loss of, key services for prolonged period. Community unable to function without significant support.

Risk Evaluation

Once classified, the likelihood and consequence ratings have been multiplied to establish a 'risk score' to support the evaluation of risks by means of a risk matrix.

The risk matrix sourced from the DoEHLG[7] guidance and as outlined in Table 19.3) indicates the critical nature of each risk. This risk matrix has therefore been applied to evaluate each of the risks associated with the proposed development. The risk matrix is colour coded to provide a broad indication of the critical nature of each risk:

- The red zone represents 'high risk scenarios';
- The amber zone represents 'medium risk scenarios'; and
- The green zone represents 'low risk scenarios'.

Table 19.3: Risk Matrix (Source DoEHLG7)

Likelihood Rating							
	Very likely	5					
	Likely	4					
	Unlikely	3					
	Very unlikely	2					
	Extremely Unlikely	1					
			Minor	Limited	Serious	Very Serious	Catastrophic
			1	2	3	4	5
			Consequence Rating				

19.3 Baseline Conditions

19.3.1 Natural Disasters

Ireland's geographic position means it is less vulnerable to natural disasters such as earthquakes or tsunamis, which might pose risk to projects of this nature and scale in other locations. However, in recent times there has been an increase in the number of severe weather events in the country, particularly those leading to flooding and flash flood incidents.

Severe weather conditions in 1986, 1989, 2000 and 2004 for example, caused severe flooding in Arklow town, primarily in the Lower Main Street, South Quay and Ferrybank areas. With regards natural disasters, severe weather conditions pose one of the most common risks to Ireland and to the proposed development.

19.3.2 Major Accidents

There are two Industrial sites within Arklow, which are subject to Industrial Emissions Directive ('IE') Licences from the EPA:

- Avoca River Park Limited – located upstream of the proposed development adjacent to the Avoca River; and

- Sigma-Aldrich Ireland Limited – located on Vale Road adjacent to the M11 flyover and close to the Avoca River.

The Sigma Aldrich facility is also designated as a 'Seveso site', in accordance with Council Directive 2012/18/EU on the control of major-accident hazards involving dangerous substances. This classification as a ‘Seveso site’ identifies the facility as an industrial establishment where dangerous substances are used or stored in large quantities. The occurrence of a major emission, fire or explosion resulting from a Seveso site has the potential to give rise to a major accident or disaster, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances.

19.4 Likely Significant Effects

19.4.1 Do Nothing Scenario

In the do-nothing scenario, the potential risk of the proposed development causing, or being affected by a disaster and/or accident would be eliminated as the proposed Arklow Wastewater Treatment Project would not be implemented.

19.4.2 Assessment of Effects during Construction

Two risks specific to the construction of the proposed development have been identified. These are outlined in the Construction Risk Register in Table 19.4.

Table 19.4: Risk register - construction

Risk ID	Potential Risk	Possible cause
Potential vulnerability to disaster risks		
A	Flooding of WwTP site during the construction of the replacement revetment or flooding of working areas during the construction of the interceptor sewers.	Extreme weather- periods of heavy rainfall, taking into account climate change, strong winds and tidal events
Potential to cause accidents and / or disasters.		
B	Bridge collapse	Structural collapse of bridge arches during underpinning works

19.4.3 Assessment of Effects during Operation

Six risks specific to the operation of the proposed development have been identified. These are outlined in the Operation Risk Register in Table 19.5.

Table 19.5: Risk register - operation

Risk ID	Potential Risk	Possible cause
Potential vulnerability to disaster risks		
C	Flooding of WwTP resulting in uncontrolled releases of untreated wastewater into the Avoca River or Irish Sea	Extreme weather- periods of heavy rainfall, taking into account climate change, strong winds and tidal events
D	Incident at nearby SEVESO site resulting in off-site environmental impact	Fire/Explosion; and Equipment /Infrastructure failure
Potential to cause accidents and / or disasters.		
E	Discharge, spillage or longer-term seepage of untreated wastewater, fuel, chemicals solvents etc. into watercourse or groundwater table	Equipment and power failure; Failure of, or damage to WwTP infrastructure or inlet works; Fuel spillage during tanker unloading/ delivery operations; Loss from above-ground tanks/ pipelines, discharge to surface water; and Flooding of site resulting in uncontrolled discharge.
F	Fire/Explosion	Equipment or infrastructure failure; Electrical problems; and Employee negligence.
G	Collapse/ damage to structures	Earthquakes; and Vehicular collisions.
H	Vehicle collisions on site	Employee negligence; and Failure of vehicular operations.

These risks have been assessed in accordance with the relevant classification (Refer to Table 19.1 and Table 19.2) and the resulting risk analysis is given in Table 19.6.

The risk register is based upon possible risks associated the proposed development. As outlined in **Section 19.2.4.2**, the consequence rating assigned to each potential risk assumes that all proposed mitigation measures and safety procedures have failed to prevent the major accident and/or disaster.

Table 19.6: Risk assessment

Risk ID	Potential Risk	Possible cause	Environmental effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
Construction								
Potential vulnerability to disaster risks								
A	Flooding of WwTP site during the upgrade of the revetment, or flooding of working areas during the construction of the interceptor sewers.	Extreme weather-periods of heavy rainfall, taking into account climate change, strong winds and high tide	Sedimentation of the Avoca River or Irish Sea, Damage to, or depletion of aquatic habitats and species; Potential flooding of properties	2	The risk of flooding during the construction of the revetment is considered very unlikely. As outlined in **Chapter 5**, the removal of the existing rock revetment and construction of the replacement will be carried out in a staged process along the revetment in sections of approximately 15 to 25m. By using this method, the section under construction can be quickly protected during storm events and thus flood risk for the WwTP site will be minimised during the upgrade.	2	The risk of flooding during the construction of the revetment will result in a limited consequence in that there would be 'a limited number of people affected' with 'localised effects of short duration.' Further, there will be 'normal community functioning' in Arklow with 'some inconvenience' The 'generic command, control & co-ordination systems' as well as the 'common elements of response' detailed in the Wicklow County Council Major Emergency Plan will work to reduce the consequence of potential flood events during construction.	4
Potential to cause accidents and / or disasters.								
B	Arklow Bridge collapse	Structural collapse of the bridge arches during underpinning works	Injury or loss of life.	1	Standard best practice construction measures will be implemented by the contractor during construction. The risk of bridge collapse during the underpinning of Arklow Bridge is considered extremely unlikely in that it 'may occur only in exceptional circumstances'	2	In the event of the collapse of Arklow Bridge, a limited consequence is envisaged in that a 'limited number of people' will be affected, with 'a few serious injuries.' There will also be 'localised displacement of a small number of people for 6-24 hours, with normal community	2

Risk ID	Potential Risk	Possible cause	Environmental effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
							functioning with some inconvenience'. As outlined in **Chapter 5**, the bridge works will likely to be undertaken during night time. As such, there will be limited risk of pedestrians or vehicles being on the bridge deck in the event of a collapse. The 'generic command, control & co-ordination systems' as well as the 'common elements of response' detailed in the Wicklow County Council Major Emergency Plan will work to reduce the consequence of potential bridge collapse during construction.	
Operation								
Potential vulnerability to disaster risks								
C	Flooding of WwTP resulting in uncontrolled releases of untreated wastewater into the watercourse or sea	Extreme weather-periods of heavy rainfall, taking into account climate change, strong winds and tidal events.	Damage to, or depletion of aquatic life; and Illness or loss of life.	2	As described in Chapter 3 '*Alternatives'*, a Flood Risk Assessment was carried out for the proposed development site. This study concluded that, while portions of this land are within flood zones A or B, they are well protected by an existing flood defence embankment. Further, Wicklow County Council and the OPW are currently in the process of developing the Arklow Flood Relief Scheme, which will	2	The potential flooding of the WwTP site will result in a limited consequence, in that a limited number of people will be affected, and there will be localised effects of a short durations. The 'generic command, control & co-ordination systems' as well as the 'common elements of response' detailed in the Wicklow County Council Major Emergency	4

Risk ID	Potential Risk	Possible cause	Environmental effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
					be in part incorporated into the design and construction of the proposed development (i.e the upgraded revetment works). The Arklow FRS will be designed to withstand a 1 in 100-year flood event from the Avoca River as well as 1 in 200 year tidal flooding. Thus, the risk of flooding is predicted to be 'very unlikely.'		Plan will work to reduce the consequence of potential flood events during operation. .	
D	Incident at nearby Industrial Emission Directive (IED) licenced site/ SEVESO site resulting in off-site environmental impact	Fire /Explosion; and Equipment/ Infrastructure failure	Illness or loss of life; Damage to, or depletion of habitats and species; and Impacts on ambient air quality.	1	The closest licensed site to the proposed development is a 'Seveso site'- the Sigma Aldrich facility at Vale Road, Arklow. Having regards to the sites Annual Environmental Reports (AER's) for the previous 5 years, it can be determined that any incidents that have been reported at the site in previous years have been minor in nature. The possibility of an incident occurring that will result in a significant negative impact on the proposed development, resulting in a major accident and/or disaster is considered 'extremely unlikely' in that it 'may occur only in exceptional circumstances; once every 500 or more years' The Sigma Aldrich facility is a lower tier Seveso site and	4	According to the Health and Safety Authority, '*major industrial accidents involving dangerous substances pose a significant threat to humans and the environment; such accidents can give rise to serious injury to people or serious damage to the environment, both on and off the site of the accident. In Europe, a catastrophic accident in the Italian town of Seveso in 1976 prompted the adoption of legislation on the prevention and control of such accidents'*.	4

Risk ID	Potential Risk	Possible cause	Environmental effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
					COMAH requires them to prepare an Internal Emergency Plan which details both the systems that exist to deal with various emergencies and the response expected The site is also required to prepare a safety report and major accident prevention policy, and is subject to regular inspections from the Health and Safety Authority. According to the sites Environmental Liabilities Risk Assessment, the facility is well managed in terms of environmental controls. Risks that were identified as 'high severity' risks were identified to occur on a low to infrequent basis as a result of the management and design of the site, thus resulting in an overall low risk score. Having regard to the mechanisms in place to mitigate and avoid any major accident or incident at the Sigma Aldrich site, the comprehensive range of emergency response procedures in place in the event of these occurring, as well as the outcome of the sites ELRA, it is considered that the likelihood of a major incident occurring at the Sigma Aldrich facility which will significantly impact the proposed			

Risk ID	Potential Risk	Possible cause	Environmental effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
					development will be very unlikely.'			
Potential to cause accidents and / or disasters.								
E	Discharge, spillage or longer-term seepage of untreated wastewater, fuel, chemicals solvents etc into watercourse or groundwater table	Equipment failure; Failure of, or damage to WwTP infrastructure or inlet works; Fuel spillage during tanker unloading/ delivery operations; Loss from above-ground tanks/ pipelines, discharge to surface water; Power failure; and Flooding of site resulting in uncontrolled discharge.	Damage to, or depletion of aquatic habitats and species; and Illness or loss of life.	3	The risk of discharge of untreated wastewater into the Avoca River, Irish Sea or groundwater table is considered to be unlikely in that the instance 'may occur at some time' with 'few, infrequent, random recorded incidents.' As outlined in **Chapter 4**, diesel will be stored on-site in a bunded area to ensure containment and prevent spillages of fuel. No fuels, chemicals or solvents will be stored outside of the confines of the WwTP buildings.	2	Should untreated wastewater be discharged into the watercourse or sea, a limited impact is predicted in that the incident could be classified as 'simple contamination with localised effects of short duration.' Further, should untreated wastewater be released into the watercourse or sea, there will be a 'limited number of people' that would be affected, and the 'community could function as normal with some inconvenience.' It should be noted that the release of untreated wastewater to the watercourse is representative of current practice in Arklow town. As outlined in Chapter 14, a 'locally important' aquifer is located beneath the site of the proposed development. This aquifer is classified as being of 'low vulnerability'	6

Risk ID	Potential Risk	Possible cause	Environmental effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
F	Fire/Explosion	Equipment or infrastructure failure; Electrical problems; and Employee negligence.	Illness or loss of life; Damage to, or depletion of habitats and species; and Impacts on ambient air quality.	2	The WwTP is very unlikely to give rise to fire or explosion. As outlined in Chapter, diesel will be stored on-site to supply the emergency generator. However, is not considered to be a significant fire risk. In accordance with Chapter 19 of the Safety, Health and Welfare at Work Act 2005 (the 2005 Act), the development shall be subject to a fire safety risk assessment which would assist in the identification of any major risks of fire on site, and mitigation of the same during operation.	3	Should a fire/explosion occur at the WwTP site, a serious impact wold occur in that a significant number of people in the affected area could be impacted with multiple fatalities (<5)'. Further, 'external resources would be required for personal support' and 'there would be simple contamination with widespread effects for an extended duration.' The 'generic command, control & co-ordination systems' as well as the 'common elements of response' detailed in the Wicklow County Council Major Emergency Plan will work to reduce the consequence of potential fire/explosions at the site.	6
G	Collapse/ damage to structures	Earthquakes; and Vehicular collisions.	Injury or loss of life.	1	According to the Irish National Seismic Network (INSN), earthquakes measuring ~2 on the Richter Scale are "normal" in terms of seismicity in Ireland. These are known as microearthquakes; they are not commonly felt by people and are generally recorded only on local seismographs. As such, buildings in Ireland are extremely unlikely to be damaged or collapse due to seismic activity.	3	In the event of a building collapse, a serious impact would occur in that 'a significant number of people in affected area would be impacted with multiple fatalities (<5), multiple serious or extensive injuries (20), significant hospitalisation.'	3

Risk ID	Potential Risk	Possible cause	Environmental effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
					Having regard to on-site speed restrictions and vehicular movements, it is not predicted that any collision of vehicles and the WWTP buildings/infrastructure would result in significant damage/collapse.			
H	Vehicle collisions on site	Employee negligence; and Failure of vehicular operations.	Injury or loss of life.	3	A limited number of vehicles will be permitted on the site of the WWTP to facilitate servicing/maintenance of equipment /infrastructure, the removal of de-watered sludge, and staff/visitor parking. As such, it can be determined that there is some 'opportunity, reason or means' for a vehicle collision to occur on site, 'at some time.' An unlikely risk is therefore predicted.	1	A minor consequence is predicted. Having regard to on-site speed limits and vehicular movements, a 'small number of people would be affected' should a vehicular collision occur, with 'no fatalities and small number of minor injuries with first aid treatment.'	3

The risk assessment in Table 19.7 categorises each of the potential risks by their 'risk score.' A corresponding risk matrix is provided in Table 19.8, which is colour coded in order to provide an indication of the critical nature of each risk. As outlined in **Section 19.2.4.2**, the red zone represents 'high risk' scenarios', the amber zone represents 'medium risk scenarios' and the green zone represents 'low risk scenarios.

Table 19.7: Risk scores

Risk ID	Potential Risks	Likelihood Rating	Consequence Rating	Risk Score
E	Discharge, spillage or longer-term seepage of untreated wastewater, fuel, chemicals solvents etc. into watercourse or groundwater table	3	2	6
F	Fire/Explosion	2	3	6
C	Flooding of WwTP resulting in uncontrolled releases of untreated wastewater into the watercourse	2	2	4
D	Incident at nearby SEVESO site resulting in cumulative environmental impact	1	4	4
A	Flooding of WwTP site during the construction of the replacement revetment	2	2	4
H	Vehicle collisions on site	3	1	3
G	Collapse/ damage to structures	1	3	3
B	Bridge collapse	1	2	2

Table 19.8: Risk Matrix

Likelihood Rating							
	Very likely	**5**					
	Likely	**4**					
	Unlikely	**3**		E			
	Very unlikely	**2**		A, C	F		
	Extremely Unlikely	**1**	H	B	G	D	
			Minor	**Limited**	**Serious**	**Very Serious**	**Catastrophic**
			1	**2**	**3**	**4**	**5**
			Consequence Rating				

As outlined in Table 19.8, the potential risks identified during the construction and operation of the proposed development can all be classified as 'low risk scenarios.'

The scenario with the highest risk score in terms of a major accident and/or natural disaster during the construction phase of the proposed development was identified as being 'flooding of WwTP site during the construction of the replacement revetment.'

The scenarios with the highest risk score in terms of a major accident and/or natural disaster during the operational phase of the proposed development were identified as being 'discharge, spillage or longer-term seepage of untreated wastewater, fuel, chemicals solvents etc. into watercourse or groundwater table', and 'fire/explosion.'

19.4.4 Flooding of WwTP Site during the Construction of the Replacement Revetment

There is a potential risk of the WwTP site flooding during the construction of the replacement revetment. However, as outlined in **Chapter 5**, the removal of the existing rock revetment and construction of the replacement revetment will be carried out in a staged process along the revetment in sections of approximately 15 to 25m. By using this method, the section under construction can be quickly protected during storm events and thus flood risk for the WwTP site will be minimised during the construction of the revetment.

As such, the risk of flooding to the WwTP site during the construction of the revetment was given a risk score of 4. This indicates a scenario that is 'very unlikely' to occur, and will have 'limited' consequences should it do so, representing a 'low risk scenario'.

19.4.5 Discharge, Spillage or longer-term Seepage of untreated Wastewater, Fuel, Chemicals Solvents etc. into Watercourse or Groundwater Table

There is a potential risk of untreated wastewater being released into the watercourse from a WwTP facility, following the occurrence of an incident or malfunction on-site.

However, as outlined in **Section 19.2.1**, the scope of this assessment has been based on the understanding that the proposed development will be designed, built and operated in line with best international current practice. As such, the risk of discharge, spillage or longer-term seepage of untreated wastewater, fuel, chemicals solvents etc. into the watercourse or groundwater table, resulting in a major accident and/or disaster, was given a risk score of 6. This indicates a scenario that is 'unlikely' to occur, and will have 'limited' consequences should it do so, representing a 'low risk scenario.'

19.4.6 Fire/Explosion

As with any industrial development or place of work, there is a potential risk of fire/explosion at the proposed WwTP facility.

However, as outlined in **Section 19.2.1**, the scope of this assessment has been based on the understanding that the proposed development will be designed, built and operated in line with best international current practice. Further, in accordance with Chapter 19 of the Safety, Health and Welfare at Work Acts 2005 to 2014, the proposed development shall be subject to a fire safety risk assessment which will assist in the identification of any major risks of fire on site, and mitigation of the same during operation.

As such, the risk of fire/explosion occurring at the proposed development resulting in a major accident and/or disaster was given a risk score of 6. This indicates a scenario that is 'very unlikely' to occur, but will have 'serious' consequences should it do so, representing a 'low risk scenario.'

19.5 Mitigation Measures and Monitoring

19.5.1 Mitigation

19.5.1.1 Mitigation During Construction

As outlined in **Section 19.4**, the scenario with the highest risk score in terms of the occurrence of major accident and/or disaster during construction was identified as 'flooding of WwTP site during the construction of the replacement revetment.'

The construction methodology employed by the contractor, that will involve replacement of the revetment in sections, will work to mitigate the risk of flooding in that it will enable the section under construction to be quickly protected during storm events.

Further, and as outlined in **Section 5.9** and **Appendix 5.1**, a detailed CEMP will be prepared prior to the commencement of any works and implemented during the works. The CEMP will be a live document maintained by the contractor that will work to ensure that potential risks of major accident and/or disaster are identified, avoided and mitigated, as necessary. Refer to **Appendix 5.1** for an outline CEMP that sets out the minimum standards to be employed by the contractor.

19.5.1.2 Mitigation During Operation

As outlined in **Section 19.2.1**, the proposed development will be designed and built in line with best international current practice and, as such, mitigation against the risk of major accidents and/or disasters will be embedded through the design.

In accordance with the provision of the European Commission Guidance[2] a Risk Management Plan will be prepared and implemented on site to ensure an effective response to disasters or the risk of accidents. The plan should include sufficient preparedness and emergency planning measures.

Further, a maintenance programme will be implemented at the site, in compliance with the conditions of the Waste Water Discharge Authorisation required under the Waste Water Discharge (Authorisation) Regulations 2007 - 2016. The purpose of the maintenance programme is to ensure that all critical equipment at the WwTP and elsewhere throughout the proposed development is operating correctly, therefore reducing the risk of major accidents and/or disasters on site.

As outlined in **Section 19.4**, the scenarios with the highest risk score in terms of a major accident and/or disaster during operation were identified as 'discharge, spillage or longer-term seepage of untreated wastewater, fuel, chemicals solvents etc. into the watercourse or groundwater table,' and 'fire/explosion.'

The storage of diesel in a contained and bunded area on-site will mitigate '*by prevention'* the risk of surface and/or ground pollution, as well as the risk of fire/explosion resulting from the potential spillage of fuel.

As a further means of mitigation '*by remedy,*' fire extinguishers will be provided in the Administration building, and an industrial purpose fire hose reel will be installed to service both the Inlet Works Building and the Process Building, in accordance with the relevant NSAI Standards[11].

The proposed development will also be subject to a fire safety risk assessment in accordance with Chapter 19 of the Safety, Health and Welfare at Work Acts 2005 to 2014, which will assist in the identification of any major risks of fire on site, and mitigation of the same during operation.

19.5.2 Monitoring

19.5.2.1 Monitoring During Construction

As outlined in **Section 5.9** and **Appendix 5.1**, a detailed CEMP will be prepared prior to the commencement of any works and implemented and monitored during the works. The CEMP will be a live document maintained by the Contractor, and will work to ensure that potential risks of major accident and/or disaster are monitored, as necessary.

Refer to **Appendix 5.1** for an outline CEMP that sets out the minimum standards to be employed by the contractor.

[11] NSAI (2015) *IS291:2015 Selection, commissioning, installation, inspection and maintenance of portable fire extinguishers. NSAI (2012) IS EN 671-1:2012: Fixed firefighting systems. Hose systems. Hose reels with semi-rigid hose.*

19.5.2.2 Monitoring During Operation

Irish Water and the operator of the proposed development will continue to assess the risk of major accidents and/or disasters on site on an on-going basis during operation.

The maintenance programme, record of reported incidents, as well as general site activities will be monitored on an on-going basis to ensure risk of major accidents does not increase over time.

19.6 Residual Effects

19.6.1 Residual Effects during Construction

The risk of a major accident and/or disaster during the construction of the proposed development is considered 'low' in accordance with the risk evaluation methodology[7]. It is considered that there will not be significant residual effect(s) during the construction of the proposed development.

19.6.2 Residual Effects during Operation

The risk of a major accident and/or disaster during the operation of the proposed development is considered 'low' with regards the risk evaluation methodology[7]. It is therefore considered that there will not be significant residual effect(s) during the operation of the proposed development.

19.7 References

Council Directive 2009/71/Euratom of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations (OJ L 172, 2.7.2009, p. 18).

Department of Defence. (2017). *A National Risk Assessment for Ireland 2017*

Department of Environment, Heritage and Local Government. (2010) *A Guide to Risk Assessment in Major Emergency Management*

Directive 2012/18/EU of the European Parliament and the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC (OJ L 197, 24.7.2012, p. 1).

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

Environmental Protection Agency. (2014). *Guidance on Assessing and Costing Environmental Liabilities*

European Commission (2017) *Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report*

Government of Ireland (2006) *A Framework for Major Emergency Management*

National Standards Authority of Ireland. (2015). *IS291:2015 Selection, commissioning, installation, inspection and maintenance of portable fire extinguishers.*

National Standards Authority of Ireland. (2012). *IS EN 671-1:2012: Fixed firefighting systems. Hose systems. Hose reels with semi-rigid hose.*

Wicklow County Council. (2015). *Major Emergency Plan*

20 Cumulative and Interactive Effects

20.1 Introduction

Cumulative effects are changes to the environment that are caused by an action in combination with other actions. They can arise from and this EIAR will look at:

- the interaction between all of the different permitted and planned projects in the same area in combination with this proposed development; and
- the interaction between the various impacts within this proposed development.

Cumulative effects will consider whether the addition of many minor or significant effects of the proposed development itself or the cumulation of effects of other permitted or planned projects have the potential to result in larger, more significant effects when combined with the effects of the proposed development.

Interactive effects will consider the interaction between the various environmental aspects, for example the interaction between noise and ecology.

This chapter summarises the residual effects that have been identified in **Chapters 6 – 19** and determine whether they give rise to cumulative and/or interactive effects based on best scientific knowledge. Accordingly, when a topic is not mentioned, the authors have concluded that there are no likely residual significant effects that could give rise to cumulative and/or interactive effects.

20.2 Assessment Methodology

20.2.1 Overview

The assessment of cumulative effects has been undertaken on a qualitative basis by each of the environmental topic leads based on best scientific knowledge.

The approach has aligned with the overarching EIA guidance as outlined in **Section 1.4.3 of Chapter 1** (including the draft EPA guidance[1] and EC guidance[2]) as well as per the methodology adopted for each environmental factor as described in **Chapters 6 – 19**. A summary of these effects is provided herein based on best scientific knowledge.

[1] Environmental Protection Agency (2017) Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft August 2017)
[2] European Commission (2017) Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report

20.2.2 Interactive Effects

The EIAR has considered and assessed the interactive effects arising from the construction and operation of the proposed development based on best scientific knowledge. Interactive effects (or interactions), as defined in Section 20.1 above specifically refer to any direct or indirect effects caused by the interaction of environmental factors as outlined in Part 1(e) in Article 3 of the EIA Directive which states:

"The environmental impact assessment shall identify, describe and assess in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project on the following factors:

(a) population and human health;

(b) biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC;

(c) land, soil, water, air and climate;

(d) material assets, cultural heritage and the landscape;

(e) the interaction between the factors referred to in points (a) to (d)."

A workshop was held in May 2018 to facilitate discussion between environmental topic leads and enable them to understand the interactions and make recommendations to mitigate significant effects (including interactive effects) where practicable. This workshop also facilitated information exchange between environmental specialists during the preparation of this EIAR.

20.2.3 Cumulative Effects

The EIAR has considered and assessed cumulative effects arising from the construction and operation of the proposed development. A cumulative assessment has been undertaken based on best scientific knowledge in accordance with Part 5 of Annex IV of the EIA Directive:

"e) the cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources;"

The assessment specifically considers whether any of the proposed and/or recently approved schemes in the local area have a potential to exacerbate (i.e. alter the significance of) effects associated with the proposed development based on best scientific knowledge. The schemes of relevance in the local area are described in detail in **Sections 2 2.2.6 and 2.2.7 of Chapter 2** and summarised below.

Table 20.1 duplicates **Table 2.1 in Chapter 2** in relation to the developments considered for cumulative effects. Any other existing projects not identified do not have the potential to exacerbate effects. The proposed Arklow Flood Relief Scheme and potential future residential receptors associated with land use zoning outlined in the Arklow LAP have been considered as they are known to be planned in the area, despite not being in the planning system at present.

Table 20.1: Schedule of developments considered for cumulative effects

Planning Reference	Name	Address	Relevance	Description	Status	Decision Date
18/316	Mill Sea Ltd	North Quay, Arklow	Located on Mill Road adjacent to the planning boundary	Demolition of existing disused industrial buildings including gas bottle filling plant, warehouse, administration offices, site office, security office and store of total floor area 2035m^2.	Grant	22 May 2018
18/289	F and S Duffy	7 and 8 Bridge Street, Arklow	Located on Bridge Street approximately 50m from the planning boundary (at its nearest point)	Demolition of two buildings and erection of a retail and commercial building of 160.2m^2 and associated site works	Application received	No decision at time of writing
18/251	Gas Networks Ireland	Belarnine Plaza District, Bridgewater Centre	Located on North Quay adjacent to the planning boundary for the proposed development	3m high 'lamp post' style relief vent stack servicing the existing above ground district regulating installation with all ancillary services and associated site works	Grant	7 May 2018
15/857	Joby Developments	North Quay, Arklow	Located on Mill Road adjacent to the planning boundary	Demolition of existing structures and construction of two 5 storey blocks comprising of eight retail units, 50 residential units, an on-site wastewater treatment facility, ancillary parking and all associated site works	Grant	11 October 2015
10/610009	Arklow Sailing Club	North Quay, Arklow	Located on North Quay adjacent to the planning boundary	Alterations & additions to existing clubhouse comprising the construction of a new single storey extension of 50.4m^2, the provision of a new entrance porch, notice board and patio area all to the front, and the construction of a single storey extension	Grant	17 May 2010
08/610068	T and J Dowling	2/3 Lower Main Street, Arklow	Located on Lower Main street approximately 90m from the planning boundary (at its nearest point)	Demolish existing buildings on site and erect a mixed use development comprising two retail units and four apartment to connect to the existing services	Grant	1 October 2008
13/610028					Extension to original permission	26 September 2013
09/610054	J and B Lambert	Innisfail, South Quay, Arklow	Located on South Quay adjacent to the planning boundary	Two storey dwelling (112m^2) with all ancillary site works to include connection to mains services	Grant	16 January 2010
86/10038	K O'Brien	5 Doyle's Lane, Arklow	Located on Doyle's Lane approximately 20m from	The demolition of 11.5m² existing single storey study, construction of 76.4m² 2 storey extension with balcony and alterations to existing 78m²	Grant	17 July 2008

Planning Reference	Name	Address	Relevance	Description	Status	Decision Date
			the planning boundary (at its nearest point)	2 storey house. Demolition of southern and western boundaries and the re-building of same and associated works		

20.3 Interactive Effects

20.3.1 Overview

The assessment of interactive effects has considered likely significant effects that may arise during construction and operation of the proposed development based on best scientific knowledge. A summary of these effects is presented in the matrix in Table 20.2.

If there is the potential for likely significant effects during construction, this is indicated by the 'C' column in the matrix. The 'O' column in the matrix indicates the potential for likely significant effects during operation. If there is considered to be no potential for an effect, this is indicated by '-' in the matrix.

The purpose of the matrix in Table 20.2 is to summarise likely interactive effects of significance. Actual effects and the description of significance are dealt with in the most relevant chapter (Refer to **Chapters 6 – 19** for further detail).

Table 20.2: Interactive effects summary matrix

	Planning and Policy		Traffic and Transportation		Air Quality and Climate		Odour		Noise and Vibration		Biodiversity		Heritage		Landscape and Visual		Land and Soils		Water		Resource and Waste Management		Population and Human Health		Material Assets		Major Accidents and Natural Disasters	
	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O
Planning and Policy					✓	✓					✓	✓	✓	✓	✓	✓				✓			✓	✓				
Traffic and Transportation					✓	✓			✓	✓					✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓
Air Quality and Climate			✓	✓				✓	✓	✓							✓		✓				✓	✓			✓	✓
Odour						✓																						
Noise and Vibration			✓	✓							✓	✓	✓	✓														
Biodiversity	✓	✓							✓						✓	✓											✓	✓
Heritage	✓	✓							✓	✓					✓	✓	✓	✓	✓				✓	✓				
Landscape and Visual	✓	✓	✓	✓							✓	✓	✓	✓									✓	✓	✓	✓		
Land and Soils			✓		✓								✓	✓							✓	✓						
Water		✓									✓	✓	✓	✓			✓	✓			✓	✓	✓	✓		✓	✓	✓
Resource and Waste Management			✓	✓													✓	✓	✓	✓								
Population and Human Health	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓					✓	✓	✓	✓
Material Assets																				✓			✓	✓			✓	✓
Major Accidents and Natural Disasters											✓	✓							✓	✓					✓	✓		

20.3.2 Interactive Effects during Construction

Likely significant interactive effects during construction that have been identified based on best scientific knowledge are discussed in Table 20.3:

Table 20.3: Interactive effects during construction

Receptor	Environmental factors	Summary of effect	Further information
Properties on River Walk, South Quay and North Quay (including Marina Village)	Air Quality and Climate Noise and Vibration Population and Human Health Landscape and Visual	General disturbance to residential receptors (including noise generation, dust deposition, use of generators, presence of hoarding at working areas etc.) associated with construction at working areas	Local, temporary, short term, slight – significant negative effect. Refer to **Chapters 8, 10 and 17**.
Arklow town	Landscape and Visual Population and Human Health Heritage	Visual impact of the working areas, plant and equipment on the landscape (including river and coastal views) and resulting impact on tourism, leisure and amenity in the area	Local, temporary, short term, slight – significant negative effect. Refer to **Chapters 12, 13 and 17**.
Properties on River Walk and South Quay	Noise and Vibration Population and Human Health	Noise and groundborne vibration generated during the tunnelling of the sewers and associated relocation of residents	Slight significant, temporary negative effect. Refer to **Chapters 10 and 17**.
Properties on River Walk, South Quay, North Quay (including Marina Village) and Seaview Avenue	Air quality and Climate Noise and Vibration Traffic and Transportation Population and Human Health	Generation of additional vehicles (construction traffic) on the road network and associated potential for air and noise emissions and disturbance.	Local, temporary, short term, slight – moderate negative effect. Refer to **Chapters 7, 8, 10 and 17**.
River Walk Irish Sea	Landscape and visual Traffic and transportation Population and human health	Temporary loss of riverfront pedestrian walkway to accommodate working areas at the Alps	Temporary slight – moderate negative effect. Refer to **Chapters 7, 13 and 17**.
Road network in Arklow town	Traffic and Transportation Population and Human Health	Effects on traffic flows on the road network and diversion of vehicles and associated	Local, temporary, short term, slight – moderate negative effect.

Receptor	Environmental factors	Summary of effect	Further information
		disturbance to journey patterns and/or severance.	Refer to **Chapters 7 and 17**.
Avoca River Irish Sea	Biodiversity Water Noise and Vibration Population and Human Health	Potential effects of constructing in the Avoca River and/or Irish Sea on water quality, flood risk and aquatic biodiversity (including underwater noise impacts on marine mammals)	Short term, slight negative effect. Refer to **Chapters 8, 11, 14 and 17**.
Arklow town Avoca River Irish Sea	Biodiversity Water Land and Soils Population and Human Health	Potential effects of runoff from working areas and/or sediment from exposed ground affecting existing land, water quality and/or sensitive receptors	Slight – moderate, temporary negative effect. Refer to **Chapters 11, 14, 15, and 17**.
Arklow Bridge	Landscape and Visual Heritage Noise and Vibration Land and Soils Biodiversity	Effects of the underpinning works to Arklow Bridge and associated potential settlement, disturbance to bat species, structural damage from vibration and/or disturbance to local residents	Slight – moderate, temporary negative effect Refer to **Chapters 10, 11, 12, 13 and 14**.
Trees on River Walk, South Quay and North Quay	Landscape and Visual Biodiversity	Removal of trees to accommodate working areas and construction activities and associated impacts on bats and birds	Slight – moderate, temporary negative effect. Refer to **Chapters 11 and 13.**
WwTP site Construction employees Local residents	Air quality and Climate Land and Soils Water Population and Human Health	Removal of asbestos containing material and contamination (including soils and groundwater) at the WwTP site, generation of and associated potential human health effects	Imperceptible - slight, negative effect. Refer to **Chapters 8, 14, 15 and 17**.
WwTP site Waste management facilities	Waste Land and Soils Traffic and Transportation	Generation and associated management and transport of construction, demolition and	Short term, slight, negative effect. Refer to **Chapters 7, 14 and 16.**

Receptor	Environmental factors	Summary of effect	Further information
		excavation waste (and associated transportation of) to construct the proposed development	

20.3.3 Interactive Effects during Operation

Likely significant interactive effects during operation that have been identified based on best scientific knowledge are discussed in Table 20.4:

Table 20.4: Interactive effects during operation

Receptor	Environmental factors	Summary of effect	Further information
Avoca River Irish Sea	Water Biodiversity Population and human health Planning and Policy	Elimination in so far as possible of the discharge of untreated wastewater to the Avoca River and availability of wastewater treatment in Arklow town.	Positive, permanent effect. Refer to **Chapters 11, 15 and 17**.
Arklow town	Landscape and visual Planning Heritage Biodiversity Population and Human Health	Potential visual impacts associated with land reclamation and provision of amenity space at River Walk and Quay, replanting at working areas (including the quayside and the Alps) and reinstatement of Seafarers Memorial Garden	Moderate -slight negative, changing to slight positive - neutral as reinstated vegetation and trees become established. Refer to **Chapters 6, 12, 13 and 17.**
Arklow town	Planning Water Population and Human Health	Potential improvements to water quality and improved opportunities for water based tourism, recreation and amenity	Significant positive – Refer to **Chapters 6, 15 and 17**
WwTP site	Water Material Assets	Upgrade to the revetment to achieve relevant design standards and reduce coastal flood risk	Positive, permanent effect. Refer to **Chapters 15 and 18.**

20.4 Cumulative Effects

20.4.1 Overview

The assessment of cumulative effects has considered likely significant effects that may arise during construction and operation of the proposed development.

Cumulative effects were assessed to a level of detail commensurate with the information that was available at the time of assessment based on best scientific knowledge. Where information regarding other schemes in the local area was limited, these gaps were acknowledged within the assessment and the associated uncertainty in these cases is documented in **Section 2.6.6 of Chapter 2**.

20.4.2 Cumulative Effects during Construction

Likely significant cumulative effects during construction of the proposed development that have been identified based on best scientific knowledge in **Chapters 7 – 19** are summarised below.

Whilst a planning application has not yet been submitted, the proposed Arklow Flood Relief Scheme is anticipated in the near future and this may give rise to cumulative effects should the construction of the proposed development and the proposed Arklow Flood Relief Scheme overlap temporally and/or spatially. As outlined in **Section 1.5.3.5 of Chapter 1** and **Section 2.6.7 of Chapter 2,** efforts have been made to consider both proposals and the design team have had regard to the existence of the other scheme and potential for interaction to the extent that this is possible and appropriate given the fact that the proposed Arklow Flood Relief Scheme remains in design stage as at the time of submission of this application.

During the design development, it was recognised that a number of efficiencies and/or benefits could be achieved from each project having regard to the other's design proposals and construction of the overlapping elements of each of the schemes in an integrated manner in so far as possible. On this basis, a number of meetings were held between the design teams and proponents of both schemes to optimise the design development (as described in **Section 1.5.3.5 of Chapter 1**). This particularly focused around Arklow Bridge and South Quay where there will be a physical overlap between both schemes. In summary, the following potential cumulative effects during construction of the proposed development and the proposed Arklow Flood Relief Scheme have been identified herein based on best scientific knowledge:

- **Traffic and Transportation:** The simultaneous construction of both projects will result in greater traffic flows, including HGVs on streets within Arklow and greater effects are likely (should the proposed Arklow Flood Relief Scheme be submitted, receive consent and commence construction in a timely manner).

There is the potential that should the projects be carried out simultaneously (should the proposed Arklow Flood Relief Scheme be submitted, receive consent and commence construction in a timely manner), co-ordinated traffic management plans will need to be prepared and agreed with Wicklow County Council.

- **Noise and Vibration:** The simultaneous construction of both projects has the potential to exacerbate noise and vibration effects (should the proposed Arklow Flood Relief Scheme be submitted, receive consent and commence construction in a timely manner). Should dredging occur simultaneously with the construction of the tunnel shafts, for example, the overall predicted impact would be 71dB ($LA_{eq, 1\ hr}$), 6dB above the proposed noise limit, i.e. resulting in a temporary significant effect. In relation to construction traffic, simultaneous generation of construction traffic will not add significantly to the noise and vibration effects of the proposed development.
- **Biodiversity**: The Arklow Town Marsh pNHA, mature trees and notable species (including bats, Kingfisher, Atlantic Salmon, River Lamprey and Sea Lamprey, European Eel, Otter, Marine Mammals) are also present within the footprint of the proposed Arklow Flood Relief Scheme, therefore the proposed dredging and construction activities associated with the simultaneous and/or sequential construction of both development proposals may exacerbate effects on biodiversity (should the proposed Arklow Flood Relief Scheme be submitted, receive consent and commence construction in a timely manner). These effects can be mitigated by effective coordination, but not eliminated in their entirety.
- **Archaeology, Architectural and Cultural Heritage**: The likely significant effects associated with the proposed underpinning of the Arklow Bridge (which will be carried out within two arches as part of the proposed development and the remaining arches as part of the proposed Arklow Flood Relief Scheme) may be exacerbated as a result of the construction of both schemes as a greater number of arches in the bridge would be underpinned (should the proposed Arklow Flood Relief Scheme be submitted, receive consent and commence construction in a timely manner). These effects can be mitigated by effective coordination, but not eliminated in their entirety.
- **Landscape and Visual**: As outlined above, significant coordination has been undertaken between both projects. With regards to landscape and visual, the duration of the likely significant effects associated with the proposed development may be extended if simultaneous and/or sequential construction arises (should the proposed Arklow Flood Relief Scheme be submitted, receive consent and commence construction in a timely manner), however the proposed Arklow Flood Relief Scheme will not exacerbate the effects of the proposed development.
- **Water:** It is possible that the construction of the proposed Arklow Flood Relief Scheme may take place in parallel with the construction of the proposed development (should the proposed Arklow Flood Relief Scheme be submitted, receive consent and commence construction in a timely manner). The contemporaneous construction of both developments may exacerbate effects on the hydrology and flooding.

However, where practicable coordination will be undertaken by the contractors appointed to each development to ensure that underpinning of the arches and lowering of the arch included as part of the proposed development is undertaken in advance of the construction of the proposed interceptor sewer to mitigate any significant flood risk during construction of the interceptor sewers in the Avoca River.

The construction of interceptor sewers along South Quay and River Walk, and nearby construction of the proposed Arklow Flood Relief Scheme may generate the potential for direct and indirect short term significant negative effects on the hydrology of the Avoca River during construction for those reasons outlined above.

- **Population and Human Health**: Construction of the proposed development and the proposed Arklow Flood Relief Scheme (should the proposed Arklow Flood Relief Scheme be submitted, receive consent and commence construction in a timely manner) will have negative cumulative effects on aspects of accessibility and amenity for some of the population, including local residents and/or visitors. There will also be related cumulative effects on some businesses due to amenity, for example loss of riverside views or noise. These effects can be mitigated, but not eliminated in their entirety.

None of the other development proposals and/or land use zoning (that have been planned, submitted and/or approved) are considered to give rise to significant cumulative effects on any environmental factors during construction based on best scientific knowledge. The nature and scale of these development proposals are such that construction of these projects at the same time as the proposed development, would not exacerbate significant effects that have been identified in **Chapters 7 – 19** based on best scientific knowledge.

20.4.3 Cumulative Effects during Operation

Likely significant cumulative effects during operation of the proposed development that have been identified in **Chapters 7 – 19** based on best scientific knowledge can be summarised as follows:

- **Biodiversity:** During the operation of the proposed development, it is understood that a public realm design along River Walk and South Quay may be implemented as part of the proposed Arklow Flood Relief Scheme that would include tree planting along the southern and northern banks of the Avoca River and Estuary. This will be a positive effect.
- **Landscape and Visual:** Immediately west of the WwTP site, there is an existing grant of permission (Reference 15857) and given the land use zoning in the Arklow LAP, it is likely that additional mixed use development proposals will be brought forward along North Quay (facing the Avoca River and between Arklow Marina and Mill Road) and around Mill Road. Such development proposals may intensify the built environment of the locality and gradually transform its current derelict and under-utilised industrial appearance to a more intensive and active urban environment.

Such long-term change to the built environment is planned by Wicklow County Council and each individual development proposal would be subject to separate planning applications and an EIAR if appropriate. Based on the current level of information available, significant cumulative effects on landscape and visual resources are not anticipated.

- **Population and Human Health:** The proposed development will reinstate the public realm and facilitate further landscaping likely to be undertaken separately along River Walk and South Quay as part of the proposed Arklow Flood Relief Scheme. A significant positive effect associated with the proposed development and the proposed Arklow Flood Relief Scheme will be evident during operation along River Walk and South Quay and this will be exacerbated by the improved water quality and improvements to water quality and improved opportunities for water based tourism, recreation and amenity as identified in Table 20.3.

20.5 References

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

European Commission (2017) *Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report*

21 Summary of Mitigation, Monitoring and Residual Effects

21.1 Introduction

This chapter provides a summary of the proposed mitigation and monitoring measures as well as an overview of the residual likely significant effects associated with the proposed development (as identified in **Chapters 7 – 19**).

21.2 Summary of Mitigation Measures

A number of safeguards and management measures have been identified in order to mitigate negative environmental effects during construction and operation as described in detail in **Chapters 7 – 19**.

It should be noted that this generally excludes any inherent measures and elements that have been incorporated in the design as these design measures have been documented as part of **Chapter 4**. Further, any environmental management measures during construction that have been identified and are associated with construction activity and methodology are documented in the Outline CEMP which is available in **Appendix 5.1.**

The mitigation measures that have been established to minimise any likely significant negative effects arising from the proposed development on the surrounding environment are summarised in **Sections 21.2.1- 21.2.13**.

21.2.1 Traffic and Transportation

The following measures in relation to traffic and transportation will be implemented during construction:

- All trucks entering and exiting the site will be covered with tarpaulin;
- Adequate parking will be provided to avoid queuing at the site entrances and prevent disruption to neighbouring businesses. Construction vehicles will not be allowed to park on the public road either outside the site or on any of the approach roads leading to the site;
- All trucks entering the site will be restricted to suitable speed limits and will be directed to the relevant area by the Site Manager;
- Trucks required to wait on site will switch off engines to avoid unnecessary fuel usage and noise;
- All trucks exiting the site will be required to pass through a wheel wash. A lance will be provided to clean down the bodies and sides of the truck prior to leaving site;
- Roads outside the site will be visually inspected on a daily basis and power swept and washed as and when required;

- All site staff including truck drivers will be required to abide by the normal rules of the road;
- The contractor shall prepare a Detailed Construction Traffic Management Plan (CTMP) covering all construction stages that takes into account other potential construction works in the area including the proposed Arklow Flood Relief Scheme. The CTMP should demonstrate how pedestrians, cyclists and motorised vehicles can pass through the works areas safely and that measures are in place which ensure traffic operates in as an efficient manner as possible;
- The CTMP should include a detailed consultation plan to deal with third party queries from both residents and retail/ commercial operators. The CTMP will require agreement with both Wicklow County Council and An Garda Síochána. The contractor should 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.
- As part of the CTMP a Mobility Management Plan should 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 work sites.
- For works at North Quay, the following individual traffic management measures should be considered:
    - 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 made as small as possible to reduce the length of the shuttle system.

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

21.2.2 Air Quality and Climate

The following measures in relation to air quality and climate will be implemented during construction:

- Implementation of standard mitigation, as stated in the TII guidance[1], including 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.
- Erection of c. 2.4m hoarding will be provided around the working areas 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.

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

In relation to climate, the use of energy efficient design reduces the annual CO_2 emissions of the proposed development. Key energy and resource efficiency measures incorporated in the design 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);

[1] 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

- All flows 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 Process building to optimise the generation and use of renewable energy at the WwTP; and
- 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 will have heat recovery ventilation systems. The combination of these HVAC elements wills minimise associated energy use in the WwTP buildings during operation.

21.2.3 Odour

No mitigation measures are required during the construction of the proposed development with regards to odour.

No mitigation measures above those inherent design measures (including the provision of Odour Control Units) described in **Chapter 4** are required during the operation of the proposed development with regard to odour.

21.2.4 Noise and Vibration

The appointed contractor(s) will be required to prepare a Noise and Vibration Management Plan (NVMP) that will outline how they will comply with the noise criteria set out in this EIAR. The NVMP 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 contractor will be required to adhere to for construction activities and the noise and vibration monitoring programme that the appointed contractor(s) will be required during construction.

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

The following measures in relation to noise and vibration will be implemented during construction:

- The contractor will take specific noise abatement measures and comply with the recommendations of the standard[2] and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001 and 2016 so as to acknowledge the EC (Noise Emission by Equipment for Use Outdoors) (Amendment) Regulations 2006;
- A site representative shall be appointed to be responsible for matters relating to noise and vibration;
- Construction of temporary infrastructure (e.g. haul roads and the causeway) 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 plant, 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 and equipment, 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;
- Ensuring that plant is shut down when not in use;

[2] 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.

- 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 shall be provided around working areas, 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 monitoring should be undertaken at the start of each new activity to determine the compliance with limit values. This may involve monitoring on a daily basis initially (for the first three weeks), but subject to satisfactory results, this could be relaxed to once a week/twice-weekly depending upon the site activities. The frequency will be increased again if particularly noisy activities (such as driven piling) are undertaken;
- Continuous noise and vibration monitoring will take place at three of the nearest sensitive receptors (including Arklow Bridge). Environmental noise and vibration monitoring will be undertaken by suitably-trained and experienced staff;

- BS5228-1[2] provides an example of noise insulation and temporary rehousing policy and defines 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, the standard[2] recommends re-housing. The contractor will outline the specific construction methodologies and agree a schedule that minimises effects on receptors. Any requirement for temporary re-housing will be confirmed by the contractor 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.
- 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.

During the construction of the marine outfall, there is the potential for noise impacts on marine mammals. The Department of Arts, Heritage and the Gaeltacht have published guidance[3] 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 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.

[3] 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.

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.

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.

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 in Chapter 10 would be expected.

21.2.5 Biodiversity

The following measures in relation to biodiversity will be implemented during construction:

Terrestrial biodiversity, habitats, and flora

The mitigation measures for habitats and flora aim to implement Objective NH12 of Wicklow County Development Plan 2016-2022 (see **Section 11.3.1.3 of Chapter 11**), in the context of the ecological baseline conditions recorded within the planning boundary of the proposed development.

Chapter 5 provides for top-soiling and seeding of existing areas of Amenity grassland **GA2** within the planning boundary of the proposed development, where these are removed or damaged during the construction phase. Further, **Section 13.5 of Chapter 13** (as summarised in **Section 21.3.7)** makes recommendations in relation to the planting of replacement trees in these locations. The species listed in **Table 11.10 in Chapter 11** are suitable for seeding in these areas, and managed as short meadow.

Wildflower grassland management

Initially, sown areas will need to be monitored for germination and establishment, and any unwanted species removed manually. Subject to monitoring, mowing may not be required during the first year after seeding. After the meadow is established, the following regime is recommended:

Short meadow would generally be mown 5 times per year, with cut material removed:

- First cut after the 15 April
- Second cut at end of May
- Third cut in mid-late July (maximises growth of Clovers and other wildflowers)
- Fourth cut at the end August
- Fifth cut after mid-October.

Long meadow would be mown once a year, in late September or October, with cut material removed.

For both short and long meadow, a high cut setting of >8-10cm is recommended during mowing or strimming.

At the Alps SWO and storm water storage tank site, Honeysuckle will be planted at 2m centres along the western and eastern sides of the perimeter fence. This measure will provide shelter and habitat for insects and feeding habitat for bats at a small site where tree and shrub planting would be inappropriate. The grass and wildflower seed mix listed in **Table 11.10 in Chapter 11** will be seeded within and adjoining the temporary construction site as part of completion works and managed initially as short meadow, to implement measures to control Buddleia are required in this area as identified in **Appendix 11.2.3**.

Landscaping around the four buildings at the WwTP site will follow a basic grid, derived from the primary geometries of the site. This grid will include hard landscaping between the buildings in addition to soft landscaping that will be planted around the site perimeter. This landscaping will be provided as part of the completion works, as illustrated in **Drawing No. 247825-00-L002 in Volume 3**.

Planting of trees, shrubs and climbers, and seeding with the bespoke mix of native grasses and wild flowers listed in **Table 11.10 in Chapter 11**, to be managed as short and long meadow, will be carried out in areas agreed with the project architect Clancy Moore within the WwTP site, and also along the site road frontage where a 5m setback to be provided will allow space for planting of groups of trees and short meadow, with Honeysuckle provided at intervals along the WwTP site boundary fence. Irish native species are proposed throughout, as specified in **Tables 11.10 and 11.11 in Chapter 11**, with the exception of Scot's pine for which a cultivar is likely to be more suitable for this coastal location.

Birds

Tree felling, removal of scrub and other tall vegetation will be carried out between 1 September and 28 February, to avoid any risk to breeding birds and their habitats.

At the WwTP site, depending on the schedule of demolition of existing buildings, the sequence of demolition works may require to be modified to take account of a small number of breeding birds that may be present within structures, in the event of works occurring from 1 March to 31 August.

Nesting boxes for the Red-listed species Grey Wagtail, and for Pied Wagtail will be provided in alternate arches of Arklow Bridge, on ledges above high water level in the existing concrete structure on the upstream side of the bridge, because existing ledges are not secure from predation, in order to provide nesting habitat for these species that feed extensively along the river channel.

Bats

As all bat species recorded within the planning boundary are protected under Annex IV of the Habitats Directive, the works to be carried out to the two southernmost arches of Arklow Bridge and their associated piers require a derogation from the National Parks and Wildlife Service of the Department of Culture, Heritage and the Gaeltacht to allow works that would create a risk to bats and would remove existing roosting options. The measures proposed will meet the requirements for protecting the bats availing of Arklow Bridge. A Derogation Licence No. DER/BAT 2018 – 73 has been issued and is reproduced in **Appendix 11.7**. All measures outlined herein will be complied with.

The measures proposed specifically for the two southernmost arches of Arklow Bridge derogation include:

- Examination of the bridge prior to works by the licensed bat specialist for evidence of bats.
- Exclusion of bats if necessary with one-way valves devised by the bat specialist.
- Capture of any bats that are still present prior to works and retention until the risk of injury or re-entry to the bridge has been removed.
- Provision of 4 x 2FR Schwegler woodcrete bat tubes for each modified arch (i.e. 12 x 2FR bat tubes). These bat boxes must be attached to the bridge in an unlit area above high-water mark.
- The boxes should be attached upright unless there is insufficient clearance above the river and the lower section would be immersed. Two boxes should be attached together to form a large cavity suitable for a large population of bats.

Examination of all mature trees, and bat boxes along River Walk with roost potential prior to removal

All mature trees at the Alps, along River Walk, and along the south and north quays in Arklow shall be examined for bats prior to felling.

This may be achieved through a bat detector assessment if undertaken in the active season (prior to November and after March) or alternatively may require supervision at the time of felling. Any mature trees will require survey prior to felling.

All buildings within the WwTP site shall be examined for bats prior to removal. This may be achieved through a bat detector assessment if undertaken in the active season (prior to November and after March) or alternatively may require supervision at the time of removal.

Lighting at the WwTP site

External lighting will be installed around the WwTP for the safety and security of staff on the site. The lighting will be kept close to the buildings and only operate when there is movement. The lighting will be designed in consultation with the licenced bat expert, using emerging lighting technologies and having regard to best practice.

Mitigation for bats includes the following additional lighting considerations:

- Floodlighting is required for two of the external yards, and will be located within the building facade, and screened from broader light spillage by the louvered elements of the facade. Floodlights will be LED, as these have glass lenses which can be used to direct the light to the working area and reduce light spillage;
- Floodlights for working areas will make use of multiple lights to produce a more uniform light output and to lower the individual output from a single source – these will however still be quite high output;
- The site lighting incorporates the use of street lights to light the roadway around the building. The street lights will be selected to minimize upward lighting spill, hoods, louvres, shields or cowls would be fitted on the lights to reduce light spillage, and will incorporate the use of presence detection;
- Perimeter fence lighting will also incorporate presence detection, and will be off by default until motion is detected;
- low level (~ 1m high) bollard lighting is being used in selected areas (refer to architect's landscape plans);
- lights should be of low intensity. It is better to use several low intensity lights than one strong light spilling light across the entire area. The source of light should be Light Emitting Diodes (LEDs) as this is a narrow beam highly directional highly energy efficient light source. The lighting should allow for a light level of 3 lux at ground level. This low lighting is thus easier to control both the direction but also the actual light level because it is so close to the target area (if using bollard lighting);
- narrow spectrum lighting should be used with a low UV component. Glass also helps reduce the UV component emitted by lights.

In the event of security lighting being required, it is recommended that infra-red lighting and infra-red cameras are employed to record anti-social activity to assist in crime solving and prevention. This would not raise the visible light levels that would affect mammals and birds to a much greater extent.

Additional habitat creation measures for bats

It is envisaged that the façade of the new buildings at the WwTP will provide roosting opportunities for bats. As part of the proposed development, the appointed bat specialist shall review the buildings and advise on an appropriate location for of a purpose-built bat box such as the Improved Roost-Maternity Bat Box; likely to be located on the southern facade of both Process and Inlet works Buildings at about 4.5m off the ground. These locations will not be directly illuminated.

Planting of trees, shrubs, climbers, and species rich grassland within the planning boundary of the proposed development is detailed in **Chapter 4** and **Section 11.5.1.1**.

Marine mammals

The Standard Management Conditions for the contractor will include a requirement to consider alternative construction methodologies during the development of the detailed design, including confirmation of the sound generation characteristics (in air and in water) of all methodologies and all the equipment intended to be used in coastal and marine environments (i.e. in all areas east of Arklow Harbour at South Quay), and to apply the appropriate risk minimisation measures to manage the risk to marine mammals from man-made sound sources in Irish waters. These risk minimisation measures include the following list of measures (listed on page 18 of the Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters[4]):

- A6.1. Minimise the duration over which the sound-producing activity is intended to take place;
- A6.2. Minimise the individual and cumulative sound pressure and exposure levels delivered into the environment by the activity. If necessary the use of alternative, lower impact equipment and methods could be explored (e.g., vibratory hammer, gravity base piles).
- A6.3. Incorporate the use of clear “ramp-up” (i.e., “soft-start”) procedures, whereby sound energy input to the marine environment is gradually or incrementally increased from levels unlikely to cause significant behavioural impact on marine mammals to the full output necessary for completion of the activity.
- A6.4. Incorporate the use of fully enclosing or confined bubble curtains, encircling absorptive barriers (e.g., isolation casings, cofferdams) or other demonstrably effective noise reduction methods at the immediate works site, in order to reduce underwater sound propagation from on-site operations.

[4] Issued by the Minister for Arts, Heritage and the Gaeltacht as official guidelines and codes of practice under Regulation 71 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011).

Studies have shown that such methods can provide a significant reduction in sound input to the wider aquatic environment in the order of 10-30 dB.

- A6.5. Use trained and experienced marine mammal observers (MMOs) to provide effective means of detecting marine mammals in the vicinity of coastal and marine plans or projects. Associated operational considerations must also be taken into account (see section 4.2 of the Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters).

Implementation of these measures during construction will ensure that no risks of injury to, or of a disturbance/behavioural response by marine mammals from man-made sound will arise during construction.

Aquatic ecology

The contractor shall submit a detailed programme of work to the client and to Inland Fisheries Ireland showing the order of procedure and the method by which it is proposed to carry out the authorised works, together with a timetable for completion of such work. These works shall comply with the Inland Fisheries Ireland guidance[5].

The seasonal restriction contained in the guidance[5] has been modified in consultation with Inland Fisheries Ireland, in respect of the proposed development, to take account of the presence and seasonal passage on migration of Habitats Directive Annex II listed fish species Atlantic Salmon, River Lamprey, and potentially also Sea Lamprey in the Avoca River and Estuary. All instream works including the installation and removal of sheet piling or geotextile wrapped gabions required to provide barriers between works areas /temporary haul roads and aquatic habitats will be carried out during the three months of July to September inclusive.

The following mitigation measures will apply:

- Four weeks' notice shall be given in writing to the Employer's Representative and Inland Fisheries Ireland before the authorised works commence;
- A suitably qualified Environmental Clerk of Works shall be appointed to oversee and monitor all measures taken to protect the aquatic environment;
- The Contractor shall pay all statutory fees associated with the works;
- The Contractor shall be responsible for maintaining flows in the river at all times.
- The Contractor will be permitted to construct temporary haul roads in the river beside the proposed pipeline however the flow must be maintained throughout this period to enable free passage of fish. The details of the all temporary works in and immediately adjoining the Avoca River shall be subject to approval by the Employer's Representative and by Inland Fisheries Ireland;
- The Contractor shall take all practicable measures to prevent the deposition of silt or other material in, and the pollution or damage to the Avoca River;

[5] Inland Fisheries Ireland (2016) Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters

- Any construction equipment and vehicle which in the opinion of the Employer's Representative presents a risk of affecting the Avoca River shall be removed from Site;
- Instream machine works shall be minimised, and any machines working in the watercourse must be protected against leakage or spillage of fuels, oils, greases and hydraulic fuels;
- Instream earthworks must be executed so as to minimise the suspension of solids. Construction works, especially ones involving the pouring of concrete, must be conducted in the dry;
- De-watering of any in-stream or marine sheet piled areas will be via a screened water intake pipe, to avoid injury or mortality to any fish that may be present;
- Search for and safe removal to safe waters of any fish trapped in enclosed works areas in the aquatic environment will be carried out by suitably qualified and licenced personnel, using methodologies to be agreed with Inland Fisheries Ireland;
- Discharge from the dewatering process would be passed to a suitably sized settlement pond or a propriety silt removal system, before discharge to the Avoca River or the local sewer network. Back-up equipment will be required to be maintained ready for use at all works sites. Any discharge to either sewer or watercourse would be subject to a discharge licence. It is noted that the existing sewer network currently discharges untreated waters to the Avoca River;
- In order to minimise the volumes of water required to be removed from contained works areas in which in-situ cement works and/or excavation are required, works areas will be covered overnight and other periods when works are not in progress, in order to minimise infiltration of rainfall into works areas;
- To minimise the risk of spills and/or leaks, standard good practice will be followed with regard to pollution prevention as part of the appointed Contractor's detailed CEMP(s);
- All in-situ cement works will be monitored by the appointed contractor's Environmental Manager to ensure that spill prevention and remediation measures are in place, to minimise the risk and extent of spills and to rapidly deploy clean up equipment;
- Machinery maintenance work, re-fuelling of construction equipment and the addition of hydraulic oil or lubricants to vehicles / equipment will take place in designated bunded areas within the temporary construction compounds. All waste oil, empty oil containers and other hazardous wastes will be disposed of in compliance with the requirements of the Waste Management Acts 1996, as amended. All of the construction machinery operating near any watercourse will be systematically checked in order to avoid leaks of oils, hydraulic fluids and fuels; and

- Spill-kits and hydrocarbon absorbent packs will be stored in the cabin of each vehicle and operators will be fully trained in the use of this equipment.

Coastal processes

Relevant mitigation measures for coastal processes are described in **Section 15.5.1 of Chapter 15,** in **Appendix 15.5** and outlined in **Section 21.3.9**.

21.2.6 Archaeology, Architectural and Cultural Heritage

The following measures in relation to archaeology, architectural and cultural heritage will be implemented during construction:

- All ground excavations associated with the proposed development will be monitored by a suitably qualified archaeologist. This will enable the identification of any previously unrecorded features/ deposits of archaeological significance. Full provision will be made to ensure the preservation by record of any such features, should that be deemed the most appropriate manner in which to proceed, following consultation with the DCHG;
- All archaeological works will be carried out under the supervision of a project archaeologist, appointed on behalf of Irish Water, to ensure all mitigation measures are implemented;
- All excavations associated with the outfalls and revetment upgrade, will be monitored by a suitably qualified underwater archaeologist. Works will be carried out under licence to the DCHG and full provision will be made to ensure the preservation by record of any features that may be identified, should that be deemed the most appropriate manner in which to proceed, following consultation with the DCHG;
- All excavations associated with the interceptor sewer within the river channel (and any associated underpinning works) will be monitored by a suitably qualified underwater archaeologist. Works will be carried out under licence to the DCHG and full provision will be made available to ensure the preservation by record of any features that may be identified, should that be deemed the most appropriate manner in which to proceed, following consultation with the DCHG;
- All archaeological works will be carried out under the supervision of a project archaeologist, appointed on behalf of Irish Water, to ensure all mitigation measures are implemented; and
- All works to Arklow Bridge will be carried out under the supervision of a conservation engineer. A full assessment of potential effects will be undertaken once the preferred methodology has been selected for the underpinning works. This will lead to the production of a construction method statement that will ensure the historic fabric of Arklow Bridge is maintained throughout construction.

No likely significant effects to archaeology, architecture and cultural heritage during the operation of the proposed development have been identified. Therefore, no mitigation measures have been proposed with respect to effects from operation of the proposed development.

21.2.7 Landscape and Visual

The following measures in relation to landscape and visual will be implemented during construction:

- The nature of the construction activities in the townscape environment is such that there will always be disruption. Mitigation during construction relates to phasing of construction activity to different working areas sequentially to minimise the duration of significant effects arising from construction activities at any one location, and/or effective pedestrian and traffic management to minimise inconvenience and ensure access is maintained as appropriate;
- While the establishment of working areas, tunnelling shafts and traffic diversion will require felling of many existing quayside trees, the detailed design has identified opportunities to protect and retain most of the more valuable Willow trees along the riverside walkway upstream of Arklow Bridge that contribute to the setting of the Avoca River and provide a high degree of visual amenity in this locality;
- Where trees are required to be removed along South Quay and North Quay for construction, such trees are of lower value and will be re-planted post construction so as to reinstate the existing visual environment along the quayside;
- All tree protection works will be implemented strictly in accordance with BS5837:2012[6];
- Requirement for detailed construction management plans that set out robust tree protection methodologies in accordance with BS5837: 2012, where trees are to be retained, including in particular the Willow trees upstream of Arklow Bridge, and ensuring that tree protection is implemented and maintained throughout construction;
- Careful dismantling, storage and ultimate reinstatement of the Seafarers Memorial Garden has been identified as important to the locality and contemporary culture of the area, and a detailed method statement will be required from the appointed contractor to ensure the feature is satisfactorily reinstated following construction;
- For the most part, (excluding the land reclamation areas downstream of Arklow Bridge along South Quay), the existing finishes will be reinstated post construction. Where land is reclaimed downstream of Arklow Bridge, the widened quayside will incorporate a simple grass verge between the existing low wall concrete kerb upstand and the new quay wall.

[6] British Standards Institute (2012) BS 5837:2012 Trees in relation to design, demolition and construction. Recommendations.

This will provide a quayside finish that is consistent with the existing quayside, and will facilitate potential further public realm plans anticipated as part of the proposed Arklow Flood Relief Scheme); and

- Reinstated vegetation is undertaken by a suitably qualified landscape contractor, and their contract will include 2-year aftercare.

The following measures in relation to landscape and visual will be implemented during operation:

- The design of the proposed development has been coordinated with the separate design development of the planned Arklow Flood Relief Scheme (which is scheduled for submission at a later date), including coordination of the quay wall design at South Quay – Arklow Bridge and other structural components to avoid duplication and redundancy, and also in anticipation of quayside public realm upgrades on River Walk, South Quay and North Quay likely to occur as part of the planned Arklow Flood Relief Scheme;
- All tree protection works, planting and aftercare will be implemented strictly in accordance with BS5837:2012[6];
- As set out in **Chapters 3 and 4**, the architectural vision and design details anticipate the WwTP as a high quality architectural set-piece that will take the place of the Old Wallboard facility at Ferrybank. It is to contribute to the regeneration of the area and to catalyse future urban waterfront development as anticipated in the Arklow LAP;
- The specimen building design at the proposed WwTP will be further developed by the architect. The architect's services will be maintained, to ensure that all build ups and finishes are completed to the correct specification and standard of build quality;
- The detail and alignment of the interceptor sewer and the land reclamation proposals along South Quay have been developed to protect the setting and integrity of Arklow Bridge. The full extent of the nineteen arches will remain visible from both upstream and downstream, and the southern quay wall detail will be stepped locally to retain the integrity and visibility of the first (i.e. southernmost) arch; and
- The proposed structural interventions and reinforcement to the Arklow Bridge will have negligible visual effect above low water level. Nonetheless, the alignment of the interceptor sewer under the southernmost arch, and the riverbed in the adjoining two arches will be reduced. The trench for the sewer will be backfilled and covered to the level of the existing riverbed and finished using salvaged flag stones from the existing south quay wall further downstream. During operation, this will provide a riverbed finish through the southern arch that is consistent with other bridge arches, and will also purposefully reuse the salvaged fabric of the south quay.

21.2.8 Land and Soils

As outlined in **Section 5.8** of **Chapter 5** and in the Outline CEMP (Refer to **Appendix 5.1**), the adopted construction techniques will comply with the requirements of statutory bodies (Building Control Amendment Regulations, Health Service Executive inspections, Irish Water inspections and compliance with Employers Requirements). The following measures in relation to land and soils will be implemented during construction:

- Precautionary measures will be taken to contain any areas within the planning boundary at risk of contaminated run-off;
- Potential pollutants shall be adequately secured against vandalism and will be provided with proper containment according to the relevant codes of practice. Any spillages will be immediately contained and contaminated soil shall be removed from the proposed development and properly disposed of in an appropriately licensed facility;
- Dust generation shall be kept to a minimum through the wetting down of haul roads as required and other dust suppression measures;
- Any stockpiles of earthworks and site clearance material shall be stored on impermeable surfaces and covered with appropriate materials;
- Silt traps shall be placed in gullies to capture any excess silt in the run-off from working areas;
- Soil and water pollution will be minimised by the implementation of good housekeeping (daily site clean-ups, use of disposal bins, etc.) and the proper use, storage and disposal of these substances and their containers as well as good construction practices as described in Section 5.8 of chapter 5 Construction Strategy, the Outline CEMP as well as the CIRIA guidance[7];
- A contingency plan for pollution emergencies will also be developed by the contractor prior to the commencement of the works and regularly updated during construction. This contingency plan will identify the actions to be taken in the event of a pollution incident in accordance with the CIRIA guidance7 which requires the following to be addressed:
    - Containment measures;
    - Emergency discharge routes;
    - List of appropriate equipment and clean-up materials;
    - Maintenance schedule for equipment;
    - Details of trained staff, location and provision for 24-hour cover;
    - Details of staff responsibilities;
    - Notification procedures to inform the EPA or Environmental Department of the Wicklow County Council;

[7] Masters – Williams et al (2001) Control and management of water pollution from construction sites in their publication Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors

- Audit and review schedule;
- Telephone numbers of statutory water consultees; and
- List of specialist pollution clean-up companies and their telephone numbers.

Alps SWO and Stormwater Tank

- Excavations shall be kept to a minimum, using shoring or trench boxes where appropriate. For more extensive excavations, a temporary works designer shall be appointed to design excavation support measures in accordance with all relevant guidelines and standards;
- All excavated material will, where possible, be reused as construction fill. The appointed contractor will ensure acceptability of the material for reuse for the proposed development with appropriate handling, processing and segregation of the material. This material would have to be shown to be suitable for such use and subject to appropriate control and testing according to the Earthworks Specification(s). These excavated soil materials will be stockpiled using an appropriate method to minimise the impacts of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff. Any surplus suitable material excavated that is not required elsewhere for the proposed development, shall be used for other projects where possible, subject to appropriate approvals/notifications;
- Earthworks haulage will be along agreed predetermined routes along existing national, regional and local routes. Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to its original condition. Where practicable, compaction of any soil or subsoil which is to remain in situ along the sites will be avoided;
- Earthworks operations shall be carried out such that surfaces shall be designed with adequate falls, profiling and drainage to promote safe runoff and prevent ponding and flooding. Runoff will be controlled through erosion and sediment control structures appropriate to minimise the water impacts in outfall areas. Care will be taken to ensure that the bank surfaces are stable to minimise erosion;
- Ground settlement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations;
- Ground settlements will be controlled through the selection of a foundation type and method of construction which are suitable for the particular ground conditions; and
- To reduce the amount of dewatering required at any given time, it is likely that the contractor would construct the sewer in sections. Discharge from the dewatering process would be passed to a suitably sized settlement pond or a proprietary silt removal system located within the working area where possible, before discharge to the Avoca River or the local sewer network. Any discharge to either sewer or watercourse would be subject to a WWDA.

South Interceptor Sewer, North Interceptor Sewer and Central Interceptor sewer including river crossing

- All excavated material will, where possible, be reused as construction fill. The appointed contractor will ensure acceptability of the material for reuse for the proposed development with appropriate handling, processing and segregation of the material. This material would have to be shown to be suitable for such use and subject to appropriate control and testing. These excavated soil materials will be stockpiled located within the working area where possible, using an appropriate method to minimise the impacts of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff. Any surplus suitable material excavated that is not required elsewhere for the proposed development shall be used for other projects where possible, subject to appropriate approvals/notifications;
- Earthworks haulage will be along agreed predetermined routes along existing national, regional and local routes. Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to its original condition. Where practicable, compaction of any soil or subsoil which is to remain in situ along the sites will be avoided;
- Earthworks operations shall be carried out such that surfaces shall be designed with adequate falls, profiling and drainage to promote safe runoff and prevent ponding and flooding. Runoff will be controlled through erosion and sediment control structures appropriate to minimise the water impacts in outfall areas. Care will be taken to ensure that the bank surfaces are stable to minimise erosion;
- Ground settlement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations. Monitoring will be more rigorous at Arklow bridge as it is a protected structure. This will include more frequent monitoring and more monitoring points. Monitoring points will be located on the face of the bridge piers and centred every 1m or at least one monitoring point for each phase in the underpinning procedure. Horizontal, vertical and rotational displacement in all directions will be monitored;
- Ground settlements will be controlled through the selection of a foundation type and method of construction which are suitable for the particular ground conditions;
- To reduce the amount of dewatering required at any given time, it is likely that the contractor would construct the sewer in sections. Discharge from the dewatering process would be passed to a suitably sized settlement pond or a proprietary silt removal system located within the working area, before discharge to the Avoca River or the local sewer network. Any discharge to either sewer or watercourse would be subject to a WWDA Infilling of river channel and installing sheet piles; and
- The temporary causeway will be contained on the river side to mitigate against siltation migration into the Avoca River.

The two most likely methods to achieve this containment would either be an additional row of sheet piles on the river side of the causeway or alternatively a row of stone gabions wrapped in a geotextile membrane. Either method would require that the containing material (i.e. the sheet piles or the gabion walls) are extended (i.e. to a height above the surface of the causeway) to be effective. The infilling will produce a favourable lateral force on the existing quay wall but an unfavourable lateral force on the sheet piles. Horizontal movement monitoring of the sheet piles will be implemented during construction activities to ensure that the movement does not exceed the design limitations.

WwTP and Revetment

- Excavations and therefore the transport of soils across the site shall be kept to a minimum, using shoring or trench boxes where appropriate. For more extensive excavations, a temporary works designer shall be appointed to design excavation support measures in accordance with all relevant guidelines and standards;
- It should be noted that both the excavation and import of materials will be required for construction of the revetment;
- Excavations in made ground for the WwTP and the revetment will be monitored by an appropriately qualified person to ensure that any spots of contamination (such as nitrocellulose or asbestos) encountered are identified, segregated and stored in an area where there is no possibility of runoff generation or infiltration to ground or surface water drainage. Care will be taken to ensure no cross-contamination with clean soils elsewhere throughout the site;
- Excavated contaminated soils will be segregated and stored in an area where there is no possibility of runoff generation or infiltration to ground or surface water drainage. Care will be taken to ensure no cross-contamination with clean soils elsewhere throughout the site;
- Dewatering will be required for the construction of the WwTP. Discharge volumes could be up to 250m^3/day and would be passed to a suitably sized settlement pond or a propriety silt removal system, along with any other treatment as required by WCC before discharge to the Avoca River or the local sewer network. This will most likely include treatment to remove elevated heavy metals which were noted during the ground investigation. Any discharge to either sewer or watercourse would be subject to a WWDA;
- Ground settlement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations;
- Ground settlements will be controlled through the selection of a foundation type and construction methods which are suitable for the particular ground conditions. See **Chapter 5** for further details;

- All excavated material will, where possible, be reused as construction fill. The appointed contractor will ensure acceptability of the material for reuse for the proposed development with appropriate handling, processing and segregation of the material. This material would have to be shown to be suitable for such use and subject to appropriate control and testing according to the Earthworks Specification(s). These excavated soil materials will be stockpiled using an appropriate method to minimise the impacts of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff. Any surplus suitable material excavated that is not required elsewhere for the proposed development shall be used for other projects where possible, subject to appropriate approvals/notifications;
- Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to its original condition. Where practicable, compaction of any soil or subsoil which is to remain in situ along the sites will be avoided; and
- Earthworks operations shall be carried out such that surfaces shall be designed with adequate falls, profiling and drainage to promote safe runoff and prevent ponding and flooding. Runoff will be controlled through erosion and sediment control structures appropriate to minimise the water impacts in outfall areas. Care will be taken to ensure that the bank surfaces are stable to minimise erosion.

Outfalls (Long Sea Outfall and SWO)

- Ground settlement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations;
- Ground settlements will be controlled through the selection of methods of construction as outlined in **Chapter 5** which are suitable for the particular ground conditions;
- Based on ground conditions and construction methods, there should be limited mobilisation of those sediments; and
- Best practice guidelines[8] will be adhered to as a minimum for any dredging exercises to be carried out. Measures to minimise disruption to the seabed and mobilisation of sediments will be applied and seabed conditions will be taken into account when selecting construction methods.

No mitigation has been proposed with respect to effects from operation of the proposed development in relation to land and soils.

21.2.9 Water

The following measures in relation to water will be implemented during construction:

[8] British Standards (2016) BS6349-5 - Maritime works – Part 5: Code of practice for dredging and land reclamation

Hydrology and Water Quality

The standard best practice measures in the Outline CEMP (Refer to **Appendix 5.1**) for the proposed development will mitigate significant negative effects on surface water quality during construction. The Outline CEMP has regard to the guidance contained in the handbook published by CIRIA[9].

Further, temporary works will be designed to minimise effects on the hydrology and flow regime in the study area during construction. The outline CEMP includes a range of site specific measures which will include the following:

- During construction, surface water runoff would be collected by the temporary drainage system installed by the contractor and then treated or desilted on-site before discharge into the Avoca River;
- Earthworks operations shall be carried out such that the surfaces are designed with adequate slope to promote safe runoff and prevent flooding;
- Good housekeeping such as site clean ups, use of disposal bins, etc. will be adopted in construction areas;
- In order to prevent accidental release of hazardous materials such as fuels, cleaning agents etc. into surface water during construction, all hazardous materials will be stored within appropriately bunded containment areas designed to retain spillages;
- Temporary bunds will be used for storage of oil/diesel; and
- The temporary causeway and the surface water runoff from this area would be entirely contained to prevent any pollution entering the Avoca River. This would be contained through the implementation of best practice measures outlined in the Outline CEMP (Refer to **Appendix 5.1**).
- As outlined in **Chapter 5**, it is necessary to construct launch and reception chambers to facilitate tunnelling works. As these shafts will extend beneath the ground water level, it will be necessary to "plug" these shafts to prevent water ingress.

Mitigation during construction will include implementing best practice during excavation and tunnelling works to avoid the release of bentonite and prevent sediment running into the drainage network and/or hydrological environment during construction of the proposed development.

Coastal processes

The following mitigation measure has been proposed with respect to effects on coastal processes from construction of the proposed development:

- Construction of the long sea outfall will generally be restricted to the period May – September, with the period between November-February generally avoided. In this manner, the months with likely worst wave and wind conditions, which lead to higher levels of sediment suspension and transport, are avoided.

[9] CIRIA(2015) Environmental Good Practice on Site Guide, 4th Edition.

Flood risk

WwTP site

During construction, there is a risk of coastal erosion and a risk of wave overtopping. Similarly to the construction of the long sea outfall, works between November and February should be avoided. It is also recommended that the contractor considers tidal and wind forecasts and monitors these closely to minimise the risk of coastal erosion and wave overtopping.

Given the absence of a significant risk of flooding at the site of the proposed WwTP, no further mitigation measures to address flood risk during construction are required.

Interceptor sewers

In order to mitigate and minimise the potential flood risk caused by the construction of the temporary causeway and the interceptor sewers in the Avoca river channel, the following sequence of works is proposed prior to construction of the temporary causeway:

- Proposed underpinning of the 2 southernmost arches and lowering of the second Arch by c. 1m at the bridge is completed.
- Proposed in-stream works at and upstream of the bridge is fully completed (i.e. the upstream interceptor sewer manhole and the laying of the interceptor sewer beneath the bed of Bridge Arch 1).
- The temporary works should proceed from downstream to upstream (i.e. from east to west direction).
- Following completion of construction of the interceptor sewer in the Avoca River (i.e. when the causeway is no longer required), the causeway would be removed in a similar sequential manner.
- Timely removal of sections of the causeway should be a priority once works have been completed.

The following measures in relation to water will be implemented during operation of the proposed development:

Hydrology and Water Quality

The proposed development will improve water quality in the Avoca River by eliminating, for the most part, the discharge of untreated wastewater into the river channel. Excess storm flows will continue to be discharged as emergency overflows in the event of WwTP pumping station failure, however this is likely to occur significantly less than the permitted 7 spills per bathing season.

All storm flows to the Avoca River (discharged as emergency overflows) would be screened via static screens in the CSOs to ensure the maximum particle size in the water column does not exceed 6mm in diameter to ensure compliance with Irish Water standards.

Coastal processes

No mitigation measures have been proposed with respect to effects on coastal processes from operation of the proposed development.

Flood risk

Given the absence of a significant risk of flooding of the site of the proposed WwTP, no mitigation measures to address flood risk during operation are required.

As the proposed development directs almost all wastewater flows to the WwTP shows that the proposed development will result in an overall slight beneficial impact upstream of the bridge in terms of flooding, no mitigation measures are required to address flood risk during operation.

21.2.10 Resource and Waste Management

The following measures in relation to resource and waste management will be implemented during construction:

- The contractor is required to prepare, implement and maintain a Construction and Demolition Waste Management Plan throughout construction that addresses the following as a minimum:
  - Description of the proposed development;
  - Wastes arising including procedures for minimisation/reuse/recycling;
  - Estimated cost of waste management;
  - Roles including training and responsibilities for construction and demolition waste;
  - Procedures for education of workforce and plan dissemination programme;
  - Record keeping procedures;
  - Waste collectors, recycling and disposal sites including copies of relevant permits or licences; and
  - Waste auditing protocols.
- The Contractor will minimise waste disposal so far as is reasonably practicable;
- Waste from the proposed development will be transported by authorised waste collectors in accordance with the Waste Management (Collection Permit) Regulations 2007 to 2016 to take into account the Waste Management (Collection Permit) (Amendment) Regulations 2016;
- Waste from the proposed development will be delivered to authorised waste facilities in accordance with the Waste Management Acts 1996-2011 and the Waste Management (Collection Permit) (Amendment) Regulations 2016;

- Source segregation: Where possible metal, timber, glass and other recyclable material will be segregated during construction works and removed off site to a permitted/licensed facility for recycling. Waste stream colour coding, and photographs of wastes to be placed in each container as required, will be used to facilitate segregation. Where waste generation cannot be avoided this will maximise the quantity and quality of waste delivered for recycling and facilitate its movement up the waste hierarchy away from landfill disposal and reduce its environmental impact;
- Material management: 'Just-in-time' delivery will be used so far as is reasonably practicable to minimise material wastage;
- Supply chain partners: The contractor will engage with the supply chain to supply products and materials that use minimal packaging, and segregate packaging for reuse;
- Waste Auditing: The contractor will record the quantity in tonnes and types of waste and materials leaving site during the construction phase;
- Waste fuels/oils may be generated from equipment used on-site during construction and may be classified as hazardous waste. Such wastes will be stored in a secure, bunded area on-site prior to collection by a contractor who holds the appropriate waste collection permit;
- Possibilities for re-use of clean non-hazardous excavation material as fill on the site or in landscaping works will be considered following appropriate testing to ensure material is suitable for its proposed end use. Where excavation material may not be re-used within the proposed works the contractor will endeavour to send material for recovery or recycling so far as is reasonably practicable;
- The name, address and authorisation details of all facilities and locations to which waste and materials are delivered will be recorded along with the quantity of waste in tonnes delivered to each facility. Records will show material which is recovered and which is disposed of; and
- The contractor(s) will ensure that any off site interim storage or waste management facilities for excavated material have the appropriate waste licences or waste facility permits in place.

No mitigation measures have been proposed with respect to effects on resource and waste management from operation of the proposed development.

21.2.11 Population and Human Health

The following measures in relation to population and human health will be implemented during construction:

- Provide for safe pedestrian access at points of entry and exit of construction vehicles accessing River Walk and Châteaudune Promenade from Main Street;

- Ensure provision of a safe surface for the existing eastern footpath (currently gravel) from Vale Road for use of the walk by more vulnerable older age groups as an alternative to the temporary closure of surfaced section from River Walk;
- Provide continued access to boat moorings on North Quay during open cut works;
- Where practicable, use short sections of transparent hoarding or include viewing windows in the hoarding at locations popular for amenity such as in front of the cafes on River Walk and at the Bridgewater Shopping Centre;
- Stagger works wherever possible and remove hoarding as soon as it is no longer needed to mitigate against severance;
- Avoid works that could involve high noise or visual intrusion during major social events around the Avoca River, notably any sites used by the annual Arklow Maritime Festival or other public events.
- Provide temporary signalling or manning of junction between Ferrybank and Seaview Avenue while diversion to Bridgewater Shopping Centre is in effect;
- Maintain regular proactive consultation with local residents and businesses, particularly along River Walk, South Green, Harbour Road, Bridgewater Shopping Centre, Aldi and Marine Village, but also with all living or working along South Quay, North Quay and Ferrybank.
- Other than the mitigation outlined in the respective **Chapters 7 - 10**, no further mitigation has been proposed with respect to human health effects during construction of the proposed development. This is because, in accordance with the best scientific evidence no significant health effects are predicted with the mitigation already proposed.

Other than the mitigation outlined in the respective **Chapters 7 - 10**, no further mitigation measures have been proposed with respect to population and human health effects from operation of the proposed development.

21.2.12 Material Assets

The following measures in relation to material assets will be implemented during construction:

- Wherever possible, mitigation by avoidance of negative effects on property was a priority during the design development of the proposed development. Landowners will be compensated as appropriate for permanent and temporary land acquisition, in accordance with the relevant legislation. The details of any individual agreements will be private and confidential and therefore mitigation measures in the form of compensation are not specific or detailed herein;
- A Property Protection Scheme will be put in place by Irish Water prior to works commencing on site. This will involve advance condition surveys prior to construction for all properties within the zone of influence of the proposed development.

If it is determined that any reported minor cosmetic damage has been caused by construction of the proposed development, suitable remedial works will be undertaken to repair the damage to the properties with the use of the appropriate conservation technique;

- Mitigation measures for all areas of temporary land acquisition will involve reinstatement to their original condition so far as is reasonably practicable;

  Access to all existing properties will be maintained at all times during the construction of the proposed development. This may require temporary alternate access arrangements at some locations. All access will be reinstated upon completion of construction;

- The contractor will be obliged to put measures in place to ensure that there are no interruptions to existing utilities and services unless this has been agreed in advance with the relevant service provider. As outlined in **Chapter 5**, all utilities and services diversions will be agreed and undertaken as part of the enabling works and in advance of the commencement of construction activities. All construction activities in the vicinity of existing services and utilities will be carried out in ongoing consultation with the relevant service provide and undertaken in compliance with any requirements or guidelines they may have;

- Sewer diversions will be undertaken as part of the enabling works prior to the commencement of construction activities. Upon commissioning, the older pipelines being abandoned will be sealed off and/or removed as described in **Chapter 5;**

- Surface water management measures will be adopted along the entire site, as outlined in **Chapter 15** and **Section 21.2.9**;

- As described in **Chapter 5** and outlined in **Appendix 5.1**, the contractor will be required to prepare and maintain a detailed CEMP during the construction phase of the proposed development. The appointed contractor will be required to comply with the Outline CEMP. Effective implementation of the CEMP would ensure that disruption and nuisance are kept to a minimum throughout the construction of the proposed development. The detailed CEMP will be required to have regard to the guidance[9] and industry best practice. The CEMPs will be effective throughout construction and the contractor will be required to review and update the CEMP as construction progresses.

- In addition to the CEMP, it is anticipated that the contractor will prepare relevant management plans and Works Method Statements in advance of any works commencing on site. Every effort will be made to ensure that any significant effects on material assets will be avoided, prevented or reduced during the construction of the proposed development.

The following measures in relation to material assets will be implemented during operation:

- Landowners will be compensated as appropriate for permanent land acquisition, in accordance with legislation. The details of any individual agreements will be private and confidential and herein.

21.2.13 Major Accidents and Natural Disasters

The following measures in relation to major accidents and natural disasters will be implemented during construction:

- The construction methodology for the revetment employed by the contractor, that would involve replacement of the revetment in sections, will work to mitigate the risk of flooding in that it would enable the section under construction to be quickly protected during storm events; and
- A detailed CEMP would be prepared prior to the commencement of any works and implemented during the works. The CEMP will be a live document maintained by the contractor that would work to ensure that potential risks of major accident and/or disaster are identified, avoided and mitigated, as necessary.

The following measures in relation to major accidents and disasters will be implemented during operation:

- As outlined in **Chapter 4 and Section 19.2.1**, the proposed development will be designed and built in line with best international current practice and, as such, mitigation against the risk of major accidents and/or disasters would be embedded through the design.
- In accordance with the provision of the European Commission Guidance a Risk Management Plan will be prepared and implemented on site to ensure an effective response to disasters or the risk of accidents. The plan should include sufficient preparedness and emergency planning measures.
- Further, a maintenance programme would be implemented at the site, in compliance with the conditions of the Waste Water Discharge Authorisation required under the Waste Water Discharge (Authorisation) Regulations 2007 - 2016. The purpose of the maintenance programme is to ensure that all critical equipment at the WwTP and elsewhere throughout the proposed development is operating correctly, therefore reducing the risk of major accidents and/or disasters on site.

  As outlined in Section 19.4, the scenarios with the highest risk score in terms of a major accident and/or disaster during operation were identified as ‘discharge, spillage or longer-term seepage of untreated wastewater, fuel, chemicals solvents etc. into the watercourse or groundwater table,’ and ‘fire/explosion.’

The storage of diesel in a contained and bunded area on-site would mitigate '*by prevention'* the risk of surface and/or ground pollution, as well as the risk of fire/explosion resulting from the potential spillage of fuel.As a further means of mitigation '*by remedy,*' fire extinguishers would be provided in the Administration building, and an industrial purpose fire hose reel would be installed to service both the Inlet Works Building and the Process Building, in accordance with the relevant NSAI Standards[10]; and

- The proposed development would also be subject to a fire safety risk assessment in accordance with Chapter 19 of the Safety, Health and Welfare at Work Acts 2005 to 2014, which would assist in the identification of any major risks of fire on site, and mitigation of the same during operation.

21.3 Summary of Monitoring Measures

A range of monitoring measures has been identified to demonstrate that the proposed development conforms to the predictions made as part of this EIAR. This monitoring will take place after consent is granted and provide assurance that aspects of the proposed development are functioning as intended and thus not generating significant effects.

Monitoring has been identified to occur after consent is granted in order to provide assurance that aspects of the proposed development are functioning as intended (and thus not generating significant effects) as described in detail in **Chapters 7 – 19**. Where appropriate, remedial actions have also been identified.

The monitoring measures outlined for the proposed development are summarised in **Sections 21.3.1 - 21.3.13**.

21.3.1 Traffic and Transportation

For each construction stage, the individual traffic management plans will 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.

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

21.3.2 Air Quality and Climate

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^2/day (averaged over one year) will be applied as a 30-day average.

[10] NSAI (2015) *IS291:2015 Selection, commissioning, installation, inspection and maintenance of portable fire extinguishers. NSAI (2012) IS EN 671-1:2012: Fixed firefighting systems. Hose systems. Hose reels with semi-rigid hose.*

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

21.3.3 Odour

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

The following measures in relation to odour will be implemented during operation:

- 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 odour units 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.

21.3.4 Noise and Vibration

The following measures in relation to noise and vibration will be implemented 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 10.11 in Chapter 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 10.6 and Table 10.11 in Chapter 10**, respectively. If exceedances are recorded, the possibility of alternative construction methodologies will be examined to reduce impact at sensitive receptors.

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 accordance with EPA licensing standards. Monitoring at the site boundary will be undertaken during commissioning and at predetermined frequencies over the life time of the proposed development.

21.3.5 Biodiversity

The following measures in relation to biodiversity will be implemented during construction:

- Monitoring of new seeding and planting provided as habitat and flora mitigation will be carried out during implementation of these measures;
- Monitoring of the effectiveness of implementation of bat mitigation measures, including occupancy of bat roost boxes and bat responses to WwTP site lighting, will be carried out during the construction phase; and
- Monitoring and reporting of marine mammals will be provided by Marine Mammal Observers referred to in **Section 11.5.1.1**.

The following measures in relation to biodiversity will be implemented during operation:

- Monitoring of new seeding and planting provided as habitat and flora mitigation will be carried out during the first two years of operation; and
- Monitoring of the effectiveness of implementation of bat mitigation measures, including occupancy of bat roost boxes, and bat responses to WwTP site lighting, will be carried out during the first two years of operation.

21.3.6 Archaeology, Architectural and Cultural Heritage

The mitigation measures recommended in **Chapter 12** and **Section 21.2.6**, including the monitoring of works by qualified archaeologists and a conservation engineer, would support effective monitoring during construction to allow the further assessment of the scale of the predicted impacts and the effectiveness of the recommended mitigation measures.

No monitoring has been proposed with respect to archaeology, architectural and cultural heritage effects from operation of the proposed development.

21.3.7 Landscape and Visual

It is likely that the appointed contractor will need to have an individual appointed to liaise with residents and other stakeholders in advance of establishing working areas so as to ensure such working areas have the minim potential impact of residents and their properties. Additionally, reinstatement of the Seafarers Memorial Gardens will require the provision of a proposed reinstatement layout for agreement with the local community and Wicklow County Council prior to carrying out the works.

Monitoring during operation relates principally to the aftercare of reinstated landscape areas to ensure the proper establishment of soft landscape as proposed. Any plants or trees that fail will be required to be replaced in the next available planting season.

21.3.8 Land and Soils

The following measures in relation to land and soils will be implemented during construction:

- Excavations in made ground will be monitored by an appropriately qualified person to ensure that any contaminated material is identified, segregated and disposed of appropriately. Any identified hotspots shall be segregated and stored in an area where there is no possibility of runoff generation or infiltration to ground or surface water drainage. Care will be taken to ensure that the hotspot does not cross-contaminate clean soils elsewhere;
- Any excavation shall be monitored during earthworks to ensure the stability of side slopes and to ensure that the soils excavated for disposal are consistent with the descriptions and classifications according to the waste acceptance criteria testing carried out as part of the site investigations;
- Ground settlement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations. Monitoring will be more rigorous at Arklow bridge as it is a protected structure. This will include more frequent monitoring and more monitoring points. Monitoring points will be located on the face of the bridge piers and centred every 1m or at least one monitoring point for each phase in the underpinning procedure. Horizontal, vertical and rotational displacement in all directions will be monitored;
- The construction of the offshore elements shall follow international best practice in regard to the management of the trenching / excavations, the stability of the excavation/trenched area and the disposal of any spoil generated from either the excavation or the tunnelling / horizontal directional drilling works;
- Movement monitoring shall be carried out during any activities which may result in ground movements or movements of any nearby structures; and
- Water quality monitoring will be carried out at all discharge points as per the requirements of the issued WWDA.

Ongoing monitoring of the infrastructure for leaks shall be carried out during operation. If leaks are detected, the system should include measures for the management of any resulting contamination of the surrounding soils.

21.3.9 Water

The following measures in relation to water will be implemented during construction:

Hydrology and water quality

- Visual monitoring would be undertaken as part of the regular site audits during the construction of the proposed development to ensure existing surface water drainage discharge into the Avoca River/coastal waters is not impacted by the proposed development; and

- This is necessary to ensure that surface water flooding is not caused by any damages to existing surface water sewers/outfalls discharging into the Avoca River during construction of the interceptor sewers.

Flood risk

- The contractor is required to monitor tide and wind forecasts to minimise the risk of coastal erosion and wave overtopping; and
- The contractor is required to monitor weather forecasts to inform operation of the temporary causeway.

The following measures in relation to water will be implemented during operation of the proposed development:

Hydrology and water quality

- Monitoring of all SWOs by storm water level indicator instruments will be undertaken by the operator to provide records of any overflows, ensuring that bathing season spill events are recorded.

Coastal processes

- The scour protection at the outfall shall be monitored to ensure its performance and avoid any potential risk derived from the potential future exposure of the pipeline and/or diffuser. Scour protection will be monitored by Irish Water as part of the overall long outfall maintenance. Outfall monitoring would include visual inspection either by divers or robotics and would be performed every 5 years and after significant storm events as part of the overall operational management regime. The inspection crew would check the pipeline for scour protection damage, slide, anchor, or other damage. Scour protection shall be reinstated and/ or repaired if any damage is observed.

Flood risk

No monitoring during operation is required for flood risk during the operation of the proposed development.

21.3.10 Resource and Waste Management

Monitoring required as part of the CDWMP and the Outline CEMP, as set out in **Sections 16.5.2.1 and 21.2.10** and **Appendix 5.1**, in relation to waste will be undertaken and recorded by the contractor(s).

Monitoring of sludge generation and management will be undertaken in accordance with the provisions of operational procedures for the WwTP and the NWSMP. No monitoring has been proposed with respect to effects from other operational wastes from the proposed development.

21.3.11 Population and Human Health

The following measures in relation to population and human health will be implemented during construction:

- Traffic flows should be monitored to ensure that significant delays or congestion are not occurring in Arklow town due to diversions or construction traffic; and
- Regular proactive consultation should be undertaken with local businesses and a log of complaints/issues raised by stakeholders should be maintained and monitored throughout construction. Where practicable, residents and local businesses should be advised in advance on the timing of works to understand the effect on business turnover or population amenity.

The following measures in relation to population and human health will be implemented during operation:

- Monitoring of the volume of HGV movements to and from the WwTP are proposed. In other respects, the positive effect of the proposed development mitigates the need for further monitoring with regard to population and human health effects during operation of the proposed development.

21.3.12 Material Assets

No monitoring measures have been proposed with respect to effects on material assets during construction and operation of the proposed development.

21.3.13 Major Accidents and Natural Disasters

As outlined in **Chapter 5**, a detailed CEMP would be prepared prior to the commencement of any works and implemented and monitored during the works. The CEMP will be a live document maintained by the Contractor, and will work to ensure that potential risks of major accident and/or disaster are monitored, as necessary. Refer to Appendix 5.1 for an outline CEMP that sets out the minimum standards to be employed by the contractor.

The following measures in relation to major accidents and natural disasters will be implemented during operation:

- Irish Water and the operator of the proposed development would continue to assess the risk of major accidents and/or disasters on site on an on-going basis during operation; and
- The maintenance programme, record of reported incidents, as well as general site activities will be monitored on an on-going basis to ensure risk of major accidents does not increase over time.

21.4 Residual Significant Effects

This EIAR has been prepared by competent experts in accordance with Article 1(2)(g) of the EIA Directive to identify the likely significant effects associated with the proposed development in accordance with the relevant legislation and guidance.

A range of likely significant effects have been avoided or reduced through the implementation of mitigation measures and monitoring, therefore leading to the residual effects as outlined in **Sections 21.4.1 - 21.4.13**.

21.4.1 Traffic and Transportation

21.4.1.1 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, long term 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.

21.4.1.2 Operation

No residual effects on traffic and transportation are anticipated during the operation of the proposed development.

21.4.2 Air Quality and Climate

No residual effects are predicted on air quality and climate during the construction and operation of the proposed development.

21.4.3 Odour

21.4.3.1 Construction

No residual effects on odour are anticipated during the construction of the proposed development.

21.4.3.2 Operation

As outlined in **Section 9.5.2 of Chapter 9**, the odour levels are predicted to be in compliance with the limits presented in **Section 9.2.2 of Chapter 9**, therefore no significant residual effects are expected to occur at any of the receptor locations during the operation of the proposed development.

21.4.4 Noise and Vibration

21.4.4.1 Construction

Compliance with noise limit values in can be achieved at the nearest sensitive receptors to the proposed 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 of Chapter 10** will assist in reducing the impact on nearby sensitive receptors.

Residual short-term, slight to significant negative effects are predicted during the construction of the proposed development as outlined in Table 21.1

Table 21.1: Summary of residual noise and vibration effects during construction

Construction Phase	Summary of Residual Effect
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

21.4.4.2 Operation

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

21.4.5 Biodiversity

21.4.5.1 Construction

The residual indirect effects on the European site Buckroney – Brittas Dunes and Fen SAC (site code: 000729), in respect of the Qualifying Interests are assessed as neutral. No residual direct or indirect effects arise on European sites.

The residual effects on the listed fish species listed in Annex II of the Habitats Directive (Atlantic Salmon, River Lamprey and Sea Lamprey) during construction are assessed as neutral.

The residual effects on bat species listed on Annex IV of the Habitats Directive (Common pipistrelle, Soprano pipistrelle, Leisler's bat and Daubenton's bat) are assessed as neutral.

The residual effects on cetacean species listed on Annex IV of the Habitats Directive, and on Harbour Seal and Grey Seal listed on Annex II of the Habitats Directive, are assessed as neutral.

The residual effects on breeding birds and their nests, eggs and nestlings, are assessed as neutral.

Residual local effects on terrestrial flora and habitats within the planning boundary, providing locally important biodiversity and ecological connectivity through the urban environment of Arklow, are assessed as short term, slight, and reversible, in the context of the urban area of Arklow.

21.4.5.2 Operation

The residual indirect effects on the European site Buckroney – Brittas Dunes and Fen SAC (site code: 000729), in respect of the Qualifying Interests are assessed as neutral. No residual direct or indirect effects arise on European sites.

The residual effects on fish species listed on Annex II of the Habitats Directive (Atlantic Salmon, River Lamprey and Sea Lamprey) are positive during operation.

The residual effects on cetacean species listed on Annex IV of the Habitats Directive, and on Harbour Seal and Grey Seal listed on Annex II of the Habitats Directive, are assessed as neutral.

The residual effects on breeding birds and their nests, eggs and nestlings, are assessed as neutral. The provision of nesting boxes for Grey Wagtail and Pied Wagtail at Arklow Bridge is assessed as slight positive during operation.

Residual local effects on terrestrial flora and habitats within the planning boundary, providing locally important biodiversity and ecological connectivity through the urban environment of Arklow are assessed as not significant.

The residual effects on bat species listed on Annex IV of the Habitats Directive (Common pipistrelle, Soprano pipistrelle, Leisler's bat and Daubenton's bat) are assessed as neutral.

21.4.6 Archaeology, Architectural and Cultural Heritage

No residual effects are predicted upon archaeological, architectural and cultural heritage resources during construction and operation of the proposed development.

21.4.7 Landscape and Visual

Residual landscape/townscape effects will generally relate to the new WwTP element and revetment, the widened South Quay area immediately south of Arklow Bridge, and the Alps SWO and stormwater storage compound as it interfaces with the riverside walkway.

Residual landscape/townscape effects within the townscape of Arklow and its wider environs will vary considerably throughout the townscape of Arklow town and its wider environs, and these are described with reference to the series of photomontages (Refer to **Appendix 13.1** and **Volume 3**) for a range representative locations throughout the project development area and it context.

The overall residual landscape/townscape and visual effect is considered to be moderate and neutral, or less.

21.4.8 Land and Soils

No residual effects are predicted in relation to land and soils during construction and operation of the proposed development.

21.4.9 Water

21.4.9.1 Construction

Hydrology and Water Quality

Hydrology and Drainage

No residual effects on hydrology and drainage are anticipated during the construction of the proposed development.

Water Quality

The residual effect on water quality will be short term, slight negative effects during construction of the proposed development.

Coastal Processes

The residual effects on coastal processes are assessed as neutral during construction.

Flood Risk

No residual effects on flood risk are anticipated during the construction of the proposed development.

21.4.9.2 Operation

Hydrology and Water Quality

Hydrology and Drainage

During operation, all flows from the Arklow catchment will be conveyed to the proposed WwTP at Ferrybank, save during extreme rainfall events where overflows through the SWO's may occur (albeit modelling has confirmed that these spills will be very limited). There will therefore be no residual effect on drainage during operation of the proposed development.

There will be an overall reduction in the frequency of sewer surcharge associated with the proposed development which is considered a significant positive residual effect on hydrology during operation of the proposed development.

Water Quality

During operation as the majority of the storm flows will be conveyed to the WwTP, the spills via the SWO's will be on average less than 1 spill/bathing season which is well below the permitted 7 spills/bathing season. There will be a significant positive residual effect in relation to surface water quality, due to the removal of existing outfalls discharging untreated wastewater into the Avoca River and appropriate treatment of all wastewater.

The proposed 900m outfall and SWOs will replace the 19 existing outfalls and overflows. All treated effluent will discharge into the harbour, therefore there will thus be a significant positive effect on water quality both in the harbour and on the bathing areas, as a result of the proposed development.

Coastal Processes

No significant residual effect is expected on coastal processes during operation of the proposed development.

Flood Risk

There will be an overall reduction in the existing flood extent following construction of the proposed development (associated with the bridge underpinning works) which will be a slight positive effect during operation of the proposed development.

It should be noted that the sheet pile wall constructed as part of the proposed development would also serve as advance works for the flood walls to be built as part of the proposed Arklow Flood Relief Scheme. It is recognised that once constructed, the proposed Arklow Flood Relief Scheme would further reduce any residual flood risk during the operation of the proposed development and thus bring about further positive, cumulative effects on flood risk.

21.4.10 Resource and Waste Management

The following residual effects in respect to resource and waste management are as follows:

- The residual effect of excavation waste is expected to be slight, negative and short-term.
- The residual effect of demolition waste is expected to be slight, negative and short-term.
- The residual effect of general construction waste is expected to be imperceptible and short term.
- The residual effect of operational waste is expected to be imperceptible and long term.
- The residual effect of decommissioning waste is expected to be slight negative and short term.

21.4.11 Population and Human Health

21.4.11.1 Construction

There will be a significant residual effect on local businesses such as cafes and restaurants that have a partial dependence on views of the river and amenity use. In addition, residual effects on the amenity of people living beside the river and the proposed interceptor sewer is inevitable. These effects will be temporary in nature and will have been moderated by the proposed mitigation.

No residual effects on human health have been identified during construction of the proposed development.

21.4.11.2 Operation

The provision of wastewater treatment in Arklow town will reactivate the potential for the economic and residential development providing a significant positive residual effect for the community and local economy during operation of the proposed development.

The elimination, in so far as possible, of the discharge of untreated wastewater into the Avoca River will have a significant positive residual effect on water quality and recreational activities associated with the Avoca River, including general tourism and water sports. However, use of the Avoca River for direct contact recreation such as swimming may still be compromised by legacy contamination from historical mining that was undertaken in the upper catchment.

Significant positive effects in terms of public health and socio-economic benefits with resultant benefits for human health are predicted on the basis of having an efficient and adequate wastewater treatment facility operating that is capable of accommodating population growth.

21.4.12 Material Assets

21.4.12.1 Construction

A slight negative long-term effect on existing land-owner's is predicted where land will be permanently acquired to facilitate the proposed development. For areas of temporary land acquisition where compensation will be agreed and which will be reinstated to their original condition as a minimum, it is concluded that there will be no residual significant effects. A slight negative long-term effect on land-use is predicted where land will subject to permanent wayleaves and permanent rights of way in order to facilitate the proposed development.

The residual effects of the proposed development on electricity, telecommunications, gas, water supply, sewer network and drainage infrastructure during construction is not significant.

21.4.12.2 Operation

A slight negative long-term effect on existing land-owner's is predicted where land will be permanently acquired to facilitate the proposed development.

The proposed development is considered to be an improvement over the 'do-nothing' scenario as the redevelopment of a brownfield site at Ferrybank and the removal of dilapidated buildings by the provision of vital infrastructure for Arklow town is considered to be a significant positive long-term residual effect.

A slight negative long-term effect on land-use is predicted where land will be subject to permanent wayleaves and permanent rights of way in order to facilitate the proposed development.

It is anticipated that the residual effects of the proposed development on electricity, telecommunications, gas, water supply, sewer network and drainage infrastructure during operation are not considered to be significant. The proposed development will result in a permanent, positive residual effect on the wastewater network by providing a robust, reliable collection network and treatment capacity that is capable of accommodating anticipated population growth in Arklow town.

21.4.13 Major Accidents and Natural Disasters

The risk of a major accident and/or disaster during the construction and operation of the proposed development is considered 'low' in accordance with the risk evaluation methodology. It is considered that there would no significant residual effects during the construction and operation of the proposed development.

21.5 References

British Standards (2016) *BS6349-5 - Maritime works – Part 5: Code of practice for dredging and land reclamation*

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.*

CIRIA (2015) *Environmental Good Practice on Site Guide, 4th Edition*

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.

IFI (2016) *Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters.*

Masters – Williams et al (2001) *Control and management of water pollution from construction sites in their publication Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors*

NSAI (2015) *IS291:2015 Selection, commissioning, installation, inspection and maintenance of portable fire extinguishers. NSAI (2012) IS EN 671-1:2012: Fixed firefighting systems. Hose systems. Hose reels with semi-rigid hose.*

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*