N4-N15 Sligo Urban Improvement Scheme

Sligo County Council

Environmental Assessment Report Volume 2 of 4: Main Text

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An Roinn Iompair Turasóireachta agus Spóirt
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Sligo County Council

N4-N15 Sligo Urban Improvement Scheme

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Term	Definition
AA	Appropriate Assessment
AADT	Annual Average Daily Traffic (expressed in vehicles per day)
ACA	Architectural Conservation Area
Alluvium	Deposits from a river or stream
Amelioration (of impacts, etc.)	"Ameliorate" means to make less severe or to amend. Impact amelioration proposals suggest ways to improve the negative effects of a project on the environment.
Annual Mean Concentration	The average concentration of a substance over the period of a year.
Aquifer	A subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater.
Archaeology	The study of past societies through its surviving structures, artefacts and environmental data.
Architectural Heritage	Structures, buildings, traditional and designed, and groups of buildings including streetscapes and urban vistas, which are of historical, archaeological, artistic, engineering, scientific or technical interest, together with their setting, attendant grounds, fixtures, fittings and contents.
At-Grade Junction	Road junction at which at least one road meets another at the same level.
BAP	Biodiversity Action Plan
Baseline survey	A description of the existing environment against which future changes can be measured.
BCI	Bat Conservation Ireland
BCT	Bat Conservation Trust
Biotic	Processes which relate to living organisms
BOD	Biochemical Oxygen Demand
BSBI	Botanical Society of British & Ireland
BTO	British Trust for Ornithology
c.	Circa (in approximately)
$CaCO_3$	Calcium Carbonate
CAFE	Clean Air For Europe Directive
Carriageway	That part of the road constructed for use by vehicular traffic.
Catchment	That area determined by topographic features within which falling rain will contribute to run-off at a particular point under consideration.
C&D	Construction and Demolition
CDP	County Development Plan
CF	Community Facilities
CFRAMS	Catchment Flood Risk Assessment and Management Study
CIEEM	Chartered Institute of Ecology and Environmental Management

Term	Definition
CH_4	Methane
CIRIA	Construction Industry Research and Information Association
CMS	Construction Method Statement
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CPO	Compulsory Purchase Order
CRTN	Calculation of Road Traffic Noise
cSAC	Candidate Special Area of Conservation
CSM	Conceptual Site Model
CSO	Central Statistics Office
Cumulative Impact	The addition of many small impacts to create one larger, more significant, impact.
Cutting (Cut)	Section of earthworks where the level of the proposed road is below the original ground level.
dB	Decibels
dB(A)	The term used to express a level of sound or decibel level. The (A) denotes that levels are 'A'-weighted.
DEFRA	Department of Environment, Food and Rural Affairs
dESCP	Detailed Erosion and Sedimentation Control Plan
Design	Design proposals for the proposed road scheme as presented in the Environmental Impact Statement.
DMRB	Design Manual for Roads and Bridges.
DMURS	Design Manual for Urban Roads and Streets.
DO	Dissolved Oxygen
"Do-Minimum" Scenario	The situation or environment that would exist if minimal intervention or development were carried out.
"Do-Something" Scenario	The situation or environment that would exist if the proposed road development is implemented.
DoEHLG	Department of Environment, Heritage and Local Government.
EAR	Environmental Assessment Report
EC	European Commission
ECoW	Ecological Clerk of Works
EEA	European Economic Area
EEV	Enhanced Environmentally-friendly Vehicle
EFO	Environmental Fisheries Officer
EGB	Eastern Garavogue Bridge
Embankment	A bank or mound constructed to carry a roadway at a level higher than the original ground level.

Term	Definition
EIA	Environmental Impact Assessment - The process of examining the environmental effects of the proposed road development - from consideration of environmental aspects at design stage through to preparation of an Environmental Impact Statement, evaluation of the EIS by the competent authority and the subsequent decision as to whether the development should be permitted to proceed, also encompassing public response to that decision.
EQS	Environmental Quality Standards
EIS	Environmental Impact Statement-A statement of the likely significant effect, if any, which the proposed development, if carried out, is likely to have on the environment.
EOP	Environmental Operating Plan
EPA	Environmental Protection Agency
EQS	Environmental Quality Standard
Estuarine	Environment associated with semi-enclosed coastal body of water which has a free connection with the open sea and where fresh water, derived from land drainage, is mixed with sea water.
ESB	Electricity Supply Board
eTen	European Telecommunications Network
ETS	Emissions Trading System
EU	European Union
Fauna	A collective term for the animals of a region.
Fill	Material used for raising the level of the ground.
Flora	A collective term for the plants of a region.
Fluvial	Pertaining to a river
FRA	Flood Risk Assessment
g/m^3	Grams per metre cubed
GAC	Generic Assessment Criteria
GDP	Gross Domestic Product
GES	Good Ecological Status
GHG	Greenhouse Gases
GPA	Guidelines for Planning Authorities
Grade / Gradient	Slope along any length of road
GSI	Geological Survey of Ireland
GWDTE	Groundwater Dependent Terrestrial Ecosystem
ha	Hectares = 10,000 square metres.
HA	Highways Agency
HA DMRB	Highways Agency Design Manual for Roads and Bridges
HAWRAT	Highways Agency Water Risk Assessment Tool
HGV	Heavy Goods Vehicle

Term	Definition
HMWB	Heavily Modified Water Bodies
Horizontal Alignment	Direction and course of the roadway on a plan.
HRA	Hot Rolled Asphalt
HSE	Health Service Executive
Hydrocarbons	A compound of hydrogen and carbon, such as any of those which are the chief components of petroleum and natural gas.
IAN	Interim Advice Note
IFI	Inland Fisheries Ireland
Impact	The degree of change in the environment resulting from a proposed road development.
Impact Interactions	The reactions between impacts on different environmental factors, whether between the impacts of just one project or between the impacts of the other projects in the area.
Imperceptible Impact	An impact capable of measurement but without noticeable consequences.
Indirect Impact	Impacts on the environment which are not a direct result of the project, often produced away from the project or as a result of a complex pathway.
Infrastructure	Basic public facilities e.g. roads, sewers, water supply, telephones and electricity.
IPPC	Integrated Pollution Prevention and Control
IUCN	International Union for Conservation of Nature and Natural Resources
IWeBS	Irish Wetland Bird Survey Data
KER's	Key Ecological Receptor's
kph	Kilometres per hour
l/s	Litres per second
Landtake	Land required for the construction of the proposed new road. The area of land between the fence lines.
L_{den}	The day-evening night composite noise indicator adopted by the EU for the purposes of assessing overall annoyance.
L_{eq}	Equivalent continuous steady sound level. Effectively an average value.
LI	Locally Important
Long-Term Impact	Impact lasting twenty to fifty years
m/s	Metres per second
m^3/s	Metres cubed per second
Medium-Term Impact	Impact lasting seven to twenty years
Methodology	The specific approach or techniques used to analyse impacts or describe environmental features and conditions.
Method Statement	A document outlining the work task or process to be completed, along with the potential hazards involved and mitigation measures to reduce or avoid risk.

Term	Definition
mg/l	Milligrams per litre
mg/m^2/day	Milligrams per metre squared per day
mg/m^3	Milligrams per metre cubed
Mitigation	Measures designed to avoid, reduce, remedy or compensate for adverse impacts
Mitigation Measures	The manner by which a proposed road development is modified to avoid, reduce or remedy anticipated adverse environmental effects.
MIX	Mixed Use
Moderate Impact	An impact that alters the character of the environment in a manner that is consistent with the existing and emerging trends.
MOTR	Mineral Oils Tax Relief
N	Nitrogen
National Roads Project Management Guidelines	The National Road Authority's Guidelines for the management of the planning and implementation of national road schemes.
NBDC	National Biodiversity Council
Negative Impact	A change which reduces the quality of the environment (for example, by lessening species diversity and the reproductive capacity of the ecosystem, by damaging health, property or by causing nuisance).
Neutral Impact	A change which does not affect the quality of the environment.
NECD	National Emissions Ceiling Directive
NH_3	Ammonia
NHA	Natural Heritage Area
NIAH	National Inventory of Architectural Heritage
NIS	Natura Impact Statement
NMU	Non-Motorised User
NO_2	Nitrogen Dioxide
NOX	Oxides of Nitrogen
NPWS	National Parks and Wildlife Service
NRA	National Roads Authority
NSS	National Spatial Strategy
NTM	National Traffic Model
NTS	Non-Technical Summary
NTS (in relation to drawings)	Not to scale
N_2O	Nitrous oxide
OPW	Office of Public Works
OS	Open Space
OSI	Ordnance Survey
P	Phosphorus

Term	Definition
Pavement	Road structure - includes the road surface and the underlying structural layers.
PCU	Passenger car units
Permanent Impact	Impact lasting over fifty years
pESCP	Preliminary Erosion and Sedimentation Control Plan
PM	Particulate Matter
pNHA	Proposed Natural Heritage Area
Positive Impact	A change which improves the quality of the environment (for example, by increasing species diversity and the reproductive capacity of the ecosystem, or by removing nuisances or improving amenities).
Profound Impact	An impact which obliterates all previous characteristics.
PP	Pollutant Pathways
PPE	Personal Protective Equipment
PPV	Peak Particle Velocity
QI	Qualifying Interest
RBD	River Basin District
RBMPs	River Basin Management Plans
RE	Commercial Residential
Receptor	Any element in the environment which is subject to impacts.
Residual Impact	The degree of environmental change that will occur after the proposed mitigation measures have taken effect.
Return Period	The frequency with which a certain event would be expected to occur on average over a long period of record.
RFCs	Ratios of flow to capacity
RMP	Record of Monuments and Places
Road Alignment	The geometric layout of the road (see horizontal alignment and vertical alignment). Refers to the direction and course of the roadway.
Road Network	Description (often in diagrammatic form) of a system of roadways
Route	The chosen route for which this EAR has been prepared
Route Corridor	Broad area of land considered at the initial design stage of a route within which the final roadway will eventually be sited.
RPGs	Regional Planning Guidelines
RSA	Road Safety Authority
SAC	Special Areas of Conservation
SATURN (Traffic Model)	Simulation and Assignment of Traffic to Urban Road Networks
SCC	Sligo County Council
Scope / Scoping	The process of identifying the significant issues (scope) which should be addressed by a particular Environmental Impact Statement.

Term	Definition
Sensitivity	The potential of a receptor to be significantly impacted.
Services	The conduits, pipes and lines that carry water, telephones, electricity, sewage, etc.
Severance	A term used to describe the possibility that a development may disrupt activities or movements in an area or divide an area, community, etc. in an adverse manner.
Short-Term Impact	Impact lasting one to seven years
S.I.	Statutory Instrument
Significance	The sensitivity of the environment to change or the consequence of change for the receiving environment.
Significant Impact	An impact which, by its magnitude, duration or intensity alters an important aspect of the environment.
Slight Impact	An impact which causes changes in the character of the environment which are not significant or profound.
Slip Road	Length of one-way road at a junction that connects roads usually at different levels.
SMR	Sites and Monuments Record
SO_2	Sulphur Dioxide
SPA	Special Protection Area
Spring	A flow of water that occurs where the water table intercepts the ground surface.
Statutory Consultees	Organisations and authorities stipulated by legislation (in Acts and Regulations) that are to be sent a copy of the scheme environmental impact statement, together with a notice in the prescribed form stating that the road authority has made an application to An Bord Pleanála for an approval of the proposed road development.
Statutory Instrument	An order, regulation, rule, scheme or bye-law made in exercise of power conferred by statute.
Summary of Mitigation Measures / Environmental Commitments	A list of all the environmental mitigation measures that the road authority proposes to undertake in conjunction with the construction of the scheme.
Temporary Impact	An impact which is not permanent or lasting
TEN-E	Trans-European Energy Network
TENs	Trans-European Networks
TEN-T	Trans-European Transport Network
TFS	Transfrontier Shipment
TII	Transport Infrastructure Ireland
TSAS	Trophic Status Assessment Scheme
TSS	Total Suspended Solids
TUBA	Transport User Benefits Appraisal
UIS	Urban Improvement Scheme

Term	Definition
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
Unsaturated zone	The zone between the land surface and the water table, in which pores and fissures are only partially filled with water. Also known as the vadose zone.
Verge	Strip adjacent to and abutting the hard shoulder of carriageway of a road - usually grassed.
Vertical Alignment	Direction and course of the roadway in profile
VOCs	Volatile Organic Compounds
Water Table	The surface at which pore water pressure in an aquifer is equal to atmospheric pressure, and which separates the saturated zone from the unsaturated zone.
WeBS	Wetland Bird Survey
WFD	Water Framework Directive
WHO	World Health Organisation
WMU	Water Management Unit
WTF	Water Transfer Form
ZoI	Zone of Influence
99.8th Percentile Flow	The flow rate (expressed in m^3/s) at a given location on a river which over the long-term is equalled or exceeded 98.8% of the time.
$\mu g/m^3$	Micrograms per metre cubed

1. Introduction & Need for the Proposed Road Development

1.1 Introduction

Sligo County Council (SCC) has developed proposals for the improvement of a section of the N4 and N15 national road corridor on the northwestern extents of Sligo City. The design of the N4-N15 Sligo Urban Improvement Scheme (Sligo UIS), hereafter referred to as "the proposed development", has been developed in the preparation of the environmental assessment of the proposed development and to establish land take requirements. The study area includes the interface of the N4, N15 and N16 national primary routes; the proposed development is therefore located on a strategic transport link connecting Sligo with Donegal to the north, Leitrim and Northern Ireland to the east and Dublin and the remainder of the national road network to the south. The location of the proposed development, in the context of its location relative to the N4-N15 route corridor and Sligo City urban area, is shown in Figure 1.1 of Volume 3 of this Environmental Assessment Report (EAR), while a full description is provided in Chapter 2.

This EAR has been prepared on behalf of Sligo County Council by Jacobs Engineering Ireland Ltd. ("Jacobs") as lead consultant, with additional specialist input from sub-consultants and individuals for the aspects outlined in Table 1-1 below. It presents a statement of the likely notable effects on the environment of the proposed development and includes a description of the measures envisaged in order to avoid, reduce and where appropriate, mitigate and remedy any identified significant adverse effects.

Table 1-1: Specialist Sub-consultant Inputs

Aspect	Sub-Consultant	Further Sub-Consultant	Detail
Flora & Fauna and Natura Impact Statement	Scott Cawley Ltd. Ecofact	-	Bats Aquatic Ecological and Lamprey Assessment
Air Quality & Climate	AWN Consulting	-	-
Noise & Vibration	AWN Consulting	-	-
Landscape & Visual	Brady Shipman Martin	-	-

The EAR documents have been subdivided into the following four volumes for ease of use:

1) Volume 1: Non-Technical Summary;
2) Volume 2: Main Text;
3) Volume 3: Figures; and
4) Volume 4: Appendices.

The remainder of this Chapter 1 is set out as follows:

- 1.2 Existing Situation;
- 1.3 Need for the Scheme;
- 1.4 Integration with Policy Objectives;
- 1.5 Scheme Objectives;
- 1.6 Public Consultation; and
- 1.7 Legislative Requirement for an EIA.

1.2 Existing Situation

The proposed development is located in the northwest of Sligo City. It extends for approximately 670 m from a point just north of Hughes Bridge, the westernmost crossing of the Garavogue River, to a point just north of the junction of the N15 with the R291 Rosses Point Road. It consists of approximately 300 m of the northernmost section of the N4 between Hughes Bridge and the junction with the N16, after which it continues for a further 370 m as the southernmost section of the N15. The N16 national primary route commences at the N16 Duck Street junction and extends to the east. The proposed development thus includes the interface of three roads that provide national road connectivity between Sligo and the wider national road network including the northwest, Northern Ireland and Dublin.

The existing section of road is a suburban all-purpose road. The N4 Sligo Inner Relief Road, which was opened in 2005, provides a high capacity dual carriageway link from the national road network to the south, through the western section of Sligo City as far as Hughes Bridge. The capacity of the route corridor was further increased in 2015 with the upgrade of Hughes Bridge which involved widening the bridge to provide three general lanes in each direction and improved Non-Motorised User (NMU) facilities. The proposed development will serve to extend the increased traffic capacity and NMU facilities further north from Hughes Bridge to north of the R291 Rosses Point Road junction.

Within the proposed development study area there are three signalised junctions; from south to north these are:

1) R870 Markievicz Road: intersects the N4 providing direct access to Sligo city centre, Sligo north and other local facilities such as Sligo General Hospital;
2) N16 Duck Street: this junction forms the intersection of the N4, N15 and N16 routes. The N16 commences at this junction heading east and continues on to the northeast of Sligo towards Enniskillen and Northern Ireland; and
3) R291 Rosses Point Road: this regional road branches off the proposed development to the west, at the northern end of the proposed development and provides access to Rosses Point some 7.5 km northwest of the junction.

There are footpaths on both sides of the road along the extent of the proposed development with crossing opportunities for pedestrians at each junction although these are confined, along the mainline, to one arm at each of the junctions. As part of the Hughes Bridge upgrade, a 3 m wide shared pedestrian and cyclist facility was incorporated along the length of the bridge in both directions. This shared facility continues into the proposed development study area adjacent to the southbound carriageway for approximately 50 m up to the Markievicz Road junction.

The Salmon Point amenity area is a former public swimming pool which has been converted to a landscaped public amenity space which is accessible all year round and occasionally hosts art projects and other such events. It lies adjacent to the proposed development at the R870 Markievicz Road junction.

The proposed development lies on the Atlantic Corridor which is a proposed road corridor to connect Waterford to Letterkenny via Cork, Limerick, Galway and Sligo. The Wild Atlantic Way is a long-distance tourism and leisure route which extends from Kinsale in Cork to Malin Head in Donegal. This route passes through the proposed development from the south before turning westwards along the R291 Rosses Point Road.

As well as being part of the strategic national road network, the proposed development will also cater to local traffic in terms of its proximity to Sligo City, Sligo General Hospital, Sligo Institute of Technology and the various pharmaceutical facilities and business parks in the wider vicinity.

There is one primary structure along the proposed development. The Copper River Bridge (also known as Rathquarter Bridge) is a twin masonry arch barrel which has been previously extended via twin steel corrugated pipes. The masonry arch structure, on the western side, supports the left slip road onto the R291 Rosses Point Road, while the N15 mainline passes above the two steel corrugated culverts.

The Copper River traverses the study area whilst the Garavogue River/Estuary runs directly to the south. Sligo Harbour and the Garavogue Estuary are directly adjacent to the west. The proposed development sits adjacent to and partially within the following designated sites. For further details see Volume 3, Figure 5.1.

1) Cummeen Strand Special Protection Area (SPA) to the west;
2) Cummeen Strand / Drumcliff Bay candidate Special Area of Conservation (sSAC) to the west and south; and
3) Cummeen Strand / Drumcliff Bay proposed Natural Heritage Area (pNHA) to the west and south.

A Health Service Executive (HSE) facility is located directly adjacent to the east and Markievicz House, a protected structure, is located there.

1.3 Need for the Scheme

1.3.1 History

The road improvement aspirations along the N4-N15 route corridor follow on from the implementation of the N4 Sligo Inner Relief Road in 2005, a 4.5 km dual carriageway that extends from the Carraroe roundabout south of Sligo to Hughes Bridge. The primary objective of the N4 Inner Relief Road was to remove traffic from the most congested streets in the town centre; after implementation, the scheme was found to have provided considerable benefits to Sligo in terms of traffic volume reductions on congested city centre streets and improved access to Sligo and its environs.

The section of road proposed development has been part of two previous road development projects which were progressed in recent years to improve the N4-N15 route corridor. In 2006, a preferred route was selected and approved by SCC for the “N4-N15 Sligo to County Boundary” realignment scheme. This project included the widening of Hughes Bridge and the construction of 26 km of dual carriageway running from Hughes Bridge to the Leitrim county boundary to the north. The preliminary design, EIS and Compulsory Purchase Order (CPO) for that scheme were prepared however approval to publish and advance the scheme further was not granted by the funding agency, the National Roads Authority (NRA), which has since become Transport Infrastructure Ireland (TII), due to funding constraints in place at that time. This project ran from 2006 to 2011 and, while the road development remains an objective of SCC, there are no plans to undertake any further work on this scheme at this time.

In 2011, SCC proposed the “N4-N15 Sligo to Borough Boundary” scheme, a truncated version of the N4-N15 Sligo to County Boundary realignment scheme. This reduced scheme would also commence at, and include, Hughes Bridge but would terminate at the Sligo Borough administrative boundary. This scheme was some 1.6 km in length. The preliminary design, EIS and CPO was finalised in 2011 however the EIS and CPO were not published, the project was has not been progressed any further and, while the road development remains an objective of SCC, there are no plans to undertake any further work on this scheme at this time.

In 2012, SCC received approval from the NRA to progress the design and planning process for the Hughes Bridge widening element of the N4-N15 Sligo to Borough Boundary scheme. Following the successful granting of Part 8 planning permission in January 2013, funding to construct the scheme was approved in 2014. Construction of this scheme was completed in mid-2015.

Also in 2015, Transport Infrastructure Ireland (TII) requested SCC to progress the planning, design and preparation of the required environmental assessments and CPO for the proposed development running from north of Hughes Bridge to north of the R291 Rosses Point Road junction, a distance of some 580 m. The proposed development is now therefore being developed as a stand-alone project to address the ongoing traffic congestion, junction capacity and road safety issues at this location. In 2015, Jacobs was appointed by SCC to progress the design of the proposed development including the environmental assessments, CPO, planning and statutory approvals, construction supervision and contract administration through to the handover of works.

1.3.2 Safety

Using the most recent statistics available, between 2005 and 2013 there were eighteen collisions within the study area, one of which was serious in nature whilst the remainder were minor. The majority of accidents occurred at the N16 Duck Street junction as can be seen from Image 1.1 below taken from the Road Safety Authority database.

Image 1.1: RSA collision database

Further examination of these project specific accident statistics shows that pedestrian and car accidents are the most dominant types of collisions occurring with the study area. Approximately 70% of same were minor car shunt type accidents which represent the greatest proportion of incidents. Pedestrian accidents represent approximately a 15% contribution to the subject statistics. Improving motorised and non-motorised road safety is therefore a priority and one of the key objectives of the proposed development.

The design of the proposed development has been developed to take into account these accidents and their likely apparent causes, based on the accident information available. Such specific proactive mitigation measures include the incorporation of off-road shared and segregated pedestrian and cycle facilities which represents a significant improvement compared to the existing level of provision for non-motorised and vulnerable road users. Further design measures include enhanced traffic movements as a result of increased capacity and more efficient traffic signal phasing, creating an overall improved traffic operating environment. Overall, the proposed development seeks to significantly address and / or mitigate the root causes for approximately 85% of the previous accidents recorded within its extents.

1.3.3 Traffic

At present, traffic congestion is experienced along the route corridor during the AM and PM peak hours. The lack of stacking capacity of right turn lanes leads to blocking back from junctions that impact the overall operation of the route corridor. In particular, the right turning traffic from the N4 northbound to the N16 eastbound in the AM peak causes queued vehicles to extend back across the recently upgraded Hughes Bridge.

In addition, limited pedestrian infrastructure, coupled with “all-red” pedestrian stages which are inefficient for traffic, combine to reduce traffic capacity at the junctions and provide limited pedestrian provision.

Reducing traffic congestion is a primary objective of the proposed development. Associated socio-economic benefits such as improved journey times in tandem with environmental benefits like improved air quality and noise pollution can also be realised as a direct result of a local road improvement such as the proposed development.

In short, the proposed development seeks to promote and prioritise more sustainable and safer modes of travel by providing, for example, off-road shared and segregated pedestrian and cycle facilities for shorter trips. Similarly, it endeavours to deliver reduced, more reliable journey times for general traffic, particularly during peak commuting times, through increased capacity and more efficient traffic signal phasing. The overall objectives of the original N4 Sligo Inner Relief Road are consistent with those of the proposed development, in that the provision of an efficient, reliable traffic route will facilitate reduced traffic and increased opportunities for more sustainable modes of transport within the city centre with its high pedestrian and cyclist flows.

To determine the optimum solution from a traffic perspective, macro and micro simulation traffic modelling was undertaken for a number of route option scenarios, detailed further in Chapter 2 and Chapter 3.

1.4 Integration with Policy Objectives

The rationale for the proposed development can be viewed in the context of national, regional and local policies and requirements. This section looks at how the proposed development meets the needs and aims of these various policies.

1.4.1 Strategic & Regional Need

1.4.1.1 Trans-European Transport Networks

The Trans-European Transport Networks (TEN-T) are a planned set of road, rail, air and water transport networks within the European Union. The TEN-T networks are part of a wider system of Trans-European Networks (TENs), including a telecommunications network (eTEN) and a proposed energy network (TEN-E or Ten-Energy). The European Commission adopted the first action plans on trans-European networks in 1990.

TEN-T envisages coordinated improvements to primary roads, railways, inland waterways, airports, seaports, inland ports and traffic management systems, providing integrated and intermodal long-distance, high-speed routes. A decision to adopt TEN-T was made by the European Parliament and Council in July 1996. The EU works to promote the networks by a combination of leadership, coordination, issuance of guidelines and funding aspects of development. The N4 and N15 are both strategic national primary routes in Ireland and form part of the comprehensive Trans-European Road Network.

1.4.1.2 Building on Recovery: Infrastructure and Capital Investment Plan 2016 – 2021

The Infrastructure and Capital Investment Plan was announced by the Government in September 2015 and was the first major capital expenditure plan in the aftermath of the economic downturn after 2008. The plan consists of €27 billion worth of investment in the state sector over the period 2016 to 2021. Image 1.2 below illustrates the projected sectoral share of the capital investment taken from that document.

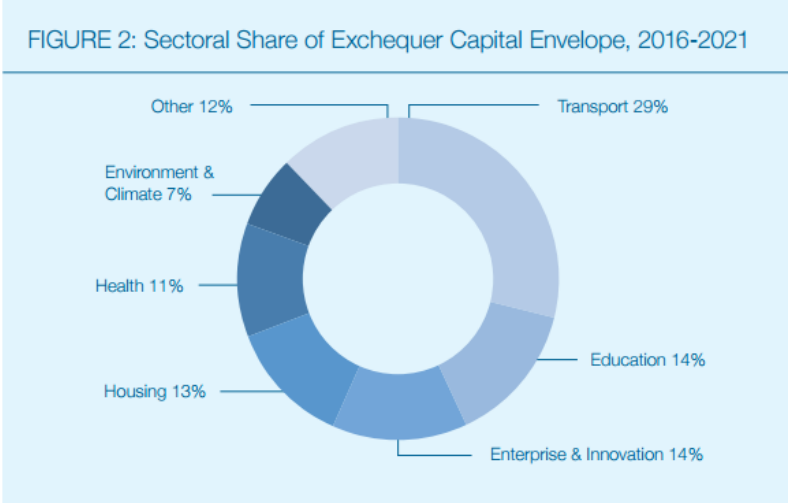

Image 1.2: Sectoral Share of Capital Investment Funding, Infrastructure and Capital Investment Plan, Department of Public Expenditure and Reform 2015

Reflecting the fact that a significant minority (29%) of the stimulus funding is due to be spent on transport, the plan recognises that *"economic growth is dependent on our capacity to move people and goods into and around the country quickly and easily"* and that *"It is essential that road, rail and public transport networks are developed and maintained to the standard required to ensure the safe and efficient movement of people and freight".* In particular, some €6 billion has been allocated to upgrading and improving the road network which specifically includes the Eastern Garavogue Bridge and its associated approach roads in Sligo.

1.4.1.3 National Spatial Strategy for Ireland 2002-2020

The National Spatial Strategy (NSS) for Ireland 2002-2020 is a twenty year planning framework designed to achieve a better balance of social, economic and physical development and population growth between regions. Its focus is on people, places and building communities. It considers that through closer alignment of residential development with employment centres, different parts of Ireland will for the future be able to sustain an improved quality of life, a strong, competitive economic position and an environment of the highest quality.

The NSS is:

- "National – it provides a national framework to guide policies, programmes and investment;
- Spatial – it is concerned with the location of people, their work and other activities and with how different places relate to each other; and
- Strategic – it offers a long-term, comprehensive twenty-year view for achieving more balanced patterns of development."

Section 3.1 of the NSS states that the strategy "*sets out how Ireland can be spatially structured and developed over the next twenty years in a way that is internationally competitive, socially cohesive and environmentally sustainable…by targeting strategic centres with the potential to be drivers of development at national level and within their own regions, and by including county towns, smaller towns, villages and rural areas in this process, a dynamic urban and rural structure can be achieved*". Having regard to the existing national road network, the NSS states that "*Improvements will be needed in the quality of connections between cities and towns which are developing as linked-centre gateways or developments hubs*".

Within the plan, Sligo is identified as a national level Gateway town and it is recognised that the urban structure in the northwest of Ireland is weak and would benefit from being strengthened. To achieve this, the NSS proposes to capitalise upon the standing of Sligo in the region and its strategic location in a regional and national context.

In relation to transport the NSS recognises that in order to support balanced regional development, Ireland's transport networks must:

- Build on Ireland's radial transport system of main roads and rail lines connecting Dublin to other regions, by developing an improved mesh or network of roads and public transport services;
- Ensure, through building up the capacity and effectiveness of Ireland's public transport networks, that increases in energy demand and emissions of CO_2 arising from the demand for movement are minimised;
- Allow internal transport networks to enhance international access to all parts of the country, by facilitating effective interchange possibilities between the national transport network and international airports and sea ports; and
- Address congestion in major urban areas by increasing the use of public transport.

Map 3 of the NSS, displayed in Image 1.3 below, illustrates the key role the Gateway of Sligo plays at the convergence of a strategic radial corridor and two strategic linking corridors.

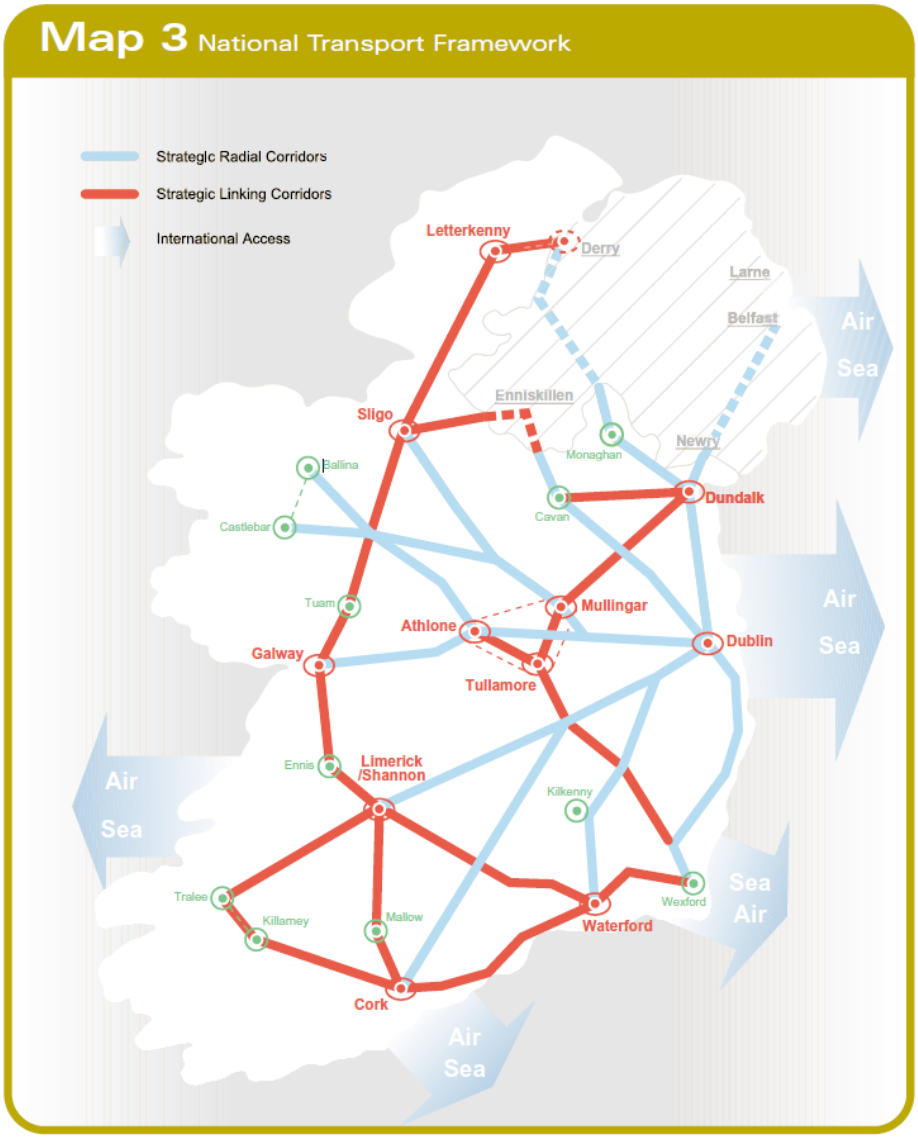

Image 1.3: NSS National Transport Framework

Within the NSS, strengthening the relationship and connectivity between Sligo and Letterkenny / Derry in their context as "Gateways" in the border region is highlighted. The proposed development will play an important role

in this by increasing traffic capacity and journey time reliability on the N4-N15 route corridor and reducing traffic congestion, thereby both reducing travel times and improving journey time reliability between the two gateways.

To build on the existing radial transport network which gravitates towards Dublin, the NSS encourages the development of a Western Corridor to provide for "*improved road and Dublin transport connections between gateways and hubs from Cork to Derry (via Limerick, Galway and Sligo)".* Sligo has a role to play in improving transport connectivity along this corridor; developing those parts of the national road network where capacity is limited clearly supports this aim.

A new National Planning Framework is currently being developed by the Government which will supersede the NSS.

1.4.1.4 The Northern & Western Regional Assembly: Regional Planning Guidelines (2010-2022)

The Regional Planning Guidelines were developed to provide a long term strategic planning framework for the development of the region which comprises the counties of Donegal, Sligo, Leitrim, Cavan, Monaghan and Louth. In the spatial development hierarchy the Regional Planning Guidelines (RPGs) help to inform and focus local policy whilst incorporating the themes and objectives set out at a national level. The RPGs reflect the importance of the Western Corridor between Sligo and the linked gateway of Letterkenny-Derry which has seen substantial population increases in recent years.

The designation of Sligo as a Gateway City in the NSS emphasises the importance of strong and strategic transport links to urban centres in the Border Region, along the Atlantic Corridor and beyond regional and national boundaries. The Border RPGs specifically support the development of a number of strategic routes in order to ensure Sligo's success as a Gateway, including all national roads and rail links.

Within its infrastructural proposals, the RPGs highlight the current issue with congestion on the N4 Inner Relief Road in Sligo at peak times, to the south of the proposed development. The limited number of crossing points of the Garavogue River is also highlighted as a constraint on north-south traffic in general in the Sligo area. Upgrading of the N4-N15 within the former Sligo Borough administrative area is identified as an immediate priority for the Sligo Gateway in order to address these congestion issues and allow Sligo to operate more efficiently in the context of its function as a gateway town of national importance. Policy INFP3 states "*Facilitate and support the improvements identified to address particular infrastructural bottlenecks / weaknesses within the Gateways*" whilst INFP4 aims to *"Protect the carrying capacity of all Strategic Radial Corridors and Strategic Links including all National Primary and relevant National Secondary routes, through the restriction of new accesses and intensification of existing accesses".* The proposed development closely aligns with both of these policies. These RPGs will remain in force until 2016 when they will be replaced with the Regional, Spatial and Economic Strategy.

1.4.1.5 Smarter Travel, 2009

Smarter Travel, A Sustainable Transport Future, is defined as the transport policy for Ireland for the period 2009-2020. The policy recognises the vital importance of continued investment in transport to ensure an efficient economy and continued social development, but it also sets out the necessary steps to ensure that people are facilitated in choosing more sustainable transport modes such as walking, cycling and public transport. The policy is a response to the fact that continued growth in demand for road transport is not sustainable from a number of perspectives: it will lead to further congestion, further local air pollution, contribute to global warming, and result in negative impacts to health through increasingly sedentary lifestyles. Chapter 3 of the policy document in relation to Smarter Travel, outlines the Key Goals of the initiative as follows:

- Improve quality of life and accessibility to transport for all and, in particular, for people with reduced mobility and those who may experience isolation due to lack of transport;
- Improve economic competitiveness through maximising the efficiency of the transport system and alleviating congestion and infrastructural bottlenecks;
- Minimise the negative impacts of transport on the local and global environment through reducing localised air pollutants and greenhouse gas emissions;

- Reduce overall travel demand and commuting distances travelled by the private car; and
- Improve security of energy supply by reducing dependency on imported fossil fuels.

The second Key Goal in particular, as defined within the policy document in relation to alleviating congestion and infrastructure bottlenecks, aligns with the ambitions of the proposed development.

1.4.1.6 Road Safety Authority, Road Safety Strategy, 2013-2020

The Road Safety Strategy seeks to reduce the number of fatalities and injuries on our roads through a number of specific objectives covering the areas of road safety education, enforcement and engineering. With regard to engineering, it acknowledges that there are frequent issues raised by road users in relation to unsatisfactory road design including cycle lane and junction design. The proposed development addresses this area of concern through the provision of high-quality, coherent off-road cycle facilities that provide a significantly improved level of segregation within the proposed development. The revised junction layouts provide an improved operating environment for vehicular traffic and the proposed design seeks to address the causes of previous road accidents that have taken place within the extents of the proposed development over previous years.

1.4.2 Specific Local Need

1.4.2.1 Sligo County Development Plan 2011-2017

Sligo functions as the major transportation node in the North-West. The city is located at the end of the national primary road N4 connecting Sligo with Dublin via Mullingar and Longford. Other primary and secondary roads link Sligo with Galway, Belfast, Letterkenny / Derry and other urban centres.

In accordance with the vision for County Sligo, in addition to strengthening the County's strategic transport links, it is the aim of the Sligo County Development Plan (CDP) to support the creation of a pedestrian-friendly and cyclist-friendly environment in the County's settlements, with a good provision of public transport, reduced congestion and attractive town and village centres which are not dominated by the car.

Sligo City occupies a strategic position in the region, at the crossroads of three national primary routes, i.e. the N4, N15 and N16. The CDP acknowledges this and aims to protect the capacity of national roads so that they can continue to operate as efficient transport corridors in the context of long term growth in national strategic traffic. Objective O-NR-1 aims to carry out ten improvement schemes to national primary and secondary routes, one of which includes the Sligo to Borough Boundary scheme, the extents of which the proposed development is located within.

Objective O-CW-3, meanwhile, aims to "*plan and make provision for the safe and efficient movement of pedestrians and cyclists in and around built up areas*" through the provision of high quality, segregated pedestrian and cyclist facilities within the study area where possible. The proposed development includes high quality off road cycle and pedestrian facilities as well as improved pedestrian crossings.

SCC has given notice that it is currently reviewing the existing Sligo County development plan and is preparing a new Sligo County Development Plan for the period 2017-2023. The pre-draft consultation for the plan ran from 15th May 2015 to 10th July 2015.

1.4.2.2 Sligo and Environs Development Plan 2010-2016

The Sligo and Environs Development Plan was published in 2010 and is intended to guide development in Sligo City and its Environs between 2010 and 2016. The plan was developed through cooperation between, and prior to the amalgamation of, Sligo County Council and Sligo Borough Council.

In the plan it is a strategic objective (T1.1) to upgrade and realign the N4-N15, from Hughes Bridge to Sligo / Leitrim boundary, including the upgrading of the N16 from the N4-N15 junction to Duck Street roundabout on the N16. A road improvement objective (T3.17) also exists within the plan to realign, upgrade and widen the R291 Rosses Point Road.

1.5 Scheme Objectives

The main objectives of the proposed development are to:

- To improve capacity in the road network to cater for existing and future traffic; and
- To improve road safety and reduce accidents.

The proposed development originates due to concerns regarding deficiencies in the existing road network in terms of capacity and safety. Its development is supported by national, regional and local government policy. Its objectives are furthermore consistent with those of the N4 Sligo Inner Relief Road which sought to remove traffic from the congested city centre and improve access to Sligo and its environs.

The proposed development will provide an appropriate level of service for all modes including improved facilities for pedestrians and cyclists, which will lead to associated improvements in overall road safety. This will have a positive net benefit to the regional and national economy and wider community in terms of savings on time, fuel and improved safety and community health benefits. The provision of the proposed development as part of a modern and efficient transport network will facilitate continued economic development of the area by maintaining strong connectivity between Sligo and the wider strategic national road network.

1.6 Consultation

1.6.1 Previous Public Consultations

A road improvement that incorporated the study area was previously progressed through the initial phases of the planning process under the N4-N15 Realignment Sligo to County Boundary scheme. A number of separate public consultations have previously been undertaken at the following times for that wider scheme, of which the proposed development forms part:

- Public Consultation April / May 2004;
- Public Consultation September / November 2004; and
- Public Consultation February to April 2005.

1.6.2 Statutory Consultees

The following consultees were contacted in October 2015 to request any additional information that they would be able to provide relevant to the proposed development, including any environmental issues or other factors that they felt should be considered as the Environmental Assessment was developed. The following consultees were contacted as they represent a wide cross-section of areas of interest in relation to the proposed development:

- Department of Arts, Heritage, Regional, Rural and the Gaeltacht Affairs;
- The Arts Council;
- Geological Survey of Ireland;
- The Botanical Society of Britain and Ireland;
- An Taisce;
- The Heritage Council;
- Badgerwatch Ireland;
- Woodlands of Ireland;
- National Botanic Gardens;
- Bat Conservation Ireland;
- Department of Housing, Planning, Community and Local Government;

- BirdWatch Ireland;
- Coillte;
- Office of Environmental Assessment (Sub-office of the Environmental Protection Agency);
- Irish Wildlife Trust;
- Office of Public Works;
- Teagasc;
- Irish Farmers Association;
- Tourism Ireland;
- Tree Council of Ireland;
- Fáilte Ireland;
- Department of Agriculture, Food and the Marine;
- Health & Safety Authority;
- Royal Irish Academy;
- Bord Na Mona;
- Inland Fisheries Ireland;
- Department of Communications, Climate Action and Environment;
- Waterways Ireland;
- Sligo Borough Council; and
- National Parks and Wildlife Services.

1.7 Legislative Requirement for an EIA

An Environmental Impact Assessment (EIA) Screening Report was prepared for the proposed development, the purpose of which was to identify the legal requirement or otherwise for an EIA. The EIA Screening Report documented the methodology applied during the screening of the proposed development, with reference to relevant legislation and guidance documents, see Appendix 1.1. The EIA Screening Report concluded that the proposed development did not require EIA. Therefore this EAR has been produced in line with TII guidelines to assess the potential environmental impact of the proposed development.

2. Description of the Proposed Development

2.1 Location

The proposed development is situated north of the Garavogue River to the northwest of Sligo City centre. It extends over a distance of approximately 670 m along the N4-N15 route corridor from a point just north of Hughes Bridge to a point just north of the N15 / R291 Rosses Point Road junction. The extent of the study area and its location in a wider context is shown in Figure 1.1, Volume 3.

2.2 Existing Carriageway Details

The existing carriageway comprises an urban two lane dual carriageway with additional right turning lanes at each of the three signalised junctions along the proposed development. The road is subject to a 50 km/h speed limit throughout the study area. Footways are provided on both sides of the road directly adjacent to the carriageway with no buffer zones. There is currently no dedicated cycling infrastructure within the proposed development extents.

Travelling northbound from the southern extent of the proposed development, i.e. from the northern end of Hughes Bridge, there are two northbound lanes, and a right turning lane for R870 Markievicz Road-bound traffic which is 36 m in length. The two straight ahead lanes continue north to the next junction where another right turning lane develops for N16 Duck Street traffic. This right-turning lane develops approximately 125 m after the R870 Markievicz Road junction and has significantly more storage capacity, being 90 m in length. At this point the designation of the mainline changes from the N4 to the N15, although there is no change in the road cross section. Having passed through the N16 Duck Street junction a left slip road develops which provides for left turn movements onto the R291 Rosses Point Road. Again, two lanes continue straight ahead through the junction. Approximately 110 m beyond the junction, the N15 reverts to single carriageway with the offside lane merging back into the nearside lane.

Travelling southbound from the northern end of the study area, the road commences as a single carriageway that develops into a dual carriageway approximately 50 m north of the R291 Rosses Point Road junction. The nearside lane is for traffic travelling straight ahead whilst the offside lane is shared between straight-ahead and right-turning traffic. These two lanes continue through the junction with a left turn slip lane developing approximately 50 m south of the Rosses Point Road junction for traffic bound for the N16 Duck Street. At the N16 Duck Street junction, two straight ahead lanes continue southbound onto the N4. Upon exiting the N16 Duck Street junction, a left turn slip lane from the N16 joins the N4 for 65m before merging with the mainline. This section of the mainline is approximately 100 m in length before a left turn slip lane develops for R870 Markievicz Road-bound traffic. Two straight ahead lanes continue southbound through the R870 Markievicz Road junction onto Hughes Bridge which is the southern extent of the study area.

The existing lane widths are generally 3.5 m within the extents of the proposed development with the exception of the section south of the R870 Markievicz Road junction where the lane widths taper down to tie into the 3 m wide lanes across Hughes Bridge. There are no direct accesses onto the N4-N15 mainline within the extents of the proposed development; there are a number of direct accesses onto the R291 Rosses Point Road.

2.3 Description of the Proposed Development

In general, the proposed development consists of an upgraded mainline carriageway, increased right-turning provision and improved facilities for pedestrians and cyclists at the three signalised junctions within the proposed development.

Given the proposed development's location on the suburban rural fringe, the design approach of the Design Manual for Urban Roads and Streets (DMURS), published by the Department of Transport, Tourism and Sport and the Department of Environment, Community and Local Government in 2013, has been adopted as far as practicable. DMURS provides guidance in the design of urban roads and streets including national primary roads. It recognises the benefits of providing significant pedestrian and cycling provision within urban locations while noting the challenges of fully applying its standards on schemes that involve the retrofitting of new

facilities to existing streets, as is the case for the proposed development. The design philosophy adopted for the proposed development has sought to apply a balanced and integrated approach to street design by applying as far as possible with respect to the four design principles of DMURS, i.e. connected networks; multi-functional streets; pedestrian focus; and multidisciplinary approach.

The proposed development is an arterial road located on the suburban rural fringe. To the north, the proposed development links into a high-speed rural road, while to the southeast the city centre is located with higher concentrations of pedestrian and cyclist movements. Located between these contrasting areas, the proposed development design, as set out hereunder and shown in Figure 2.1, Volume 3, has adopted an approach that is considered reasonable in achieving a balance between the needs of the various competing road users.

2.3.1 Carriageway

The proposed carriageway improvements are outlined in Table 2-1 below.

Table 2-1: Proposed Carriageway

Section of Development	Road Type
N4: Hughes Bridge to Markievicz Road	Multi-lane carriageway arterial road in a boulevard configuration
N4: Markievicz Rd to N16 Duck St	As above
N15: Duck St to R291 Rosses Point Rd	As above
N15: R291 Rosses Point Rd to scheme termination	As above, transitioning to a single carriageway arterial street

There are three junctions contained within the study area. Table 2-2 below describes these junctions.

Table 2-2: Junctions Contained Within Scheme

Junction	Method of Control
R870 Markievicz Road junction with N4	Traffic light controlled three-arm junction with pedestrian crossing facilities
N16 Duck Street junction with N4-N15	Traffic light controlled three-arm junction with pedestrian crossing facilities
R291 Rosses Point Road junction with N15	Traffic light controlled three-arm junction with pedestrian crossing facilities

2.3.2 Pedestrian and Cyclist Facilities

Given the location of the proposed development close to Sligo City Centre, providing improved pedestrian and cyclist facilities formed an importance aspect of the design development. The design aims to improve pedestrian and cycling facilities through the provision of upgraded footpaths and new off-road cycle facilities, which are located adjacent to a new grass verge that acts as a buffer between pedestrians and cyclists, and vehicular traffic. Segregated cyclist and pedestrian facilities are provided throughout the proposed development except for a number of locations where shared facilities are provided, namely on the eastern side of the route corridor between the N16 Duck Street and the R870 Markievicz Road, due to space constraints arising from the adjacent HSE facility internal access road; at junction crossing points; and at the southern end of the proposed development to tie-in to the existing shared facilities on Hughes Bridge. Table 2-3 tabulates the proposed pedestrian and cyclist facilities.

Table 2-3: Proposed Pedestrian and Cyclist Facilities

Location	Facility Type	Width
Ch. 70-125 (northbound)	Shared use facility	3 m
Ch. 125-740 (northbound)	Segregated Footway and Cycle Track	1.8 m and 1.75 m
Ch. 440-575 (southbound)	Segregated Footway and Cycle Track	1.8 m and 1.75 m
Ch. 440-700 (southbound)	Shared use facility	3 m

Under DMURS, it is desirable to provide single phase pedestrian crossings at signalised junctions. DMURS also recognises that on wide, heavily trafficked streets, conventional staggered crossings may be provided where the balance of place and movement is weighted towards vehicular movements. Accordingly, signalised crossing facilities are provided on all arms of the three junctions within the proposed development with the exception of the southern arm of the R291 Rosses Point Road junction, due to its proximity to the adjacent crossing on the northern arm of the N16 Duck Street junction.

2.3.3 Structures

The proposed development requires a number of new structures to be constructed as outlined in Table 2-4 below. The locations of the proposed structures are shown in Figure 2.1 with general arrangement drawings for the new retaining wall at Salmon Point and the Copper River Bridge shown in Figures 2.6 – 2.8. In the context of the proposed development and its impact on the receiving environment (i.e. Garavogue Estuary and Copper River), particular attention has been paid to the impact of these structures and the design has been undertaken so as to minimise these impacts as far as practicable.

Table 2-4: Proposed Structures Within Study Area

Location	Structure Type	Description
Ch. 70-170 (northbound) Salmon Point	Retaining Wall	New retaining wall to retain widened road carriageway and minimise impact on adjacent designated area.
Ch. 250-330 (northbound) Salmon Point	Retaining Wall	New retaining wall to retain widened road carriageway and minimise impact on adjacent designated area.
Ch. 460	Bridge	Existing twin culverts spanning Copper River to be replaced by concrete box structure. Masonry arch section to be retained.
Ch. 295-225 (southbound)	Retaining Wall	Existing retaining wall reconstructed at back of widened verge to minimise impact on HSE facility.
R291 (mainline Ch. 550-565)	Retaining Wall	Existing retaining wall reconstructed at back of verge to provide adequate sightlines on approach to junction.

2.3.4 Flood Risk Assessment and Drainage

A Flood Risk Assessment (FRA) has been carried out in accordance with the Office of Public Works' 2009 publication The Planning System & Flooding Risk Management-Guidelines for Planning Authorities in order to assess the potential flood impacts of the proposed development and identify any mitigation necessary to ensure that the proposed development, or any surrounding areas, are not at risk of flooding and/or does not cause any potential increase in flooding in the area. The FRA report, which can be found in Appendix 8.2, concludes that both flood risks and impacts associated with the proposed development are low and negligible. It recommends that any possible impacts to the fluvial, estuarine flood risk and groundwater be mitigated in the design of the Copper River Bridge. It is recommended that any possible impacts to the ground water be mitigated through the use of appropriate design of the required earthworks.

A drainage system has been produced in accordance with the HD33 of the TII DMRB for the proposed development which comprises drainage kerbs. Petrol interceptors and grease traps will be provided at all outfall locations. The drainage network will be split into three separate drainage networks which will outfall at three separate locations. The outfalls are located to the west (downstream) of the Copper River Bridge, east (upstream) of the Copper River Bridge and at the Garavogue Estuary / River on the southern side of the R870 Markievicz Road to the east (upstream) of Hughes Bridge. The design of the drainage system has been undertaken to a sufficient level to allow land-take requirements be sufficiently developed. Appropriate pollution control measures have also been developed as part of the design process.

Runoff from the N15 drainage networks will be treated in a new wetland to be constructed as part of the proposed development which will outfall to the Copper River upstream of the Copper River Bridge. The proposed wetland will be situated to the northeast of the Copper River Bridge, i.e. east of the N15 mainline and north of the Copper River. Further details are contained in Chapter 6, Volume 2. The proposed drainage networks are shown in Figure 2.9, Volume 3.

2.4 Traffic Assessment of Proposed Development

In order to determine the optimum option for the proposed development a number of options were developed and traffic modelling assessment undertaken against each one. The assessment compared a Do Minimum scenario and three Do Something improvement options which were assessed from an operational traffic and economic perspective. The traffic assessment of the proposed options was undertaken using SATURN and S-Paramics traffic modelling. SATURN is a macro-modelling package which assesses the impacts and operational effects of the proposals at a strategic network-wide level. S-Paramics, meanwhile, is a micro-simulation traffic modelling package that was used to undertake more detailed operational assessment of the N4-N15 corridor along the alignment of the proposed development to include queuing and traffic congestion at individual junctions.

The traffic modelling assessment helped to develop a preferred development option that best meets the proposed development objectives and functionality, i.e. that improves network operations, provides for increased future growth, improves journey times, increases provision for pedestrians and cyclists, and reduces traffic and congestion in Sligo City Centre. Further details of the traffic assessment are contained within Chapter 3, Volume 2.

2.5 Compatibility of Proposed Development with Scheme Objectives

The overarching objectives for the proposed development were identified as:

- To improve capacity in the road network to cater for existing and future traffic; and
- To improve road safety and reduce accidents.

The objective to provide an improved road network along this route corridor has been a long standing specific objective of both SCC and TII. This is in accordance with national, regional and local policy objectives.

Capacity on the network will be increased through the provision of extended right turning lanes where congestion currently exists. The provision of an auxiliary lane southbound between the N15 Duck Street and R870 Markievicz Road junction will significantly improve the carrying capacity of the road thereby reducing congestion and providing future capacity benefits. Journey time reliability will also improve as a result. The traffic signals along the proposed development will be electronically linked to maximise their operational efficiency.

Safety on the route will be improved through the provision of longer dedicated turning lanes thereby reducing the instances of queuing traffic infringing into straight ahead lanes, and reducing potential instances of collisions. The provision of additional improved facilities for pedestrians and cyclists will ensure greater levels of comfort and safety through segregation of vulnerable road users from vehicular traffic.

The provision of an efficient and reliable traffic route along the proposed development, away from the busier pedestrian areas such as the key shopping and commercial areas in Sligo City, will facilitate the reduction of

traffic within the city centre and potentially facilitate improved pedestrian, cyclist and public transport facilities in the busy city centre area.

Based on the above, it can be seen that the proposed development meets the overarching scheme objectives.

3. Outline of Alternatives

3.1 Introduction

In line with the stated objectives of the proposed development, a number of options were developed and assessed to ensure that the most efficient, economic and effective final proposed development layout was achieved. Accordingly, within the constraint of the proposed development's study area and in the context of the proposed development being developed as a targeted road safety, junction improvement and traffic management scheme, a number of possible route options for the proposed development were assessed. The various options are set out below in more detail:

1) Do Minimum;
2) Do Something Option 1;
3) Do Something Option 2;
4) Do Something Option 3; and
5) Do Nothing.

3.2 Alternatives Considered

3.2.1 Do Minimum

The Do Minimum scenario will act as a baseline against which potential improvement strategies will be assessed. It consists of the existing road network and the Eastern Garavogue Bridge (EGB) river crossing. The Do Minimum scenario therefore takes account of the network-wide implications of the opening of the EGB and its associated roadworks. The EGB received planning permission in 2009 and was included in the Government's 2015 Capital Expenditure Plan. It is therefore considered to have a relatively high likelihood of being advanced to construction and implementation. The location of the proposed EGB, in the context of the study area, is shown in Image 3.1 below including its associated new approach road network. The other key river crossings within Sligo are also shown. The existing road infrastructure provision within the study area, along the alignment of the proposed development, will remain unchanged from existing for this option assessment.

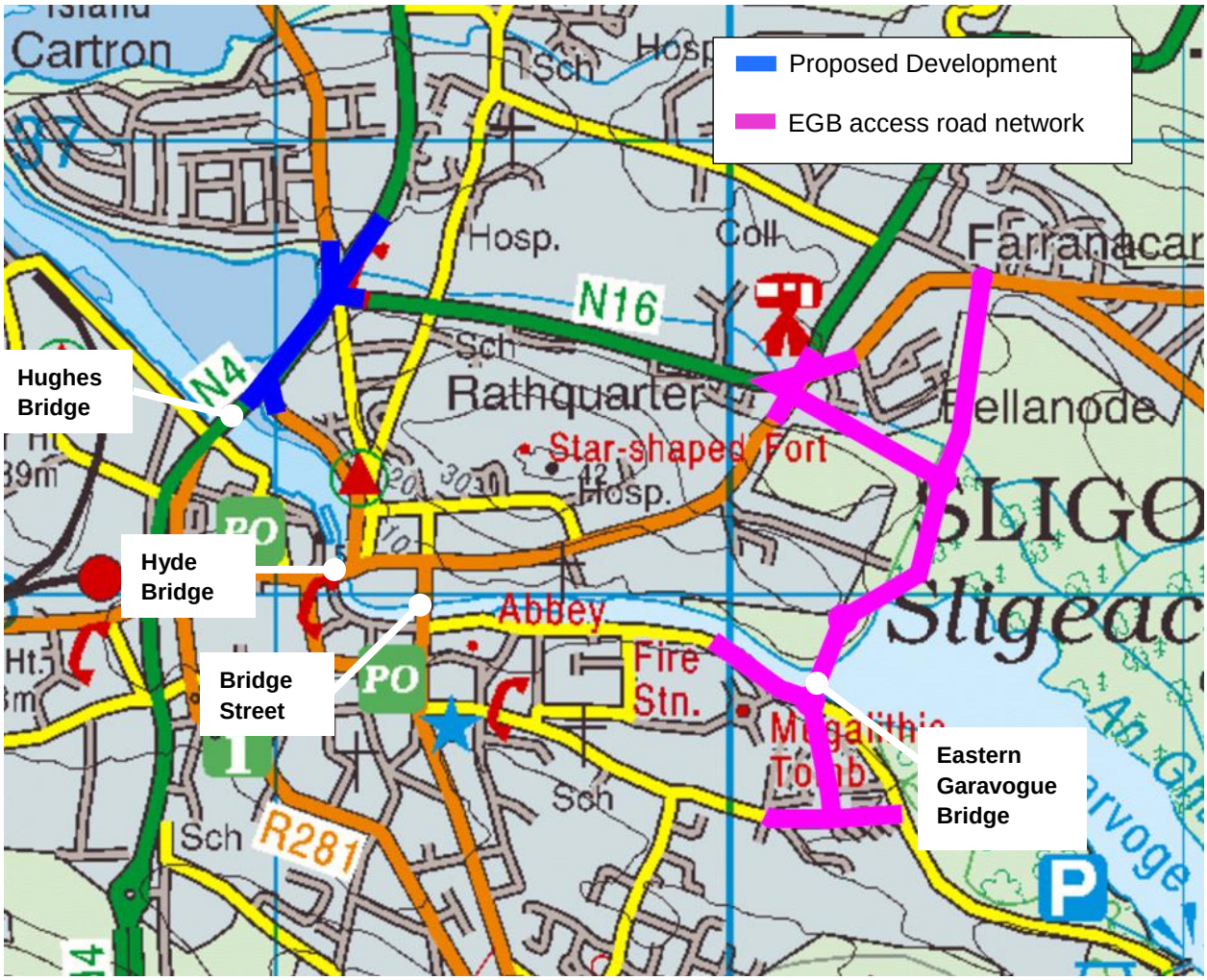

Image 3.1: Location of Eastern Garavogue Bridge

3.2.2 Do Something Alternatives

Three Do Something options were developed for the proposed development. Each of the Do Something options used the Do Minimum road network as a base network and involved the modifications to the mainline road alignment as summarised in Table 3-1 below and shown in Figures 3.1, 3.2 and 3.3, Volume 3.

Table 3-1: Do Something Options

Option	Description
Do Something Option 1	Three lanes in each direction between R870 Markievicz Road and Hughes Bridge; Three lanes northbound on the N4 between the R870 Marckievicz Road and the N16 Duck Street, one of which is a right turn lane to the N16 Duck Street; Two lanes southbound on N4 between N16 Duck Street and R870 Markievicz Road and one increased left turn lane onto the R870 Markievicz Road; Remove existing separate left turn slip lane onto R291 Rosses Point Road but provide left turn lane along mainline; Designated southbound right turn lane from N15 to R291; and Nearside lane from R291 Rosses Point Road facilitates both left and right turning traffic.

Option	Description
Do Something Option 2	As per Do Something Option 1 excluding the designated northbound left turn lane from the N4 to the R291 Rosses Point Road.
Do Something Option 3	As per Do Something Option 1 but including an additional southbound general traffic lane between the N16 Duck Street and the R870 Markievicz Road.

3.2.3 Do Nothing

The Do Nothing scenario does not consider any changes to the existing road network. It has been included in the assessment to provide context in relation to changes in network-wide traffic patterns as a result of the EGB (which is included in the Do Minimum).

3.3 Assessment of Alternative Options

In order to determine the most economically advantageous option for the proposed development, the Do Minimum and the three Do Something improvement options were assessed from an operational traffic and economic perspective. Whilst these options included the EGB and its associated network improvements, further sensitivity tests were carried out to test the ability of the proposed development to deal with the potential increased traffic volumes that would arise along the route of the proposed development in the event of it being implemented in advance, or in the absence of, the EGB, i.e. the Do Nothing scenario.

Traffic assessment of the proposed options was undertaken using SATURN and S-Paramics traffic modelling, while economic assessment was undertaken using the TUBA software package, in line with TII's Project Appraisal Guidelines. SATURN is a macro-modelling package which assesses the impacts and operational effects of the proposals at a strategic network-wide level. S-Paramics, meanwhile, is a micro-simulation traffic modelling package and it was used to undertake a more detailed operational assessment of the N4-N15 corridor along the alignment of the proposed development, including queuing and traffic congestion levels at individual junctions. TUBA (Transport User Benefits Appraisal) is a software package that takes the outputted information from the traffic models and applies economic parameters to calculate benefits and costs associated with travel time, vehicle operating costs and emissions changes.

Traffic demand forecasts were obtained from TII's National Transport Model and utilised to develop medium growth forecasts for the proposed development models for an Opening Year of 2017, Design Year of 2032 and Forecast Year of 2047.

3.3.1 Annual Average Daily Traffic

The forecast AADT per direction along links identified in the road network in the study area have been extracted from the models. These figures have been tabulated and are outlined in Table 3-2, Table 3-3 and Table 3-4 which show the 2017, 2032 and 2047 forecast AADT values, respectively.

It can be seen that the introduction of the EGB in the Do Minimum scenario reduces traffic volumes on all sections of the N4, while also reducing traffic volumes on Hyde Bridge and Bridge Street in Sligo City Centre. The introduction of the Do Something options shows a general increase in traffic volumes on the N4 above the Do Minimum level, further reducing traffic volumes within Sligo town centre. This is likely due to the provision of the proposed development's improvements increasing the attractiveness of the N4 route corridor. Do Something Option 3 generally results in the highest volumes of traffic using the N4 and N16 amongst the Do Something options, whilst also resulting in the lowest volumes of traffic within Sligo City Centre.

Table 3-2: 2017 Annual Average Daily Traffic

Link	Do Nothing	Do Minimum	Do Something Option 1	Do Something Option 2	Do Something Option 3
Hughes Bridge	25181	22367	22950	22987	23630
Hyde Bridge	11122	9270	9198	9165	9218
Bridge Street	12981	12167	11843	11837	11357
Eastern Garavogue Bridge		5943	5766	5764	5709
N4 Markievicz Road to N16 Duck Street	26402	24295	25437	25437	26039
N16 Duck Street	10443	9282	10461	10514	11445
N15 north of Rosses Point junction	15024	14835	14946	14881	14432

Table 3-3: 2032 Annual Average Daily Traffic

Link	Do Nothing	Do Minimum	Do Something Option 1	Do Something Option 2	Do Something Option 3
Hughes Bridge	27406	24091	25051	25063	25768
Hyde Bridge	11540	9630	9493	9476	9535
Bridge Street	13330	12687	12122	12116	11540
Eastern Garavogue Bridge		6422	6186	6196	6099
N4 Markievicz Road to N16 Duck Street	28724	26051	27654	27688	28279
N16 Duck Street	10675	9345	10966	11007	12147
N15 north of Rosses Point junction	16657	16480	16228	16183	15873

Table 3-4: 2047 Annual Average Daily Traffic

Link	Do Nothing	Do Minimum	Do Something Option 1	Do Something Option 2	Do Something Option 3
Hughes Bridge	27630	24305	25323	25309	26041
Hyde Bridge	11578	9634	9500	9493	9544
Bridge Street	13348	12735	12111	12116	11523
Eastern Garavogue		6448	6208	6218	6117

Link	Do Nothing	Do Minimum	Do Something Option 1	Do Something Option 2	Do Something Option 3
Bridge					
N4 Markievicz Road to N16 Duck Street	28929	26471	27910	27897	28538
N16 Duck Street	10690	9319	10988	11064	12244
N15 north of Rosses Point junction	16768	16639	16391	16283	15972

3.3.2 Journey Times

A journey time analysis of the traffic modelling was undertaken on key route corridors through the study area including: N4-N15; N4-N16; and Sligo City Centre. The analysis showed that:

- Do Something journey times on the N4-N15 route corridor remain similar to the Do Minimum although there is greater traffic capacity in the Do Something scenarios. The Do Minimum model assumed the scenario of signalised pedestrian crossings being called every cycle; this is a conservative assumption so journey times could reasonably be expected to fall marginally in practice;
- Do Something options lead to reduced journey times southbound through Sligo City Centre in the PM peak compared to the Do Minimum; and
- Do Something options lead to reduced journey times westbound on the N4-N16 Duck Street route compared to the Do Minimum, in both the AM and PM peaks.

3.3.3 Ratio of Flow to Capacity

The Ratio of Flow to Capacity (RFC) provides an indication of overall junction operation over the course of the modelled peak hour for the AM and PM peaks. In the context of the SATURN modelling it does not take into account the traffic profiles within the peak hour, but represents and average across the hour for the overall junction operation. Table 3-5 and Table 3-6 below show the Ratios of Flow to Capacity (RFCs) at the three junctions within the proposed development extents for the various options. The results are broken down by junction and for the AM and PM peak periods. It can be seen that the Do Something Options provide improvements to the RFCs when compared to the Do Minimum and Do Nothing. The Do Something Option 3 provides the lowest RFC values for each junction in each peak period.

Table 3-5: Ratio of Flow to Capacity - AM Peak

	Do Nothing	Do Minimum	Do Something Option 1	Do Something Option 2	Do Something Option 3
N4 / Markievicz Road	41	38	35	35	32
N4 / Duck St	45	45	43	45	39
N15 / R291 Rosses Point Road	34	34	30	35	30

Table 3-6: Ratio of Flow to Capacity – PM Peak

	Do Nothing	Do Minimum	Do Something Option 1	Do Something Option 2	Do Something Option 3
N4 / Markievicz Road	48	43	40	40	36
N4 / Duck St	64	60	54	53	53
N15 / R291 Rosses Point Road	36	36	33	39	33

3.3.4 Network Statistics

Network-wide statistics provide a high level overview of the operation of the overall road network based on the different infrastructure scenarios considered. Generally, queuing and journey times associated with the Do Something scenarios on the network are seen to have less queuing and lower journey times that the Do Minimum and Do Nothing scenarios as outlined in Table 3-7 and Table 3-8 below.

Table 3-7: Queuing and Travel Time AM Peak

Type	Units	Do Nothing	Do Minimum	Do Something Option 1	Do Something Option 2	Do Something Option 3
Transient Queues	PCU Hrs / Hr	235.5	227.8	226.0	226.3	222.8
Over Capacity Queues	PCU Hrs / Hr	19.8	2.3	1.5	3.3	1.6
Total Travel Time	PCU Hrs / Hr	966.6	926.1	921	922.9	916.8

Table 3-8: Queuing and Travel Time PM Peak

Type	Units	Do Nothing	Do Minimum	Do Something Option 1	Do Something Option 2	Do Something Option 3
Transient Queues	PCU Hrs / Hr	315.8	305.6	296.1	296.7	289.5
Over Capacity Queues	PCU Hrs / Hr	52.1	19.9	13.8	13.9	0.7
Total Travel Time	PCU Hrs / Hr	1131.5	1082.3	1064.3	1065.1	1046.7

3.3.5 S-Paramics Modelling Results

In general the S-Paramics microsimulation modelling aligned relatively consistently with the SATURN modelling in terms of capacity improvements with the network upgrades. The S-Paramics model considers greater detail in terms of the traffic profile within each individual peak period and the interaction of adjacent junctions. As such, it has identified Do Something Option 3 reduces queuing to levels below the Do Nothing and the Do Minimum.

3.3.6 Traffic Modelling Results

As can be seen from the traffic modelling that has been undertaken, the Do Something options provide benefits both along the proposed development route corridor and to the wider network including Sligo's commercial and shopping districts. Along the route corridor, additional traffic capacity is delivered by the Do Something options resulting in reduced congestion and associated reductions in traffic emissions.

Along the route of the proposed development, the Do Something options lead to reduced queuing and congestion compared to the Do Minimum. Across the wider network, overall network travel times fall as a result of the proposed development. Out of the three Do Something options modelled, Do Something Option 3 was

found to provide the greatest reduction in journey times overall thereby providing the most efficient solution to the overall network.

In the vicinity of the proposed development, changes in air quality are imperceptible across the Do Minimum and Do Something options indicating reduced levels of queuing and congestion. Network-wide vehicle emissions for carbon monoxide, carbon dioxide, nitrous oxides and hydro carbons indicate that the Do Minimum scenario reduces emissions when compared with the Do Nothing scenario during the AM Peak, Inter-Peak and PM Peak. The Do Something options are seen to reduce emission levels further, with Do Something Option 3 having the lowest network-wide emissions levels overall. Accordingly, Do Something Option 3 can be considered to have had the least emission levels.

4. Human Beings and Socio-Economics

4.1 Introduction

This chapter considers the impacts on human beings that could occur due to direct physical impacts of the construction work and impacts on quality of life and safety arising from changed traffic flows and changes in commuting patterns as a result of the proposed development.

This chapter also seeks to identify the land use changes and changes in economic activities directly attributable or attributable in part to the proposed development. These changes may result from direct physical impacts through construction work, or impacts through the economic system.

In addition, impacts arising from the proposed development on tourism, recreation and amenity are discussed in this chapter. Impacts are assessed on a community rather than an individual basis.

Impacts on human-related environmental aspects, such as air quality, noise and vibration, and landscape and visual are covered in Chapters 8, 9 and 10, respectively.

4.2 Description of the Existing Environment

4.2.1 The Study Area

The proposed development is situated in the northern section of Sligo City. It extends over a distance of approximately 670 m from a point north of Hughes Bridge to a point north of the R291 Rosses Point junction. The extent of the study area and its location in a wider context is shown in Figure 1.1 and detailed in Chapter 2: Description of the Proposed Development.

The study area for the Human Beings and Socio Economic assessment is comprised of the electoral divisions of Sligo East, Sligo North and Sligo West however, for the economic activity and employment impacts, a wider study area of County Sligo is used.

4.2.2 Plans and Policies

National, regional and local plans and policies are reviewed in Chapter 1. The outcomes of that review have been considered here with regard to how the proposed development is likely to facilitate the achievement of the economic and community objectives set out in them.

To conduct this assessment relevant national, regional and local plans and policies have been taken into account in order to provide advice on impact types, including cumulative impacts, and provide assistance of how the proposed development is likely to facilitate the achievement of the objectives set out in them.

Reference has been made to the Sligo and Environs Development Plan 2010-2016 and the proposed development will run adjacent to an area of Open Space (OS) to the west including the Salmon Point amenity area and Community Facilities (CF) to the east associated with the Markievicz House HSE health care facility. There is also an area of Mixed Uses (MIX), Commercial Residential (RE) to the northeast of the proposed development.

4.2.3 Baseline

4.2.3.1 Population

The 2011 Census data[1] showed a population of over 65,000 in County Sligo, and increase of 7.4% on the 2006 Census[2]. Within the electoral divisions in Sligo City, Sligo North saw population growth of 2.9% between 2006 and 2011, but Sligo West (-1.2%) and Sligo East (-7.4%) both experienced a decline in population over the same period as shown in Table 4-1.

[1] http://www.cso.ie/en/census/census2011smallareapopulationstatisticssaps/
[2] http://www.cso.ie/en/census/census2006reports/census2006volume1-populationclassifiedbyarea/

Table 4-1: Population, 2006 and 2011

Area	2006	2011	% change
Electoral Division			
Sligo East	5,334	4,937	-7.4%
Sligo North	5,346	5,502	2.9%
Sligo West	7,212	7,129	-1.2%
County			
Sligo	60,894	65,393	7.4%

4.2.3.2 Employment

The latest employment data available by electoral division is from the 2011 Census. The largest sectors by employment in Sligo East, Sligo North and Sligo West are professional services, commerce and trade and "other". In Sligo West, the manufacturing industries are relatively more important than across the other electoral divisions. The smallest sectors by employment are agriculture, forestry and fishing (less than 1% of persons at work) and the construction industry.

The pattern of employment by industry is slightly different in County Sligo, with a much largest proportion of persons at work in the agriculture, forestry and fishing sector (6.8%), and a smaller proportion in "other "as shown in Table 4-2.

Table 4-2: Persons at work by industry, 2011

Industry	Sligo East		Sligo North		Sligo West		County Sligo	
	Number	%	Number	%	Number	%	Number	%
Agriculture, forestry and fishing	12	0.7%	6	0.4%	15	0.5%	1,721	6.8%
Building and construction	36	2.0%	57	3.9%	74	2.5%	1,169	4.6%
Manufacturing industries	229	12.7%	151	10.3%	473	16.2%	3,253	12.8%
Commerce and trade	380	21.0%	247	16.9%	641	22.0%	5,071	19.9%
Transport and communications	56	3.1%	71	4.9%	159	5.5%	1,215	4.8%
Public administration	126	7.0%	92	6.3%	231	7.9%	2,043	8.0%
Professional services	513	28.4%	406	27.8%	775	26.6%	6,807	26.8%
Other	456	25.2%	430	29.5%	546	18.7%	4,155	16.3%
All	**1,808**		**1,460**		**2,914**		**25,434**	

The unemployment rate is also available from the 2011 Census data and summarised in Table 4-3. The unemployment rate varies across the electoral divisions, with the highest rate of unemployment in Sligo North at 27.7% and the lowest in Sligo West at 19.3%. Across County Sligo, the unemployment rate was 18.1% at the time of the census in 2011.

Table 4-3: Unemployment rate, 2011

Area	Unemployment rate
Electoral division	
Sligo East	26.4%

Area	Unemployment rate
Sligo North	27.7%
Sligo West	19.3%
County	
County Sligo	18.1%

Information is available about the number of people on the Live Register by Social Welfare Office (Table 4-4). The number of people on the Live Register in Sligo County peaked at 6,014 in August 2011 and has been on a largely downward trajectory since, with annual peaks in July of each year. The number of people on the Live Register in County Sligo stood at 4,127 in April 2016, 7.2% lower than in April 2015.

Table 4-4: Number of people on Live Register in Sligo County, 2011 to 2016

Date	Number on Live Register	Annual % change
April 2010	5,228	11.1
April 2011	5,418	3.6
April 2012	5,179	-4.4
April 2013	5,028	-2.9
April 2014	4,841	-3.7
April 2015	4,445	-8.2
April 2016	4,127	-7.2

4.2.3.3 Economic activity

Table 4-5 below shows the number of people in the study area by occupational activity in 2011. Higher proportion of population is employed in professional occupations in Sligo West compared to the county's average. Elementary occupations in Sligo East, North and West seem to employ a greater proportion of people than the county's average.

Table 4-5: Population by occupation, 2011

Occupation	Sligo East		Sligo North		Sligo West		County Sligo	
	Number	%	Number	%	Number	%	Number	%
Managers, Directors and Senior Officials	130	5.4%	72	3.7%	219	6.2%	1,985	6.5%
Professional Occupations	260	10.8%	226	11.5%	594	16.7%	4,871	15.9%
Associate Professional and Technical Occupations	230	9.6%	154	7.8%	290	8.2%	3,006	9.8%
Administrative and Secretarial Occupations	197	8.2%	125	6.3%	384	10.8%	3,120	10.2%
Skilled Trades Occupations	262	10.9%	241	12.2%	398	11.2%	5,462	17.8%
Caring, Leisure and Other Service Occupations	203	8.4%	185	9.4%	265	7.5%	2,316	7.6%
Sales and Customer Service Occupations	212	8.8%	160	8.1%	326	9.2%	2,112	6.9%

Occupation	Sligo East		Sligo North		Sligo West		County Sligo	
	Number	%	Number	%	Number	%	Number	%
Process, Plant and Machine Operatives	169	7.0%	137	7.0%	305	8.6%	2,339	7.6%
Elementary Occupations	325	13.5%	286	14.5%	439	12.3%	2,677	8.7%
Not stated	415	17.3%	384	19.5%	337	9.5%	2,743	9.0%
All	**2,403**		**1,970**		**3,557**		**30,631**	

The economic status of the population aged 15 and over within the study area in 2011 is shown in Table 4-6. According to Census 2011 data Sligo North has a larger student population (32.7%) than Sligo East (12.0%), Sligo West (10.0%) or County Sligo (12.7%). Sligo West has a higher proportion of retired people living in the electoral division (17.1%) compared to Sligo East (15.2%), Sligo North (11.2%) and County Sligo (14.7%). Across the study area, a small proportion of the population, aged 15 or over (approximately 1%) are looking for their first job.

Table 4-6: Economic status, 2011

Economic status	Sligo East		Sligo North		Sligo West		County Sligo	
	Number	%	Number	%	Number	%	Number	%
Looking for first job	55	1.3%	48	1.0%	55	0.9%	427	0.8%
Unemployed having lost or given up previous job	595	14.3%	510	10.6%	643	11.0%	5,197	9.9%
Student	502	12.0%	1,565	32.7%	586	10.0%	6,620	12.7%
Looking after home / family	265	6.4%	252	5.3%	366	6.3%	4,140	7.9%
Retired	632	15.2%	536	11.2%	1,002	17.1%	7,666	14.7%
Unable to work due to sickness or disability	273	6.6%	407	8.5%	261	4.5%	2,627	5.0%
Other	37	0.9%	11	0.2%	22	0.4%	173	0.3%
All	**4,167**		**4,789**		**5,849**		**52,284**	

4.2.3.4 Land use and development

There are a number of community facilities within 500 m of the proposed development, including:

- St John's Hospital, approximately 320 m northeast;
- St Edward's National School, approximately 480 m northeast;
- St Joseph's National School, approximately 460 m northeast;
- St Joseph's Church Hall, approximately 380 m east;
- Markievicz House HSE Centre / Community Care Offices, approximately 90 m northeast;
- Hopes and Dreams Montessori School, approximately 200 m northwest; and
- The Mowlam Nursing Home, approximately 500 m northwest.

East of the N4-N15, there is an area to the north of the N16 Duck Street which is a large open space identified in the Sligo and Environs Development Plan as zoned C2 for commercial and mixed use development, including

amenity. Feehily's Funeral Home is located at the corner of the N16 Duck Street, within 100 m of the proposed development, along with a bathroom and heating showroom.

There are a number of residential properties within 500 m of the proposed development, on Barrack Street, Holborn Hill and the roads off Holborn Hill to the east and west, N16 Duck Street, Ballytivnan Road and Cartron Estate and west of the N15 on the R291, Cartron Hill, Cartron Heights and Cartron Point.

4.2.3.5 Commuting patterns

Table 4-7 and Table 4-8 show the journey times and modes of transport for journeys to work, school or college. Commuting times are similar in Sligo North, Sligo East and Sligo West, although a larger proportion of journey times in Sligo North are under 15 minutes than in the other two electoral divisions of Sligo City. In County Sligo, commuting times show more variation with longer journey times on average, although 41.5% of journeys are still less than 15 minutes.

Table 4-7: Journey time to work, school or college, Census 2011

Time travelling	Sligo North	Sligo East	Sligo West	County Sligo
Under 15 mins	64.3%	47.6%	53.4%	41.5%
15 mins to under 30 mins	20.4%	32.5%	30.5%	32.1%
30 mins to under 45 mins	4.1%	6.5%	6.4%	12.8%
45 mins to under 1 hour	0.6%	1.0%	1.2%	3.1%
1 hour to under 1.5 hours	1.0%	1.3%	1.1%	2.1%
1.5 hours and over	0.9%	0.8%	1.3%	1.5%
Not stated	8.7%	10.3%	6.1%	6.9%

In terms of mode of travel, around half of commuter journeys in Sligo North are undertaken on foot, a much higher proportion than in any of the other areas. A higher proportion of journeys in Sligo East, Sligo West and County Sligo are undertaken by car, either as a driver or a passenger, than in Sligo North. In County Sligo as a whole, around 8% of commuter journeys are by bus, compared with around 3% in Sligo City.

Table 4-8: Mode of travel to work, school or college, Census 2011

Means of travel	Sligo North	Sligo East	Sligo West	County Sligo
On foot	49.9%	30.6%	26.7%	13.7%
Bicycle	1.7%	2.3%	2.3%	1.1%
Bus, minibus or coach	3.2%	3.2%	2.7%	8.2%
Train	0.4%	0.2%	0.3%	0.3%
Motorcycle or scooter	0.2%	0.3%	0.3%	0.2%
Car driver	24.0%	35.4%	41.3%	43.8%
Car passenger	12.1%	17.7%	19.3%	19.6%
Van	1.6%	2.3%	2.4%	5.3%
Other	1.2%	1.5%	1.8%	4.0%
Not stated	5.7%	6.6%	2.9%	3.9%

Table 4-8 shows that journeys by car make up a large proportion of commuting journeys in the study area. This is supported by the traffic modelling which indicates that the average annual daily traffic (AADT) on Hughes

Bridge area is 24,579 (2015, current situation with the existing N4), and at low speeds of around 40 kph northbound and at less than 30 kph southbound. The N4 Markievicz Road to Duck Street link has AADT of 25,679; southbound average speeds of 55 kph are achieved, however, northbound speeds are much lower at just 30 kph.

4.2.3.6 Tourism and recreation

The Salmon Point amenity area is located adjacent to the existing N4 at the R870 Markievicz Road junction. It is a green space with footpaths, seating and viewing points across Sligo Harbour. There is also a slipway here that provides access to the foreshore.

There are a number of tourist attractions within Sligo City itself, including Sligo County Museum, the Yeats Memorial Building, Sligo Abbey and the Model Arts and Niland Gallery while Sligo serves as a tourism hub for the wider attractions across the county including WB Yeats tourism and visitors to Strandhill, Ben Bulben and other outdoor recreation and heritage sites.

4.3 Appraisal Method used for Assessment of Impacts

4.3.1 Approach and methods

The methodology sets out the approach for assessing the potential socio-economic impacts of the proposed development. An analysis of the main socio-economic indicators and available information was undertaken, and the main elements of the analysis consisted of the following:

- A desk-based study of the available information and publicly available datasets for the establishment of the baseline conditions at the site and in the wider area; and
- A review of relevant plans and strategic documents.

Information was sourced from national statistics web pages including the Central Statistics Office (CSO) and local council and community web pages.

As part of the desk study, relevant local and regional strategies were reviewed. These included:

- Sligo and Environs Development Plan 2010-2016; and
- Sligo County Development Plan 2011-2017.

The methodology is consistent with relevant guidance on socio-economic assessment relating to infrastructure schemes. These include, but are not limited to:

- Guidelines on the Information to be contained in Environmental Impact Statements (Environmental Protection Agency, 2002);
- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (Environmental Protection Agency, 2003);
- Environmental Impact Assessment of National Road Schemes – A Practical Guide (National Roads Authority, 2006); and
- Design Manual for Roads and Bridges, Volume 11, Section 3, Part 8: Pedestrians and Others and Community Effects (UK Highways Agency, 2009) as applicable.

Impacts are assessed in terms of whether they will benefit the receptor (positive impact), if they will harm the receptor (negative impact) or if they do not affect the receptor (neutral impact). Negative and positive impacts are then categorised according to the scale of the impact:

- **Slight:** the residual effect is so minor that it will not either cause significant harm or gain;
- **Moderate:** the residual effect will be noticeable, and will cause changes in wellbeing and behaviour; or
- **Major:** the residual effect significantly changes the relevant circumstances for the receptor.

4.4 Predicted Impacts of the Proposed Development

4.4.1 During Construction

4.4.1.1 Economic activity and employment

The construction phase of the proposed development will result in a number of direct construction employment jobs over the estimated 12-month construction period. The likely number of construction-related jobs can be estimated using assumptions used as standard in the assessment of major capital works projects.

The capital cost for the proposed development works has been estimated at €5.1 million. To determine the potential job creation from the development, the capital cost estimate has been divided by €190,250 and €103,400. These figures represent the annual revenue in the construction of roads and railways per person engaged (2011 data) and the annual revenue in the construction sector per person engaged (2011 data). These figures are from the Central Statistics Office's (CSO) Construction Enterprises by NACE3 Rev 2 Activity4. This suggests that between 27 and 49 person years of employment could be directly related to the proposed development. This is equivalent to between 2% and 4% of employment within the construction industry in County Sligo.

The overall impact of the construction phase on economic activity and employment is expected to be slight-positive.

4.4.1.2 Land use and development

While the proposed development is expected to largely be constructed within the footprint of the existing road, there is expected to be land take from several areas adjacent to the road, to allow for construction, safeguarded areas and for the construction of a drainage pond for water attenuation. It is expected that 4 hectares of land will be required during the construction period, of which 0.27 ha will be temporarily acquired and restored to its previous use.

There are only a few private accesses on to the proposed development, with a small number of houses directly on the Rosses Point Road and therefore disruption to access will be minimal.

Overall, a slight-negative impact is expected on land use and development during the construction phase.

4.4.1.3 Commuting patterns

During the estimated 12 month construction period, there are likely to be minor additional delays to commuters using the N4-N15 as a result of temporary traffic management measures required to facilitate the construction of the proposed development. On average, one lane of the existing N4-N15 will be closed during the construction period, rising to more than one lane for short periods for certain elements of the construction.

The overall impact on commuting patterns from the construction phase of the proposed development is expected to be slight-negative.

4.4.1.4 Tourism and recreation

There are not expected to be any significant impacts on tourism during the construction of the proposed development.

Access to Salmon Point amenity area is expected to be restricted throughout a large part of the construction phase. The proximity of the site to the construction works is likely to have an adverse impact on amenity at the site.

[3] NACE (Nomenclature statistiques des activités économiques dans la Communauté européene) is the standard classification for economic activities in the European Community.

[4] http://www.cso.ie/px/pxeirestat/Database/eirestat/Enterprise%20Statistics%20on%20Construction/Enterprise%20Statistics%20on%20Construction_statbank.asp?SP=Enterprise%20Statistics%20on%20Construction&Planguage=0

Overall, the impact on tourism and recreation during the construction phase is expected to be minor-negative.

4.4.2 During operation

4.4.2.1 Economic activity and employment

No significant impacts on the local economy and businesses have been identified as a result of the operation of the proposed development. The impact of the proposed development during operation on economic activity and employment is expected to be neutral.

4.4.2.2 Land use and development

The permanent land take area is expected to be 3.74 ha. Effects are particularly concentrated on the areas to the north east of the proposed development.

There is also some permanent landtake from private landowner as follows:

- Residential landtake is required from the edge of two properties namely the Kilrornan property and the Suncroft Villas as a result of the proposed development. As residential receptors these are consider highly sensitive. The land take here is considered to be a slight to moderate as the effect will be noticeable but won't cause changes in wellbeing, see also Section 10 for visual impact on these properties and Section 8 and 9 for potential air and noise impacts;
- The provision of a treatment / attenuation pond in an area zoned as "open space" and "C2-commercial and mixed landuse" to the south east of the scheme will require permanent landtake, the land take is considered to be a slight negative as it could cause potential constraints to future development options in the area; and
- There is some limited landtake required at the HSE facility involving the setback of the existing limestone wall, this is not considered to be a sensitive receptor and the land take in this area is considered to be a slight to negligible negative.

The improvement in journey times, access and connectivity are considered to be a positive improvement for economic development prospects in and around Sligo. There are no specific developments identified that would suffer negative effects. The proposed development is not expected to disrupt existing plans to develop the regenerated Sligo Harbour.

Overall the impact of the proposed development on land use and development during operation is expected to be neutral with the exception of the individual slight impacts outlined above for each individual private landowner.

4.4.2.3 Commuting patterns

The operation the scheme will allow for a more efficient traffic operations on the N4 and N15, as well as their interaction with the N16. This results in an increase in traffic volumes on the route, while not fundamentally changing the travel and commuting patterns in Sligo. The scheme provides increased pedestrian crossing points at each junction along the entire route as well as providing off-road cycle provision. Both of these will make walking and cycling more efficient and safer for commuting to the City Centre, Sligo Institute of Technology or Sligo Hospital.

Overall, the impact of the proposed development on commuting patterns during operation is expected to be moderate-positive.

4.4.2.4 Tourism and recreation

The proposed development is not expected to impact on tourism or recreation once operational.

The impact of the proposed development on tourism and recreation during operation is expected to be neutral.

4.5 Proposed Mitigation and Avoidance Measures

The design of the proposed development has incorporated access arrangements and new boundary walls / arrangements where required, see Figure 2.1.

The permanent loss of land to landowners is non-mitigatable, however the loss of land is compensated through the Compulsory Purchase Order (CPO) process and will not result in any significant impacts for which mitigation measures are required.

It should, however, be noted that the impact assessment relies on appropriate traffic and safety management during the construction period to minimise the potential impacts to road users, local residents and business interests in the vicinity of the proposed development.

4.6 Residual Impacts

There are not expected to be any significant residual negative impacts.

4.7 Difficulties Encountered in Compiling Information

Local area statistics are presented based on Census 2011 data as that is the most recent data that is available on a consistent basis for the local area. This is not considered to impact on the quality or robustness of the impact assessment as presented.

4.8 Cumulative Impacts and Impact Interrelations

Impacts on air quality and noise have been addressed in Chapter 8 and 9 respectively.

Impacts on landscape and visual elements have been addressed in Chapter 10.

No cumulative significant impacts on the local communities or other socio-economic receptors are expected.

5. Flora and Fauna

5.1 Introduction

This chapter of the EAR establishes the baseline ecological value of the receiving environment and assesses the potential direct, indirect and cumulative ecological impacts on terrestrial and aquatic ecology of the proposed development within its Zone of Influence (ZoI). Mitigation measures are proposed to avoid or reduce potential impacts. The significance of any residual impacts remaining after mitigation is also identified. The boundary of the proposed development is shown in Figure 2.1.

5.1.1 Consideration of European sites

Regarding European sites (formerly 'Natura 2000 sites'[5]) all potentially significant impacts are assessed in this chapter. Additionally, following completion of a Screening Statement for Appropriate Assessment (AA) by Sligo County Council which could not exclude the likelihood of significant effects on European sites, a Natura Impact Statement (NIS) was completed. The NIS, which will inform the AA of An Bord Pleanála as competent authority, concluded that the proposed development, either alone or in combination of other projects or plans, would not result in adverse effects on the integrity of any European sites.

5.1.2 Location of Proposed development

The proposed development is part of the existing N4 and N15 national roads. It is located in Sligo City and therefore much of the habitat within the proposed development's land-take comprises existing built lands and other urban habitats. The proposed development is situated adjacent to the Garavogue Estuary, and the Garavogue River, and crosses the Copper River. It is directly abutted by the Cummeen Strand Special Protection Area (SPA) and the Cummeen Strand / Drumcliff Bay Special Area of Conservation (cSAC) and proposed Natural Heritage Area (pNHA) it is noted that part of the SAC and the pNHA fall within the existing road boundary, see Figure 5.1.

5.1.3 Relevant Characteristics of the Proposed Development

Various elements of the proposed development could give rise to potentially significant impacts on ecological receptors, and have informed the delineation of zones of influence. Different potential impacts will arise during construction and operation, and both types of potential impacts are described in Section 5.6.

The boundary of the proposed development is centred on the existing N4-N15 carriageway, to the west of the urban centre of Sligo City, approximately 1km north of the city centre (Figure 2.1). The development consists of the upgrade of a 670 m section of the existing N4-N15 route corridor to three lanes in each direction, as per the detailed description in Chapter 2. The footprint of the proposed development (as with the existing road) overlaps the Cummeen Strand / Drumcliff Bay cSAC / pNHA and lies adjacent to the Cummeen Strand SPA (Figure 5.1), although there is no overlap with designated 'Qualifying Interest' (QI) habitats, see Figure 5.2. There will be no overlap of the proposed infrastructure associated with the proposed development with the QI of the Cummeen Strand cSAC. There is potential for limited movement of construction machinery including piling rigs across the SAC intertidal areas to access the seawall to for example install sheet piling during retaining wall construction.

There are no purely freshwater watercourses within the proposed development footprint, or within more than one hundred metres of it (the Garavogue and Copper Rivers being tidal at this location). Excluding the replacement and partial demolition of the Copper River Bridge, and the demolition of a twenty metre section of boardwalk at the southwestern corner of the proposed development, there will be limited demolition of structures. There will be no construction lighting as all works would be carried out in daylight. There will be no abstraction from groundwater. Although the public lighting along the proposed development will be redesigned and upgraded, there will be no increase in lighting relative to the existing road.

The following elements of the development are of potential significance in the context of ecological impacts:

[5] "European site" replaced the term "Natura 2000 site" under the EU (Environmental Impact Assessment and Habitats) Regulations 2011 S.I. No. 473 of 2011.

- Widening of the road resulting in localised removal habitat loss, potentially including areas containing invasive species;
- Partial demolition of existing Copper River Bridge requiring instream works potentially altering the physical characteristics of the channel (e.g. bed substrate and cross-section) and including replacement of twin 1.7m diameter culverts with a single 8m x 3m box culvert at the upstream end;
- Construction of two new outfalls to the Copper River, one upstream and one downstream of the Copper River Bridge, and one new outfall to the Garavogue River / Estuary;
- Upgrading of existing footpaths to provide cycling and pedestrian facilities with potential for disturbance of designated wetland bird populations in the adjacent Garavogue Estuary;
- Construction of a retaining wall on existing rock armour along the existing Garavogue Estuary shoreline to retain the widened road carriageway and prevent encroachment onto the designated shoreline; and
- Associated with the construction of the retaining wall, the requirement for limited machinery to temporarily require access across intertidal habitats in the foreshore within the Cummeen Strand / Drumcliff Bay SAC and Cummeen Strand SPA.

5.1.4 Mitigation by Design

The potential effects from the proposed development have been assessed with the following mitigation by design in place ('embedded mitigation'). As this mitigation is inherent in the design, there is no uncertainty regarding its implementation.

5.1.4.1 Avoidance of European sites within proposed development footprint

The proposed development was designed to avoid habitat loss of QI habitats in the adjacent Cummeen Strand / Drumcliff Bay cSAC and Cummeen Strand SPA. Temporary limited movement of machinery across the cSAC / SPA during the construction of the proposed retaining wall is likely to be required. However, there will be no removal of QI habitat within any European sites.

5.1.4.2 Pollution Control during Operation

The potential effects on water quality in receiving watercourses from the operation of the proposed development has been assessed in Chapter 6, which also describes the surface water treatment incorporated into the proposed development. The relevance of water quality to the assessment of ecological receptors is summarised below as:

- In accordance with the Highways Agency Water Risk Assessment Tool (HAWRAT) and TII HD45/15, water quality in operational carriageway run-off is predicted to 'pass', for both soluble (heavy metals) and sediment-bound pollutants with the provision of treatment on one of the three outfalls. An attenuation treatment pond will be provided for one outfall which would 'fail' the HAWRAT for soluble (heavy metal) pollutants without attenuation, prior to discharge of run-off to the Copper River;
- Petrol interceptors will be provided at all outfall locations between the carriageway drainage outfall and watercourse;
- The Accidental Spillage Risk Assessment concluded there is a low risk of an accidental spillage incident, 0.5%. A penstock, handstop, or an orifice that can be readily blocked in the event of accidental spillage will be provided in the attenuation / treatment pond. The penstock can, if lowered in time, potentially retain 100% of spilled material; and
- The drainage system is also above the level of the Highest Astronomical Tide plus a 10% allowance for climate change.

5.2 Methodology

Published references used in this report, including government publications, are included in section 5.12. Resources on websites are named within the text, along with unpublished reports such as planning reports, and case references. Websites were accessed from 2015 up to and including June 2016.

5.2.1 Zones of Influence

5.2.1.1 Guidance on ZoI

The National Roads Authority's (NRA) Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009) recommends identifying a single ZoI for ecological effects[6]: However, use of a single 'fixed distance' ZoI encompassing all effect pathways may result in features not at risk of being significantly impacted potentially being included in the assessment (e.g. distant designated sites or habitat features only impacted at localised scales). In their Guidelines for Ecological Impact Assessment in the United Kingdom and Ireland the Chartered Institute of Ecology and Environmental Management (CIEEM) recognise that the ZoI will vary for different ecological features, depending on their sensitivity (CIEEM, 2016). The need to identify receptor-specific ZoIs is also supported by guidance from the Department of Environment, Heritage and Local Government (DoEHLG) for assessing impacts in the context of Appropriate Assessment (DoEHLG, 2010; p.23, para 1).

5.2.1.2 Method to Determine Zones of Influence for the proposed Development

The starting point for determining ZoIs is to analyse the characteristics of the proposed development and identify the range of ZoIs to be determined using the source-pathway-receptor conceptual model. For instance, in the case of piling activities affecting protected mammals during road construction:

- Source (s) – e.g. Piling;
- Pathway (s) – e.g. Vibration; and
- Receptor (s) – e.g. Underground mammal resting site at risk of collapse.

As recommended by CIEEM (2016), professionally accredited or published studies have been used to determine ZoIs (see Appendix 5.1). In the example above, the ZoI is 150 m, based on guidance from the NRA (2006a) regarding the distance to underground otter *Lutra lutra* sites, within which disturbing works are likely to require licencing (NRA, 2006a). Once identified, receptor-specific ZoIs are used to determine the field survey areas (i.e. in the case above, the field survey area for underground mammal sites is 150 m from piling works).

For designated sites, a slightly different approach may be employed. Initially, a single worst-case ZoI encompassing all pathways for significant impacts generates a list of preliminary sites potentially affected. Next, the list of sites and features is revised by scoping out features based upon the receptor-specific ZoIs for which the sites are designated. The worst-case ZoI in this instance is 10 km for cSACs, and 20 km for SPAs, based on the maximum ZoIs for non-bird and bird QIs respectively (Appendix 5.1). The worst-case ZoIs for designated sites exclude potential pollution effects, as discussed below in Section 5.2.1.3.

The number of different ZoIs identified was reduced by grouping features based on shared ecological dependencies and sensitivities. For instance, the potential risk of piling resulting in the collapse of underground resting sites in similar habitats for otter, badger *Meles meles*, and stoat *Mustela erminea* is presumed to be similar.

5.2.1.3 ZoI for Potential pollution effects

As described in Section 5.1.4, the treatment system embedded in the design of the proposed development means there are negligible pollution effects during road operation. However pollution could occur during construction. In cases where watercourses are located in proximity to proposed development, the largest ZoI may relate to pollution, as watercourses may carry contaminants many kilometres from the pollution source. However, the ZoI for pollution is often not possible to estimate with a high degree of confidence, and no "*transparent…objective evidence*" may be available to support the judgement, as should underpin all evaluation and decision-making in EIA according to the Environmental Protection Agency's Guidelines on the information to be contained in an EIS (2002; p.7). The EPA has recently revised these guidelines. The draft revised guidelines have been published and are currently under consultation, closing October 2017. The final revised guidelines and are likely to be published early 2017.

[6] The NRA is now Transport Infrastructure Ireland (TII). However, all pre-existing guidance documents are still quoted as NRA publications.

For instance, the potential ZoI of a fuel spill incident into a coastal stream during construction will depend on numerous factors including but not restricted to:

- The volume of fuel spilt;
- The type of fuel spilt;
- The time of year;
- The type, abundance, and physical condition of mobile aquatic populations within the plume at the time; and
- The assimilative capacity of the receiving watercourse at the time, and in coastal areas the stage of tidal cycle.

The magnitude of effects would vary over the same distance for different aquatic species in accordance with their sensitivity to pollutants, such that a single ZoI would be inaccurate. In addition, in the case of silt, particles may be remobilised meaning the ZoI will vary in time as well as space. An arbitrary and highly precautionary fixed distance ZoI could be applied, but this distance would not be scientifically supported and could necessitate lengthy analysis of distant receptors in the impact assessment.

However and most significantly, understanding the ZoI of pollution effects to different aquatic receptors will generally not alter the mitigation requirements for pollution control. The approach adopted in this assessment is therefore to:

- Assume the potential for worst-case pollution impacts exists during construction and operation, without specifying a ZoI; and
- Prescribe design-based and construction-based pollution mitigation measures, based on the specific site condition.

5.2.2 Desk Study

5.2.2.1 Extent

The desk study areas were defined differently for different ecological features, by applying the ZoIs identified in Appendix 5.1. For instance, the ZoI of effects to breeding birds from the proposed development was determined to be approximately 100 m, and the desk study gathered breeding bird data over a similar area. However, in line with NRA Guidelines for assessment of Ecological Impacts of National Road Schemes (NRA, 2009), records of known bat roosts were obtained from Bat Conservation Ireland (BCI) for areas up to 1km from the proposed development.

The area over which existing ecological records was gathered was set at 10 km from the boundary of the proposed development, to account for the potential spatial error associated with ecological records. Some records from the National Parks & Wildlife Service (NPWS) research branch are considered to be accurate only to 10 km (e.g. a record of Irish Grid O12, or 310000 Easting, 220000 Northing).

5.2.2.2 Consultation

In undertaking the assessment, non-statutory consultation letters were issued to a number of stakeholders, see Chapter 1.

Consideration has been given to the consultation responses received, as detailed below.

- Consultation with the NPWS via the DAU was requested.

  Action taken: A meeting was held on site with the NPWS and SCC on the 16th November 2016. Both the District Conservation Officer for Sligo and the Divisional Ecologist for the region were in attendance. The length of the scheme was walked and different aspects of the design and construction methods were discussed in relation to potential impacts on the cSAC / SPA. Following on from the site visit a meeting was held in SCC offices to cover all ecological surveys that were undertaken of the scheme and to close out any other issues in relation to potential impacts on the cSAC / SPA. Some aspects discussed included

embedded mitigation, best practice construction methods in relation to pollution control and key activities such as the potential for an ecological clerk of works (ECoW) to conduct site visits at construction stage.

- In addition to the above the local Conservation Ranger of the NPWS met the project ecologist on site on the 20th October 2015. The project ecologist requested any records of protected or rare species, or other features of conservation interest not held by the NPWS Research Branch, and requested information on any existing or proposed projects or plans of potential significance to the assessment of cumulative effects. The Ranger provided unpublished winter bird survey data from 2010 to 2011 for areas of Garavogue Estuary within and outside the ZoI detailed later in this report in 5.2.1.

  Action taken: The NPWS bird data has informed the impact assessment.

- A response to the consultation request was received by Inland Fisheries Ireland (IFI) on the 21st December 2015 and is included in Appendix 6.2. The IFI were subsequently contacted by phone on the 18th February 2016. During this call, the relevant IFI Environmental Fisheries Officer (EFO) revised their written request to instead request a fish habitat suitability assessment. The EFO also advised that IFI's original written request for a seasonal restriction on in-stream works was no longer required, following explanation of the proposed development and given their understanding that the works were entirely within the intertidal reach of the river. To summarise IFI's comments, following the clarifications:

  - The proposed development has the potential to impact Garavogue Estuary and the Copper River;
  - The Copper River has habitat for salmonids but the fish stock status of the river is uncertain and fish habitat suitability surveys are required;
  - Electrofishing surveys are not required as there no works within the ZoI of potential spawning habitats in the freshwater reach of the Copper River;
  - There is no seasonal restriction on instream works in the Copper River; and
  - Recommendations were made on the construction methodology to prevent pollution, and avoid instream barriers to migratory fish movements, including reference to the IFI guidance document "*Requirements for the Protection of Fisheries Habitat during Construction and Development Work*" (2016), available online from www.fisheriesireland.ie.

  Action taken: Fish surveys were completed; relevant mitigation measures from the IFI's consultation request and guidance document were incorporated into bridge design to minimise migratory barriers and water pollution.

- Bat Conservation Ireland (BCI) was consulted on the 8th December 2015 to obtain bat roost data for 3km radius from the boundary of the proposed development.

  Action taken: None required. The BCI had no records for known roosts within the ZoI of the proposed development. Bat surveys for foraging and roosting bats are included in Appendix 5.6

- Sligo County Council's Heritage Officer was consulted on the 1st December 2015 to ascertain whether the Draft Sligo Biodiversity Action Plan (BAP) 2011-2015 will be updated. The officer responded that an evaluation of the plan was proposed in 2016 and a brief had been agreed with a view to reviewing the BAP in 2016.

  Action taken: The Heritage Officer was consulted again in April 2016 prior to finalisation of the EAR however it was indicated that the revised BAP would not be available. The 'draft' Sligo BAP was the latest available at the time of writing and was used in this assessment.

5.2.2.3 Relevant Legislation, Policy and Guidelines

The assessment was carried out in accordance with the relevant legislation, policy and guidance as set out further in Appendix 5.2

5.2.2.4 Desktop Data Sources

Records for rare / protected species within 10 km of the subject lands were obtained from the NPWS Research Branch on the 11th May 2015. Records were also obtained from the online database of the National Biodiversity

Data Centre (NBDC). Bat roost records were obtained from BCI for the site and environs to a distance of 3 km on the 6th December 2015.

Additional sources are detailed in the specialist survey and assessment reports for bats (Appendix 5.6), and fisheries (Appendix 5.7). Key desktop sources were:

- Mapping of European site boundaries from NPWS available online at www.npws.ie;
- Mapping of QI habitats for Cummeen Strand / Drumcliff Bay cSAC and Cummeen Strand SPA in NPWS conservation objective supporting documents (NPWS;2013c-f);
- Additional records for protected, rare, Red Data Book / Red-listed species obtained from the NPWS Research Branch in April 2015;
- Records of bat roosts obtained from Bat Conservation Ireland in December, 2015;
- Mapping and aerial photography available online from Ordnance Survey Ireland (www.osi.ie) and Google Maps (http://maps.google.com/);
- Land zonings and land-use plans available from the Department of the Environment, Community and Local Government available online (www.myplan.ie);
- National conservation status assessments of QIs from NPWS for habitats and non-bird species (NPWS, 2013a; 2013b) and the European Topic Centre (2015) for birds (http://bd.eionet.europa.eu/article12/report?period=1&country=IE);
- Irish Wetland Bird Survey data (IWeBS) 2004-2014 for relevant sub-sites within the Cummeen Strand SPA and Drumcliff Bay SPA (annual peaks);
- Unpublished low tide count data for a single season (2010-2011) for including small number of counts for areas within the 500 m survey area / ZoI as well as the wider harbour and estuary area outside the ZoI:
- Botanical Society of Britain and Ireland website – Species Distribution Maps available online (http://www.bsbi.org.uk/; accessed on various dates in 2015);
- National Biodiversity Data Centre – Species Distribution Maps available online (www.biodiversityireland.ie/_; accessed on various dates in 2015;
- All Ireland Red lists for vascular flora (Curtis & McGough, 2005), mammals (Marnell *et al*., 2009); water beetles (Foster *et al*., 2009), butterflies (Regan *et al*., 2010), non-marine molluscs (Byrne *et al*, 2009), dragonflies and damselflies (Nelson *et al*., 2010), amphibians and fish (King *et al*., 2011); bryophytes (Lockhart *et al*., 2012);
- AA Screening Assessment for the 'N4 Traffic Improvement Scheme – Hughes Bridge Widening' produced by Scott Cawley Ecological Consultants in 2012 (scheme completed in 2015);
- Environmental Appraisal Report – Hughes Bridge Widening' produced by Arup Consulting engineers in 2012; and
- Unpublished 'N4-N15 Sligo Urban Road Improvement – Environmental Impact Statement' produced by Ryan Hanley consulting engineers in 2011 (not submitted to An Bord Pleanála).

5.2.3 Field Survey

A suite of terrestrial and aquatic surveys were undertaken between May 2015 and March 2016 as summarised in Table 5-1 below. The rationale for determining the extent of survey in each case was the scientifically-supported ZoI for each receptor, or group of receptors, as described further below and summarised in Appendix 5.1. Surveys spanned all four seasons and covered the optimal survey periods for all flora and fauna species as defined in Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes (NRA, 2008).

Table 5-1: Ecology Survey Programme Informing the assessment

Species / Habitat	Field Survey Area (meters beyond boundary of proposed development)	Survey Date(s)
Multidisciplinary phase 1 habitat survey (terrestrial and surface-water dependent habitats).	50 m beyond boundary	13th-14th May 2015 and 31st August -1st September 2015
Phase 1 habitat survey for ground-water-dependent habitats	250 m beyond boundary	
Bat activity survey and dusk / dawn emergence survey of Copper River culvert (manual).	20 m beyond boundary	24th-25th July 2015
Bat activity survey using static detector recording devices (unmanned).	20 m beyond boundary	24th-29th July 2015 and 21st-27th August 2015
Breeding bird territory mapping	100 m beyond boundary (150 m for kingfisher *Alcedo atthis*)	13th-14th May and 1st September 2015
Wintering bird surveys	500 m beyond boundary	1st September, 20th October, 18th November 2015 and January 14th-15 2016
Protected mammal surveys	150 m beyond boundary for resting sites; 300 m for watercourse crossing points	20th October, 18th November 2015 and January 14th-15 2016
Fish habitat assessment	Copper River from estuary to N16 road bridge 1.1 km upstream of the proposed development. Garavogue Estuary within vicinity of potential construction movements	25th March 2016
Macroinvertebrate kick / sweep sampling (and incidental fish recording)	Three locations on the Copper River: 10 m downstream of the Copper River Bridge (Site 1 in map included in Appendix 5.7), 10 m upstream of the Copper River Bridge (Site 2 in map included in Appendix 5.7), and approximately 400 m upstream of the Copper River Bridge (Site 3 in map included in Appendix 5.7).	25th March 2016

5.2.3.1 Habitats and Flora Survey

The field survey area for surface water-dependent habitats / flora, and 'terrestrial' flora / habitats (i.e. those not dependent on surface or ground-waters) was 50 m beyond the proposed development footprint. This accounted for a precautionary ZoI from habitat loss, given the potential for increases in the footprint of the proposed development to accommodate ancillary works such as temporary storage or access routes.

The field survey area for Ground Water Dependent Terrestrial Ecosystems (GWDTEs) was 250 m from the footprint of the proposed development in accordance with a recommended survey area for GWDTEs in the UK, when assessing potential impacts from intrusive earth works (SEPA, 2014).

Habitats and flora were classified using the Heritage Council's Guide to Habitats in Ireland (Fossitt, 2000). Within each habitat, dominant and abundant plant species and indicator species were recorded. Further

detailed botanical surveys were undertaken of habitats considered to be of high ecological value such as Annex 1 habitats (e.g. saltmarsh in the Garavogue Estuary). Searches in suitable habitat were made for any species listed on the Red Data Book for vascular plants (Curtis & McGough, 2005), the Red List for bryophytes (Lockhart *et al*., 2012), any species protected on the Flora Protection Order 2015, and any invasive species listed on Schedule 3 to the Bird and Habitat Regulations 2011-2015. Vascular plant nomenclature follows that of the Checklist of the Flora of Britain & Ireland (BSBI, 2007) and as such any name changes since 2007 (including Stace, 2010) are not included. Bryophyte nomenclature follows the British Bryological Society (Atherton *et al*., 2010).

5.2.3.2 Fauna Survey

Field survey areas varied for different fauna up to a maximum of 500 m from the proposed development for wintering birds. The suitability of the site to support notable or protected fauna including birds, mammals, and invertebrates was assessed using field surveys to recognised standards such as those published by the NRA. Habitats on site were assessed for signs of usage by protected fauna and / or those of conservation concern or on national red lists (Fitzpatrick *et al*., 2006; Byrne *et al.,* 2009; Foster *et al*., 2009; Marnell *et al.,* 2009; Regan *et al.,* 2010; King *et al.,* 2011; Nelson *et al.,* 2011). Fauna were recorded by direct observation and indirectly using field signs including tracks, feeding signs, droppings, and breeding and resting sites. Observations on potentially suitable habitat were also made.

5.2.3.2.1 Badger and Otter

The field survey area for badger and otter resting sites was 150 m beyond the footprint of the proposed development. This was based on Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes (NRA, 2006b), which state that intrusive earthworks (e.g. piling) within 150 m of a protected badger or otter breeding or resting site is likely to require licences from the NPWS due to the risk for disturbance potentially including entombment of animals from hole collapse. The status of any badger setts, otter holts (both underground breeding or resting sites), or otter couches (temporary above-ground otter resting places) were recorded along with any evidence of activity, including paths, paw-prints, feeding signs, latrines. In order to assess potential barriers to mammal dispersal from culvert design, existing usage by mammals of watercourses (i.e. used by mammals to safely cross roads) was surveyed by examining watercourses within 300 m of the proposed development, following best practice guidance from the UK Highways Agency (2001).

5.2.3.2.2 Pygmy Shrew, Hedgehog, and Stoat

The field survey area for breeding or resting sites for these species was 150 m beyond the footprint of the proposed development, extending to 300 m for road crossing points along existing watercourses (see rationale above for badger and otter). Droppings and footprints are less frequent and / or readily identifiable for these species, relative to other species such as badger. Where present, potentially suitable habitat (based on Hayden & Harrington, 2001) was investigated including signs of paw prints and droppings. Road mammal fatalities in the locality were also recorded as these are sometimes the only reliable indication of hedgehog or stoat presence in an area, beyond live sightings. The NPWS Conservation Ranger was also consulted on known mammal road fatalities in the area.

5.2.3.2.3 Bats

The field survey area for foraging and roosting bats was determined to be approximately 20 m beyond the footprint of the proposed development to address potential impacts from light spill. Bat surveys (full report provided in Appendix 5.6) had due consideration for best practice guidelines (NRA, 2005a) and the Bat Conservation Trust (Collins, 2016). Dusk emergence and pre-dawn re-entry surveys were completed on the 24th / 25th July 2015 on the Copper River Bridge. Unmanned 'static' bat detectors (Anabat SD1: Titley Electronics) were also left out from 24th-31st July and 21st-28th August 2015, at locations immediately upstream and downstream of the Copper River Bridge.

5.2.3.2.4 Breeding Birds

The field survey area for breeding birds was a minimum of 100 m beyond the proposed development to record all birds within the potential ZoI of indirect effects during construction and operation (including disruption in

territorial singing due to increased road noise). Surveys for kingfisher extended to 150 m to address potential impacts to kingfisher nest holes in soft substrates collapsing at distance (i.e. applying the same rationale as that for mammal underground resting sites). Field surveys were complemented by a desktop search of potentially suitable breeding habitat for highly sensitive breeding species, for which the ZoI of disturbance could extend up to 1km (for white-tailed sea eagle *Haliaeetus albicilla*). This desktop search, including analysis of aerial photography, concluded there was no potential for highly sensitive breeding bird species due in large part to the urban setting of the proposed development.

Breeding birds were surveyed on two visits on the 13th May 2015 and the 1st September 2015, in calm conditions, between sunrise and 11am, having regard for the Common Birds Census territory mapping method (Gilbert *et al*., 1998). The May visit recorded breeding activity of resident and migratory birds whilst the September visit recorded evidence of breeding including juvenile birds and roaming families. The categories of breeding evidence developed by the British Trust for Ornithology[7] (BTO) were applied to all birds recorded. All birds were assessed for their conservation importance in accordance with the traffic light system of Green (Low), Amber (Medium) and High (Red) conservation concern for the island of Ireland (Colhoun & Cummins, 2013).

5.2.3.2.5 Wintering Birds

The field survey area for wintering birds was 500 m beyond the proposed development, following a review of published disturbance distances to wintering birds from anthropogenic activities (Madsen, 1985; Smit & Visser, 1993; Rees *et al*., 2005; see Appendix 5.1). Wintering wetland birds were surveyed at both low and high tide in accordance with the Wetland Bird Survey (WeBS) and Low Tide Count survey methodologies in Gilbert *et al*., (1998). Monthly surveys (four in total) were completed at both high and low tide between September 2015 and January 2016. Dates, tides, and weather conditions are presented in Appendix 5.8.

5.2.3.2.6 Amphibian and Reptile Surveys

The walkover survey identified all wetland habitats as saline and unsuitable for protected common frog *Rana temporaria* and smooth newt *Triturus vulgaris*. Amenity grassland habitats within the proposed development footprint were considered unsuitable and too isolated from woodland / scrub habitats to support protected common lizard *Zootoca vivipara*. Both species groups were therefore scoped out from further assessment.

5.2.3.2.7 Invertebrates (Terrestrial and Aquatic) Surveys

Walkover surveys in May 2015 and September 2015 were undertaken in warm, sunny conditions suitable for butterfly flight. Surveys covered the footprint of the proposed development and an area up to 100 m from it to address potential barrier effects. Particular attention was paid to dry grassland habitat to the northeast of the proposed development where bare ground basking areas and adult food plants were at greatest abundance in the local area.

Kick sampling was undertaken in a silt deposit in the stretch of the river downstream of the N16 bridge over the Copper River at a location deemed suitable for lamprey larvae (juveniles).

Qualitative sampling of benthic (or bottom dwelling) macroinvertebrates was undertaken at three locations on the Copper River: 10 m downstream, 10 m upstream and approximately 400 m upstream of the Copper River Bridge. Macroinvertebrates were sampled at these sites using kick / sweep sampling (Toner *et al*., 2005).

5.2.3.3 Fish

A walkover fish habitat assessment was undertaken on the 25th March 2016 to establish the character of the Copper River and adjacent estuary, and to identify what fisheries constraints, if any, were present. The lower reaches of the Copper River were viewed from Garavogue Estuary to the N16, a stretch of approximately 1.1 km that encompassed the estuarine (transitional) and lower freshwater reaches of the river. Along this stretch, shallow parts of the Copper River were viewed.

[7] http://www.bto.org/volunteer-surveys/birdatlas/methods/breeding-evidence

The river was photographed at various representative locations throughout the study area. River habitat assessment was carried out using methodology given in the Environment Agency's 'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003' (EA, 2003). Habitat suitability for salmonids was assessed with reference to the leaflet 'The Evaluation of habitat for Salmon and Trout' (DANI Advisory leaflet No. 1) and 'Ecology of the Atlantic Salmon' (Hendry & Cragg-Hine, 2003). Habitat suitability for lamprey in the lower reaches of the Copper River and at Salmon Point was determined with reference to Ecology of the River, Brook and Sea Lamprey by Maitland (2003). Detailed methods are included in the report in Appendix 5.7.

Any fish captured during macroinvertebrate sampling were noted and identified with reference to the 'Key to British Freshwater Fish with notes on their ecology and distribution' by Maitland (2004).

5.3 Ecological Valuation and Impact Assessment Methodology

Potential impacts of the proposed development have been assessed according to:

- Guidelines on the information to be contained in Environmental Impact Statements (Environmental Protection Agency, 2002);
- Guidelines for Ecological Impact Assessment in the UK and Ireland (Chartered Institute of Ecology and Environmental Management, 2016);
- Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009a); and
- Guidelines for the Protection of Biodiversity in Construction Projects (Notice Nature, accessed online).

In accordance with the NRA Guidelines for assessment of Ecological Impacts of National Road Schemes (2009a), impact assessment was only undertaken of "Key Ecological Receptors" (KERs). These are features within the ZoI of an effect from the development (ZoI is defined in Section 5.2.1) which are "both of sufficient value to be material in decision making and likely to be affected significantly". Features qualifying as KERs must be similar in ecological value to examples of "Local Importance (Higher Value)" or higher as per the NRA examples in Appendix 5.3. Features similar in ecological value to the NRA's examples of Local Importance (Lower value) are excluded from impact assessment.

Details of the impact assessment methodology are provided in Appendix 5.4. The potential for both 'embedded mitigation' (i.e. design features), and non-embedded mitigation to have ecological impact was assessed.

All potential impacts were assigned a significance level at a particular geographic scale corresponding to the examples in the NRA guidance.

5.4 Description of the Existing Environment

5.4.1 Site Overview

The boundary of the proposed development is centred on the existing N4-N15 carriageway located approximately 1 km northwest of the city centre (Figure 2.1). The proposed development comprises a 670 m road improvement project that passes over Garavogue and Copper Rivers. The proposed development footprint encompasses the shoreline along Garavogue Estuary; a large abandoned rank grassland field not subject to any current land management; existing roadside grass verges; small areas of existing ornamental plantings in roadside gardens; and existing rock armour embankments along the Copper River and the Garavogue River / Estuary. The area of Sligo Bay to the west and Garavogue River / Estuary to the east are designated as the Cummeen Strand / Drumcliff Bay cSAC. The Copper River is tidal within the footprint of the proposed development.

5.4.2 Desk Study Results

5.4.3 Designated sites

As outlined in Section 5.2.1.3 a preliminary list of designated sites potentially impacted was initially identified using single fixed distances. All sites within 10 km of the proposed development are shown in Table 5-2. Additional sites designated for far-flying goose species at distances of up to 20 km from the proposed

development are shown in Table 5-3. This preliminary list of sites will be revised to identify sites potentially impacted in the impact assessment section.

Table 5-2: Preliminary list of designated sites potentially impacted

Site and Code	Distance from Proposed Development	Qualifying Interests (cSACs / SPAs) or Reason for Designation (pNHAs) (* = Priority Habitat)	Bird Populations
Cummeen Strand SPA (4035)	0 m (adjacent)	Common redshank *Tringa tetanus*	Non-breeding
		Light-bellied brent goose *Branta bernicla hrota*	Non-breeding
		Oystercatcher *Haematopus ostralegus*	Non-breeding
		Wetlands	N/A
Cummeen Strand / Drumcliff Bay cSAC (627)	0 m (adjacent)	Estuaries	N/A
		Embryonic shifting dunes	N/A
		Estuaries	N/A
		Fixed dunes	N/A
		Juniperus communis communities	N/A
		Mudflats and sandflats	N/A
		Petrifying springs	N/A
		Shifting dunes with *Ammophila arenaria*	N/A
		Common Seal *Phoca vitulina*	N/A
		Narrow-mouthed whorl snail *Vertigo angustior*	N/A
		River Lamprey *Lampetra fluviatilis*	N/A
		Sea lamprey *Petromyzon marinus*	N/A
Cummeen Strand / Drumcliff Bay pNHA (627)	0 m (adjacent)	Same as cSAC and SPA	N/A
Lough Gill cSAC (1976)	0.4 km (upstream)	Alluvial forests*	N/A
		Natural eutrophic lakes	N/A
		Old sessile oak woods	N/A
		Atlantic salmon	N/A
		Otter	N/A
		River Lamprey	N/A
		Sea lamprey	N/A
		White-clawed crayfish *Austropotamobius pallipes*	N/A
Lough Gill pNHA (1976)	0.4 km (upstream)	Same as Lough Gill cSAC	N/A
Colgah Lough pNHA (1658)	4.5 km	Small lake underlain by limestone bedrock including rich deposits of marl. Home to rich invertebrate fauna, comprised of molluscs, beetles leeches and a variety of waterfowl including whooper swan *Cygnus cygnus*	Breeding and non-breeding

Site and Code	Distance from Proposed Development	Qualifying Interests (cSACs / SPAs) or Reason for Designation (pNHAs) (* = Priority Habitat)	Bird Populations
Knocknaree Mountain and Glen pNHA (1670)	6 km	Flat-topped hill with cliffs and semi-natural woodland vegetation. Rare plants including ivy broomrape *Orobanche hederae* and wood fescue *Festuca altissima*	N/A
Crockauns / Keelogyboy Bogs NHA (2435)	6 km	Extensive, primarily upland site incorporating large areas of blanket bog, heath, upland grassland and associated habitats. Home to several Annex 1 bird species including chough *Pyrrhocorax pyrrhocorax*, peregrine falcon *Falco peregrinus*, hen harrier *Circus cyaneus* and red grouse *Lagopus lagopus*	N/A
Sligo / Leitrim Uplands SPA (4187)	6 km	Chough	Resident
		Peregrine falcon	Resident
Ballysadare Bay SPA (4129)	7.5 km	Light-bellied brent goose	Non-breeding
		Bar-tailed Godwit *Limosa lapponica*	Non-breeding
		Dunlin *Calidris alpina*	Non-breeding
		Grey Plover *Pluvialis squatarola*	Non-breeding
		Redshank	Non-breeding
		Wetlands	N/A
Ballysadare Bay cSAC (622)	7.5 km	Embryonic shifting dunes	N/A
		Estuaries	N/A
		Fixed dunes*	N/A
		Humid dune slacks	N/A
		Mudflats and sandflats.	N/A
		Shifting dunes with *Ammophila arenaria*	N/A
		Common seal	N/A
		Narrow-mouthed whorl snail	N/A
Ballysadare Bay pNHA (4129)	7.5 km	Same as Ballysadare Bay SPA and cSAC	Non-breeding
Ballygawley Lough pNHA (1909)	7.5 km	Lough with significant dragonfly population, and considerable numbers of wildfowl during the winter, including whooper swan	Non-breeding
Union Wood cSAC (638)	7.5 km	Old sessile oak woods	N/A
Union Wood pNHA (638)	7.5 km	Old sessile oak woods	N/A
Ben Bulben, Gleniff and Glenade Complex cSAC (623)	8 km	Alpine and Boreal heaths	N/A
		Calcareous and calcshist screes	N/A
		Calcareous rocky slopes	N/A
		European dry heaths	N/A

Site and Code	Distance from Proposed Development	Qualifying Interests (cSACs / SPAs) or Reason for Designation (pNHAs) (* = Priority Habitat)	Bird Populations
		Juniperus communis formations	N/A
		Petrifying springs	N/A
		Water courses of plain to montane levels	N/A
		Geyer's whorl snail *Vertigo geyeri*	N/A
		Otter	N/A
Ben Bulben, Gleniff and Glenade Complex pNHA (623)	8 km	Same as Ben Bulben, Gleniff and Glenade Complex cSAC	N/A
Unshin River pNHA (1898)	8 km	No site synopsis available	N/A
Lough Dargan pNHA (1906)	8 km	Small lake with varied aquatic flora, interesting marginal wet grassland communities, woodland and old wall / exposed rock habitats	N/A
Slieveward Bog NHA (1902)	9 km	Blanket bog, wet and dry heath, deciduous woodland and calcareous fen	N/A

Table 5-3: Additional designated sites potentially impacted (SPAs designated for far-flying geese within 20 km)

Site and Code	Distance from Proposed Development	Qualifying Interests (cSACs / SPAs) or Reason for Designation (pNHAs)	Bird Population	Core Foraging Range of Species (Appendix 5.1)
Ballintemple and Ballygilgan SPA (4234)	13 km	Barnacle Goose *Branta leucopsis*	Non-breeding	15 km
Ardboline Island and Horse Island SPA (4135)	14 km	Barnacle Goose	Non-breeding	15 km

The high tide water mark adjoining the proposed development boundary is largely coincident with the boundary of the Cummeen Strand / Drumcliff Bay cSAC and the Cummeen Strand SPA (Figure 5.1). The existing road and proposed development overlap the Garavogue Estuary. This part of the estuary is primarily fed by freshwater coming down the Garavogue River and flowing under Hughes Bridge. The estuary is also fed by the Copper River which rises on the shore of Lough Gill to the east and is culverted under the existing N4 (Figure 5.1).

NPWS CO mapping for Cummeen Strand / Drumcliff Bay cSAC indicates QI *mudflat and sandflat* habitat adjoins the proposed development to the west and overlaps with QI estuary habitat over the same area. This has been mapped by the NPWS as *estuarine mixed sediment to sandy mud with Hediste diversicolor and oligochaetes community complex* (NPWS, 2013c). However, habitat and fisheries surveys in the vicinity of the proposed development indicate that the habitat immediately adjacent to the proposed development (where movement of machinery is likely to be required) comprised rocky, interspersed with thin, coarse sediments, rather than fine muddy sediments which are present further out in the estuary and to the southwest of the

proposed development. This part of the estuary is therefore unlikely to support significant benthic communities associated with QI mudflat habitat. Furthermore, keystone marine communities present within the cSAC including Zostera-dominated and Mytilidae-dominated communities are not present within the ZoI of the proposed development, as indicated by habitat surveys and the NPWS CO mapping (NPWS, 2013c).

The estuary in the wider area is likely to provide habitat for QI sea and river lamprey, but habitat in the ZoI of the proposed development was determined not to be important for these species (Section 5.4.11). These are catadromous fish which reproduce and spend their larval life stage in freshwater habitats, out-migrating to estuary / sea for most of their adult life stage. The Copper River does not provide a potential migratory corridor for QI Atlantic salmon, sea lamprey or river lamprey from Lough Gill cSAC (Section 5.4.11).

There are no terrestrial QI habitats or plant species of any cSACs within the ZoI of the proposed development. The nearest known terrestrial QI habitats of any site are the alluvial woodlands of Lough Gill cSAC located at least 1.5 km to the east and upstream of the proposed development.

The NPWS CO mapping for the Cummeen Strand SPA (NPWS, 2013d) was based on the wintering season's bird data for 2010 / 2011. This data recorded, within the 500 m survey area:

- Small numbers (peak 8) of QI oystercatcher and common redshank (peak 3) feeding in the estuary at low tide; and
- No high tide roosts of any potential QI populations.

5.4.3.1 Records of Protected / Rare Flora and Fauna species

The flora records in Table 5-4 also includes Species of Conservation Concern in Sligo requiring specific action according to the Sligo BAP (preliminary list; none of the flora were identified in this way in the BAP). The results for flora are shown in Table 5-4 and the results for fauna are shown in Table 5-5.

Table 5-4: Records of Protected and Red Data Book Flora

Common name	Scientific name	Protection[1]	ConservationStatus[2]	Habitat Preference[3]
Bantry notchwort	*Leiocolea bantriensis*	None	Near Threatened	Upland
Bordered screw-moss	*Tortula marginata*	None	Near Threatened	Moist, shaded / sheltered areas, esp. on limestone
Clint crisp-moss	*Tortella densa*	None	Near Threatened	Limestone substrate, calcareous / dune grassland
Dumortier's liverwort	*Dumortiera hirsuta*	None	Near Threatened	Shady humid areas by streams / waterfalls
Felted thyme-moss	*Rhizomnium pseudopunctatum*	None	Near Threatened	Damp soil, rock, rotting wood
Fitzgerald's notchwort	*Leiocolea fitzgeraldiae*	None	Not Threatened	Upland
Heath cudweed	*Gnaphalium sylvaticum*	FPO (2015)	Vulnerable	Pasture, dry open wood, heath
Henbane	*Hyoscyamus niger*	None	Vulnerable	Sandy hills, open areas, waste ground
Intermediate wintergreen	*Pyrola media*	None	Vulnerable	Heath, rocky areas, woods, glens
Large white-	*Leucobryum*	None	Least Concern	Acidic woodland and mires

Common name	Scientific name	Protection[1]	ConservationStatus[2]	Habitat Preference[3]
moss	*glaucum*			
Lurid cupola-moss	*Cinclidium stygium*	None	Vulnerable	Calc. march, spring and fen
n/a	*Fissidens monguillonii*	None	Near Threatened	Neutral-acid rocks in waterways, avoids limestone
n/a	*Drepanocladus sendtneri*	None	Near Threatened	Nutrient poor slacks, turloughs
Prickly tamarisk-moss	*Thuidium abietinum subsp. hystricosum*	None	Endangered	Shallow unimproved grassland soil, calcareous sandy soil, dune slacks, quarry banks, rarely base-rich slopes and ledges
Red leskea	*Orthothecium rufescens*	None	Near Threatened	Wet base-rich rock, moist overhangs, seeping crevices
Robust tufa-moss	*Hymenostylium insigne*	None	Near Threatened	Tufa-encrusted turfs, crevices in damp base-rich rock, occasionally on mortar
Rough poppy	*Papaver hybridum*	FPO, 2015	Critically Endangered	Tilled fields, sandy / gravelly areas
Round-leaved wintergreen	*Pyrola rotundifolia subsp. maritima*	FPO, 2015	Endangered	Damp areas including fens, dunes, woods
Shepherd's needle	*Scandix pecten-veneris*	None	Extinct	Tilled fields
Short-beaked thyme-moss	*Mnium thomsonii*	None	Near Threatened	Upland
Showy feather-moss	*Eurhynchium speciosum*	None	N/A	Wet woodland, carr, stream banks, seepages and marsh
Small-mouthed Beardless-moss	*Weissia brachycarpa var. obliqua*	None	Least Concern	Disturbed calc. soil
Spruce's leskea	*Platydictya jungermannioides*	None	N/A	Damp shady crevices, woods, sheltered ravines
Twisted whitlow-grass	*Draba incana*	None	Vulnerable	Scree, cliffs, sandhills
Untidy earwort	*Scapania cuspiduligera*	None	Vulnerable	Upland

Footnotes

1 FPO =The current list of plant species protected by Section 21 of the Wildlife Act, 1976 is set out in the Flora (Protection) Order, 2015, which supersedes orders made in 1980, 1987 and 1999.

2 Red-listed vascular Flora from the Irish *Red Data Book 1 Vascular Plants* (Curtis & McGough 2005); red-listed bryophytes from Lockhart et al., 2012.

3 Habitat preferences and distribution data from Parnell & Curtis (2012), Curtis & McGough (2005), and the online atlas of the British and Irish Flora (http://www.brc.ac.uk/plantatlas - accessed December 2015).

The BCI had no records of bat roosts within 1 km of the proposed development. The nearest known roost was c.1.2 km from the proposed development, and there were numerous roosts of at least four species at this approximate distance (see Bat Report in Appendix 5.6). Relevant desktop records from BCI of foraging bat species from the specialist report are included in the table below.

Table 5-5: Records of Protected, Rare and Other Notable Fauna

Common name	Scientific name	Candidate for SAP under BAP[8]	National Protection[1]	European Protection[2]	Conservation Status[3, 4]
Badger	*Meles meles*	-	WA	-	Least Concern
Brook lamprey	*Lampetra planeri*	X	-	HD II	Least Concern
Chough	*Pyrrhocorax pyrrhocorax*	X	WA	BD I	Amber List; PS
Common frog	*Rana temporaria*	-	WA	HD V	Least Concern
Common lizard	*Zootoca vivipara*	-	WA	-	Least Concern
Common pipistrelle	*Pipistrellus pipistrellus*	-	WA	HD IV	Least Concern, PS
European hedgehog	*Erinaceus europaeus*	-	WA	-	Least Concern
European pine marten	*Martes martes*	-	WA	-	Least Concern
Fallow deer	*Dama dama*	-	WA	-	Least Concern
Geyer's whorl snail	*Vertigo geyeri*	X	-	HD II	Vulnerable, PS
Grey seal	*Halichoerus grypus*	X	WA	HD II	Least Concern (IUCN)
Harbour seal	*Phoca vitulina*	-	WA	HD II	Least Concern (IUCN)
Hen harrier	*Circus cyaneus*	-	WA	BD I	Amber List
Irish hare	*Lepus timidus subsp. hibernicus*	-	WA	-	Least Concern
Irish stoat	*Mustela erminea subsp. hibernica*	-	WA	-	Least Concern
Leisler's bat	*Nyctalus leisleri*	X	WA	HD IV	Near threatened, PS
Marsh fritillary	*Euphydryas aurinia*	X	WA	HD II	Vulnerable; PS
Narrow-mouthed whorl snail	*Vertigo angustior*	-	-	HD II	Vulnerable
Natterer's bat	*Myostis nattereri*;	X	WA	HD IV	Least Concern, PS

[8] http://www.sligococo.ie/media/CouncilDownloads/Heritage/Draft%20Sligo%20Biodiversity%20Action%20Plan.pdf – accessed December 2015

Common name	Scientific name	Candidate for SAP under BAP[8]	National Protection[1]	European Protection[2]	Conservation Status[3, 4]
Otter	*Lutra lutra*	X	WA	HD II / IV	Near Threatened; PS
Red squirrel	*Sciurus vulgaris*	X	WA	-	Near Threatened
River lamprey	*Lampetra fluviatilis*	X	-	HD II / HD V	Least Concern; PS
Sea lamprey	*Petromyzon marinus*	X	-	HD II / HD V	Near Threatened; PS
Smooth newt	*Lissotriton vulgaris*	-	WA	-	Least Concern
Soprano pipistrelle	*Pipistrellus pygmaeus*	X	WA	HD IV	Least Concern, PS
Striped dolphin	*Stenella coeruleoalba*	-	WA	HD IV	Least Concern (IUCN)
White-clawed crayfish	*Austropotamobius pallipes*	X	WA	HD II / HD V	Endangered (IUCN); PS

Footnotes

1. WA = Animals and their breeding / resting places protected from injury or intentional disturbance under the Wildlife Acts.

2. HD II = Protected within those candidate Special Areas of Conservation (cSACs) where they are qualifying interests, as species listed under Annex II to the Habitats Directive.

HD IV = Animals and their breeding / resting places protected from injury or disturbance (even if accidental) as species listed under Annex IV to the Habitats Directive. Protection applies anywhere they occur.

BD I = Protected within those SPAs where they are special conservation interests, as species listed under Annex I to the Birds Directive.

3. Mammal red-list from Marnell *et al*., 2009; bird red-list from *Birds of Conservation Concern in Ireland* (Colhoun and Cummins, 2013); red-listed fish and amphibians from King *et al*., 2011; red-listed non-marine molluscs from Byrne *et.al*, 2009; red-listed dragonflies and damselflies from Nelson *et al*., 2011; red-listed water beetles from Foster *et al*., 2009.

4. IUCN red list http://www.iucnredlist.org/ - accessed December 2015

5.4.4 Likelihood of Occurrence of Protected, Rare and Notable Species

5.4.4.1 Flora[9]

The majority of flora species listed in Table 5-4 occur in habitats not found within the development footprint, as determined following habitat surveys. Many of these species are found in upland habitats or have an affinity for strongly acidic or base rich soils not present within the proposed development footprint. There was limited potential habitat for a small number of bryophytes in existing roadside limestone walls throughout. All suitable habitats were surveyed for their floristic interest and none of the flora species in Table 5-4 were recorded.

[9] Habitat Preferences and distribution data from Parnell & Curtis (2012), Curtis & McGough, Doogue et al., 1998, and the online atlas of the British and Irish Flora.

5.4.4.2 Fauna

Based on the habitats present and their urban context, determined following habitat survey, there was potential for a small number of mammal species from Table 5-5 to occur within the ZoI of the proposed development. There is suitable grassland foraging habitat, and some limited potential breeding habitat for badger, stoat, otter, and pygmy shrew. Protected amphibians were unlikely to occur within the ZoI given the absence of suitable freshwater habitat. The grassland habitats present, isolated from significant areas of woodland or scrub, were considered unsuitable to support common lizard. The potential occurrence of all species is elaborated upon in the field survey results section, and potential impacts and mitigation subsequently addressed as relevant. There was no freshwater spawning habitat for Atlantic salmon, sea lamprey or river lamprey within the ZoI. Adult fish of both species are likely to occur within Garavogue Estuary, having migrated downstream from Lough Gill via the Garavogue River. There was no suitable habitat for red squirrel, smooth newt, marsh fritillary, Irish hare, brook lamprey, hen harrier, chough, or whorl snails given the urban context and habitats present.

5.4.5 Field Survey Results (Habitats and Flora)

Habitats within the field survey area generally comprised: intertidal habitats associated with Garavogue estuary; highly managed areas along the existing N4 carriageway in medians, public open spaces, and private gardens; and scattered neglected scrub or grassland. Managed areas were dominated by scattered trees and parkland (WD5), Amenity grassland (GA2), and Treelines (WL2). Limestone walls were present throughout. A narrow zone along the tide line (immediately outside the red line boundary) comprised a mosaic of Lower saltmarsh (CM1) and Upper salt marsh (CM2). Below this, the intertidal zone of the inner Garavogue Estuary comprised a mosaic of mixed sediment (LS3) and Sheltered Rocky Shores (LR3)

Other semi-natural habitats occurred in transition between coastal and managed areas. These comprised a large rank field of Dry meadow (GS2) and Wet grassland (GS4) to the east of the proposed development, north of the Copper River, and patches of Scrub (WS1) which was occasionally overgrown into Broad-leaved woodland (WD1). The Habitat Map is presented in Figure 5.3. A full flora species list by habitat is provided in Appendix 5.5. Habitat descriptions below are in the past tense, to reflect their accuracy at a point in the recent past (i.e. September 2015).

Amenity Grassland (GA2)

This habitat, of artificially sown grass seed, was intensely mown and fertilised and was associated with treelines or parkland. The habitat is of negligible value other than as foraging ground to occasional passerines or gulls.

Dry meadows and grassy verges (GS2)

The eastern edge of the proposed development boundary overlapped with a large rank and unmanaged grassland field along the existing N15 road. Ordnance survey mapping from the 19th Century indicates this field was historically agricultural and has not been developed in recent history. There was some local access by dog walkers but it was otherwise undisturbed. A small part of this field was dry species-poor grassland and dominated by tussocks of tufted hair-grass *Deschampsia caespitosa*, red fescue *Festuca rubra* and false oat-grass *Arrhenatherum elatius*. Forbs were occasional and included creeping thistle *Cirsium repens*, ribwort plantain *Plantago lanceolata*, broad-leaved dock *Rumex obtusifolius*, Japanese knotweed *Fallopia japonica*, and a hybrid mint *Mentha* cf *villosa* X *spicata*.

Wet grassland (GS4)

This dominated the rest of the rank field described above and was species-rich in parts. Dominants varied and included common couch *Elytrigia repens*, hard rush *Juncus inflexus,* common reed *Phragmites australis*, reed canary-grass *Phalaris arundinacea*, and creeping bent *Agrostis stolonifera*. Pendulous sedge *Carex pendula* and false fox-sedge *Carex otrubae* were locally abundant, the latter indicating saline influence. Hairy sedge *Carex hirta* and carnation sedge *Carex panacea* were frequent. Forbs included abundant autumn hawkbit *Leontodon autumnalis*, lesser celandine *Ranunculus ficaria* and wild angelica *Angelica sylvestris*. The ground layer comprised frequent pointed spear-moss *Calligeronella cuspidata*, neat feather-moss *Pseudoscleropodum purum* and cuckooflower *Cardamine pratensis*. Invasive Japanese knotweed *Fallopia japonica* was scattered at a number of locations. Comb moss *Ctenidium molluscum* and fairy flax *Linum catharticum* were also recorded

within this field, in areas of base-rich bare ground potentially resulting from dumping of lime-rich building waste in the recent past.

There was also a wet grassland field on the spit that reached into the estuary west of the existing road (Image 5.1).

Image 5.1: Wet grassland and saltmarsh on 'spit' at Salmon Point

This was dominated by yellow iris *Iris pseudacorus,* creeping bent and common couch. The rare 'archaeophyte' *Allium ampeloprasum* (i.e. a non-native plant introduced in ancient times) was locally abundant on this spit.

Broadleaved woodland (WD1)

This had developed from sparse planting in a strip between the N4 and the estuary, on an embankment of large boulders functioning as coastal protection. Canopy layering was absent, and the habitat was poorly vegetated from exposure to tides and northerly winds. Young sycamore *Acer pseudoplatanus* and ash *Fraxinus excelsior* dominated the canopy. The patchy field layer comprised hogweed *Heracleum sphondylium*, meadowsweet *Filipendula ulmaria* and exposure-tolerant white stonecrop *Sedum album* and red valerian *Centranthus ruber.*

Scattered trees and parkland (WD5)

These public and private green spaces comprised semi-mature specimen trees dominated by silver birch *Betula pendula*, sycamore, pedunculate oak *Quercus pedunculata*, and horse chestnut *Aesculus hippocastanum.* The field layer was artificially seeded and mown amenity grassland.

Scrub (WS1)

Unmanaged field, road and property boundaries were dominated by *Salix cinerea*, butterfly-bush *Buddleja davidii,* and brambles *Rubus fruticosus* agg. Hedge bindweed *Calystegia sepium* and herb-Robert *Geranium robertianum* were frequent, and hedge woundwort *Stachys sylvatica* was occasional. The nationally 'Endangered' moss (velvet feather-moss *Brachythecastrum velutinum* was dominant on damp ground under scattered *Salix cinerea* trees in the rank field to the east of the proposed development, but was at least 40 m from the boundary of the proposed development.

Hedgerows (WL1)

There were occasional heavily pruned low roadside beech *Fagus sylvatica* hedges along the eastern roadside at the northern end of the proposed development.

Treelines (WL2)

Widely spaced young silver birch were planted in amenity areas, and mature Leylands cypress X *Cuprocyparis leylandii* property boundary treelines were also present within the survey area. The latter included the non-native Russian-vine *Fallopia baldschuanica* but this species is not invasive like other species in the genus. There was a mature treeline of beech, along a property boundary adjacent to the footprint of the proposed development. Invasive hybrid bluebell *Hyacinthoides* X *massartiana* and Japanese knotweed occurred around trees on the shoreline to the northwest of the proposed development.

Recolonising bare ground (ED3)

This dominated a small sandy path leading to the wet grassland spit to the west of the proposed development and comprised a mix of stonewall and dry meadow species dominated by oxeye-daisy *Leucanthemum vulgare*, and several common mat-forming bryophytes including spiral extinguisher-moss *Encalypta streptocarpa* and an unidentified *Fissidens* sp.[10]

Stone walls and other stonework (BL1)

Recently constructed or repointed limestone and mortar walls were a feature throughout the proposed development site boundary. The ubiquitous silky wall-feather moss *Homalothecium sericium* was dominant amongst several other common species: wall-screw moss *Tortula muralis*, frizzled crisp-moss *Tortella tortuosa*, and false beard-moss *Didymodon fallax.* Several common ferns also occurred (Appendix 5.5).

Buildings and artificial surfaces

There was no notable vegetation associated with the residential areas within the ZoI other than flower beds and borders (BC4) dominated by non-native (but non-invasive) vegetation. The latter is of negligible value and has was not been mapped.

Tidal Rivers (CW2)

The Copper River flows through the proposed development site and under the N4-N15 road before discharging into the Garavogue Estuary (Image 5.2 and Image 5.3).

[10] Fruits were not present and are required for identification. However, this species, was determined to be one of several common species, and could not have been the rare species monguillonii

Image 5.2: Copper River Bridge viewed from upstream of proposed development

Image 5.3: Copper River; upstream of Copper River Bridge

The river is tidally influenced within c. 200 m of the proposed development, as indicated by the presence instream of *Enteromorpha* and luxuriant filamentous algae, and silted vegetation on rock armoured banks which included seaweed spiral wrack *Fucus spiralis* saltmarsh vegetation. The bed of the lower 0.5 km of the river was typically flat, of even and low gradient, and comprised angular cobbles and deeply embedded silt. When surveyed in March 2016, the mean wetted width and mean depth of this section of the river was approximately 2 m and 0.2 m respectively while the maximum depth was approximately 30 cm. During the March 2016 survey which was undertaken at low tide, there was a depth of c. 0.5 m of water in each corrugated concrete barrels of the bridge on the downstream side. The two barrels were circular in cross section on the upstream side of the bridge and were fitted with coarse-trash screens. Water depth at the entrance was minimal and it was partially blocked with woody debris and refuse. There is a more detailed description of the Copper River in the specialist fisheries survey and assessment report in Appendix 5.7. The river is not deemed to qualify as Annex 1 estuary habitat due to its poor condition, and the absence of in-stream vegetation other than algae.

Lower salt marsh (CM1) / Upper salt marsh (CM2)

Lower salt marsh was not usually distinguishable from upper salt marsh, reflecting the absence of gentle gradients required for lower salt marsh to develop fully. Both habitats are discussed together here. A key differentiator between the two habitat types is the presence or absence of rushes, there is little or no cover of

rushes in lower saltmarsh. The majority of species recorded indicated that these habitats were predominantly upper salt marsh, with just two species typical of lower saltmarsh recorded, these included sea arrowgrass *Triglochin maritimum* and sea plantain *Plantago maritima*. However, both of these species are also associated with upper salt marsh. Species associated with upper salt marsh were more frequently recorded and dominated by red fescue *Festuca rubra*, creeping bent *Agrostis stolonifera*, sea rush *Juncus maritimus and* distant sedge *Carex distans.* This habitat type also supported locally dominant stands of sea club-rush *Bolboschoenus maritimus*. Common scurvy grass *Cochlearia officinalis*, sea aster *Aster tripolium,* and sea plantain *Plantago maritima* were also frequent. Species occurring rarely or occasionally included sea milkwort *Glaux maritima,* and hemlock water-dropwort *Oenanthe crocata.* This habitat is not a QI of the Cummeen Strand cSAC in which it was located. However, this habitat type does have an affinity with Annex I habitat type: 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) (1330)' and 'Mediterranean salt meadows (*Juncetalia maritimi*) (1410)'.

Mud shores (LS4) / Estuaries (MW4)

These habitats types were recorded adjacent to the proposed development (outside the development footprint but within the ZoI) within the Cummeen Strand / Drumcliff Bay cSAC, Estuary surrounds the proposed development to the west. This corresponds to the annexed habitat *estuary* 1130 QI habitat. Mud shores were recorded further out in the bay and to the south-west of the proposed development, mud shores correspond to annexed habitat, 'mudflats and sandflats not covered by sea water at low tide (1140)'.

Mixed sediment (LS5) / Sheltered Rocky Shores (LR3)

These habitat types were recorded within the Garavoge Estuary immediately adjacent to the proposed development (outside the development footprint but within the ZoI) along the shore. This part of the cSAC has been mapped by the NPWS as Annex 1 habitat type 1140 *Mudflats and Sandflats not covered by water at low tide*. However, detailed site surveys indicated that the area of Estuary immediately adjacent to the proposed development lacked any significant areas of soft muds. Instead surveys found that the substrate was dominated instead by coarse gravel, small cobbles, and bedrock and scattered stable bounders, with frequent channel wrack *Pelvetia canaliculata* and bladder wrack *Fucus vesiculosus*, amongst sparse thin mixed sediments (

Image **5.4** and Image 5.5). Although surveys indicated that this habitat does not fit with the Annex 1 mudflat community, it does qualify as *estuary 1130* QI habitat.

Image 5.4: Mixed Sediment / Rocky Shore within Cummeen strand cSAC

Image 5.5: Substrate in Mixed Sediment / Rocky Shore habitat

5.4.5.1 Notable and Rare Flora

No protected flora, flora listed in the Red Data Book (Curtis & McGough, 2005), or flora species noted as important in the Sligo County Development Plan were recorded within the ZoI of the proposed development.

Locally abundant wild leek was recorded in the wet grassland spit at Salmon Point. The species is an infrequent[11] 'archaeophyte' in Ireland, and is rare in Northern Ireland[12] and the Burren[13], but no data is available on its occurrence in Sligo. It was recorded within the wet grassland on Salmon Point c. 20 m from the proposed development. The species is found in only 2% of 10 km grid squares in Ireland and is considered of Local-County importance. Although archaeophytes are non-native in origin, two such species are protected in Ireland under the Flora Protection Order, while four are listed on the Red Data Book (Curtis & McGough, 2005). On this basis, wild leek is considered a plant species warranting protection.

[11] Wildflowers of Ireland. http://www.wildflowersofireland.net/plant_detail.php?id_flower=508
[12] Flora of Northern Ireland website. http://www.habitas.org.uk/flora/species.asp?item=2193
[13] The Irish species register http://www.species.ie/burren/species.php?species_group=Burren&menuentry=soorten&selected=beschrijving&id=16

Image 5.6: Rare wild leek plant in wet grassland spit at Salmon Point

The only other rare species recorded was velvet feather-moss, which is 'Endangered' on the national red list for bryophytes (Holyoak *et al*., 2012). This was restricted to a few patches totalling <1 m wide, under a scrubby willow copse in the rank field to the east of the proposed development but was located more than 40 m east of the proposed development footprint (Image 5.7 and Figure 5.3). The population of this moss was valued at County Importance as a species on a national red list.

Image 5.7: 'Endangered' velvet feather moss from willow scrub copse

5.4.6 Invasive Species

The invasive species Japanese knotweed *Fallopia japonica* and hybrid bluebell *Hyacinthoides* X *massartiana* were both recorded within the footprint of the proposed development. It is an offence to allow or cause to spread either of these species, under regulation 49 of the Bird and Habitats Regulations. A small number of hybrid bluebell plants were recorded from the north-western corner of the proposed development footprint. The plants were near amenity grassland beside a stone wall on the Garavogue Estuary shoreline. A number of stands of Japanese knotweed were recorded within the proposed development footprint. Several stands were found along

the hedged boundary of the existing N15 within the rank grassland field to the east. Another stand was found near the hybrid bluebell plants on the shoreline to the west. Other stands were recorded in the wider area c. 50 m from the proposed development, and outside the predicted ZoI of disturbance. No other scheduled invasive species were recorded. Noxious species (i.e. native species posing a risk to agricultural land) known to occur in 2015 were broad-leaved dock, curled dock, creeping thistle, and common ragwort. These occurred throughout grassland and saltmarsh fringes in the case of curled dock.

5.4.7 Fauna Survey Results (Protected Mammals other than bats)

There were no access restrictions within the field survey areas. An otter footprint was recorded along the muddy shoreline west of Salmon Point, and an otter spraint was recorded on the shoreline to the northwest, adjacent to the proposed development. This indicates that otter use the shoreline around Garavogue Estuary to commute and feed. A single badger dropping was recorded within 50 m of the proposed development in the field directly northeast of the Copper River, indicating its use as foraging habitat.

There was no evidence of badger, otter, or other mammals using the Copper River to commute or feed. No badger setts or otter holts were recorded. The urban location, frequent disturbance from dog walkers, and lack of vegetation cover along the Copper River and shoreline makes the area largely unsuitable for mammal underground breeding or resting sites. Trash screens on the Copper River culvert made them unsuitable for passage by mammals.

No visual sightings were recorded of pygmy shrew or hedgehog, but sightings of these are rare. Pygmy shrew has been recorded in the locality according to the NBDC. There is suitable nesting habitat for the species within the footprint of the proposed development, in long grass in dense vegetation (including damp conditions), under rocks or logs, wherever adequate insect food supplies exist (habitat preference from Haydyn & Harrington, 2001). There is no optimal nesting habitat for hedgehog (typically hedge or woodland); and pasture is absent which is a preferred feeding area. Hedgehog is unlikely to nest within the ZoI.

No road kill of any species was observed during the survey. The NPWS Conservation Ranger's records of known otter road kills were located over 10 km from the proposed development.

5.4.8 Fauna Survey Results (Bats)

Detailed bat survey findings are provided in the Bat Report in Appendix 5.6. In summary, no bat roosts were recorded within the potential ZoI of direct disturbance, or indirect light spill. BCI held no records of known roosts within 1 km of the proposed development. A total of four bat passes from soprano pipistrelle and Leisler's bats were recorded during the dusk survey of the Copper River Bridge in July 2015. No bats were recorded during the dawn survey. There was no evidence of the Copper River Bridge being used by roosting bats. Static recorders were set out in July and August 2015 on either side of the Copper Bridge. Soprano pipistrelle, Leisler's and an unidentified *Myotis* sp. bat were recorded during this survey period. Unidentified *Myotis* sp. bats were only recorded at the downstream end of the Copper River on two dates in August 2015, albeit *Myotis* bats are likely to be under recorded due to their quieter echolocation calls. In summary, the bat survey found relatively low bat activity in the vicinity of the proposed development.

5.4.9 Fauna Survey Results (Amphibians and reptiles)

There was no potential habitat for protected smooth newt, common lizard, or common frog.

5.4.10 Fauna Survey Results (Birds)

5.4.10.1 Breeding Birds

A total of 35 species were recorded during the breeding bird surveys within the field survey area. Of these, 17 species were confirmed or probable breeders, typically associated with grassland or scrub habitats. The territories of probable / confirmed breeding birds of Medium or High Conservation within 100 m of the proposed development are illustrated in Figure 5.4 and summarised in Table 5-6**.** The potential for nests in these territories to occur within the footprint of the proposed development is also included in the table.

Table 5-6: Breeding birds – Probable / Confirmed Breeders of Medium or High Conservation Concern within 100 m of proposed development

Common name	Scientific name	Status	Conservation Concern	No. Territories within 100 m	Nests potentially within footprint
Goldcrest	*Regulus regulus*	Probable	Medium	1	0
Grey Wagtail	*Motacilla cinerea*	Probable	Red	1	1
House Sparrow	*Passer domesticus*	Confirmed	Medium	6	3
Linnet	*Carduelis cannabina*	Probable	Medium	1	0
Meadow Pipit	*Anthus pratensis*	Probable	Red	2	0
Robin	*Erithacus rubecula*	Probable	Medium	1	0
Starling	*Sturnus vulgaris*	Confirmed	Medium	1	0

Breeding territories were recorded within gardens, and scrub and grassland habitats within the ZoI. The nest of a single pair of breeding grey wagtail could be located in the Copper River Bridge or the adjacent rock armour within the footprint of the proposed development.

Kingfisher has been recorded on the Willsborough (Cartron) Stream (Cotton 2004, 2005).This stream lies 350 m from the proposed development and is not within the ZoI of potential effects to kingfisher nesting burrows (i.e. 150 m; Appendix 5.1). The reaches of the Garavogue and Copper Rivers falling within the ZoI are not suitable as kingfisher nesting habitat due to the rock gabion banks lacking soft nesting substrates, and the absence of tree cover to act as shelter or perches.

5.4.10.2 Wintering Birds

A total of 18 species were recorded during the wintering bird survey see Table 5-7: Wintering birds recorded within 500 m of proposed development.

Table 5-7: Wintering birds recorded within 500 m of proposed development

Common Name	Latin Name	Conservation Status		Peak Count (2015 / 2016)	SCI of SPA within ZoI?	% Cummeen Strand SPA Population[1]	Habitat Usage within Survey Area	
		BD Annex 1	BoCCI				Feeding	Roosting
Black-headed gull	*Chroicocephalus ridibundus*	-	Red	92	No	N/A	✓	✓ (20)
Common gull	*Larus canus*	-	Amber	3	No	N/A	✓	✓ (3)
Curlew	*Numenius arquata*	-	Red	3	No	N/A	✓	-
Cormorant	*Phalacrocorax carbo*	-	Amber	3	No	N/A	✓	✓ (3)
Grey heron	*Ardea cinerea*	-	Green	1	No	N/A	✓	-
Herring gull	*Larus argentats*	-	Red	25	No	N/A	✓	✓ (10)

Iceland gull	*Larus glaucoides*	✓	Not assessed	2	No	N/A	✓	✓ (2)
Lapwing	*Vanellus vanellus*	-	Red	1	No	N/A	✓	-
Lesser black-backed gull	*Larus fuscus*	-	Amber	2	No	N/A	✓	✓ (2)
Little egret	*Egretta garzetta*	✓	Green	2	No	N/A	✓	-
Little grebe	*Larus argentatus*	-	Amber	1	No	N/A	✓	-
Mallard	*Anas platyrhynchos*	-	Green	8	No	N/A	✓	✓ (8)
Mute swan	*Cygnus olor*	-	Amber	2	No	N/A	✓	-
Oystercatcher	*Haemotopus ostralegus*	-	Amber	4	Cumeen Strand SPA	1%	✓	✓(1)
Redshank	*Tringa totanus*	-	Red	3	Cumeen Strand SPA	1%	✓	✓(2)
Red-throated diver	*Gavia stellata*	✓	Amber	2	No	N/A	✓	-
Shag	*Phalacrocorax aristotelis*	-	Amber	1	No	N/A	✓	✓
Snipe	*Gallinago gallinago*	-	Amber	10	No	N/A	-	✓ (10)

Footnotes

- 1% National or International Populations thresholds which quality for SPA designation from Boland & Crowe (2007 were) used to calculate the % SPA Population.
- BoCCI – Birds of Conservation Concern in Ireland (BoCCI); Colhoun and Cummins, 2013.
- BD Annex 1 – Annex 1 of the Birds Directive.

Two species protected under Annex 1 of the Birds Directive (little egret and red-throated diver) were recorded in very small numbers. Two QI species of the Cummeen Strand SPA were also recorded in very small numbers; oystercatcher (4; <1% of SPA designation threshold) and redshank (3; <1% of SPA designation threshold).

Moderate numbers of herring gull (peak 25) and black-headed gull (peak 92) were recorded in open water or scavenging near a local carpark c. 150 m south of Hughes Bridge to the south of the proposed development. Moderate numbers of snipe (10) were recorded roosting at high tide on the grassland spit below Salmon Point. Populations of all other species present were very small. There were no significant high tide roosts within 500 m of the proposed development. Very small numbers of gulls, cormorant, oystercatcher, redshank and mallard roost on Salmon Point, and on rocky shorelines around the estuary. Other than occasional mallard, no wetland birds were recorded in the Copper River. Low species diversity and small numbers of individual birds were recorded feeding in the Garavogue Estuary within the survey area, relative to those recorded by Birdwatch Ireland in IWeBS data from 2009 to 2014 in the any of the four adjacent subsites. Table 5-8 compares the population sizes of Cummeen Strand SPA QI species and the four most numerous species in the survey area, to the adjacent IWeBS subsites. A comparison to the single season of data from the NPWS low tide data cannot be made, as the NPWS count area included areas both within and outside the ZoI.

Table 5-8: Cummeen Strand QI populations recorded in survey area relative to other parts of SPA

Common name	Significance	Survey Area (Peak 2015 / 2016)	Cummeen Strand and East Gibraltar (mean 2009-2014)	Cartron Marsh (mean 2009-2014)	Sligo Docks (mean 2009-2014)	Port-Finisklin (peak 2008 / 2009)
Oystercatcher	QI of Cummeen Strand SPA	4	423	18	15	76
Redshank	QI of Cummeen Strand SPA	3	169	70	32	127
Black-headed gull	Most numerous recorded in survey area (2015 / 2016)	92	41	176	293	180
Herring gull	2nd most numerous recorded in survey area (2015 / 2016)	25	28	72	169	73
Snipe	3rd most numerous recorded in survey area (2015 / 2016)	10	0	1	11	0
Mallard	4th most numerous recorded in survey area (2015 / 2016)	8	42	26	73	140

Table 5-7 shows that, with the exception of snipe, herring gull, and black-headed gull, all counts were lower than the adjacent IWeBS sites. Snipe are typically not well recorded in IWeBS sites due to their elusive roosting behaviour. Snipe were highly likely to be under-recorded in IWeBS surveys, because the method does not require surveyors to walk areas of roosting habitat to flush birds. The peak of ten snipe recorded in the survey area was obtained by walking the grassland spit below Salmon Point and counting the flushed birds in flight. Gull numbers within the survey area were high primarily due to the presence of a carpark to the east of the Hughes bridge, where birds scavenged rubbish or were fed by locals.

The low numbers and species diversity within the survey area reflects the mixed sediment / rock substrate in the vicinity of the proposed development, compared to the extensive mudflat in the adjacent bay with more abundant invertebrate prey. The existing disturbance from dog walkers around an existing path skirting the estuary near the proposed development also reduces its potential value to wintering birds.

5.4.11 Fauna Survey Results (Fish)

Fish recorded in the Copper River in the environs of the proposed development (Site 1 and Site 2, see Appendix 5.7) were European eel *Anguilla anguilla*, flounder *Platyichthys flesus*, common goby *Pomatoschistus microps* and three-spined stickleback *Gasterosteus aculeatus*. A small number of elvers (juvenile eel) were also recorded during kick sampling. Although the European eel is a native fish of significant ecological importance

and is 'Critically endangered' in the Irish 'Red List' (King *et al*., 2011), the Copper River is deemed to support a very small population of European eel, and is not a significant habitat for this species.

The stretch of the Copper River within the ZoI of the proposed development is not considered an important area for juvenile lampreys or salmonids as the ecological requirements of these fauna are not present in this part of the river. Juvenile lampreys require a substrate composed of silt, or silt and sand. The substrate in the environs of the Copper River Bridge comprises rock and compacted clay so is not suitable for juvenile lampreys, and none were found during sweep sampling. Salmon fry and parr occupy shallow, fast-flowing water with a moderately coarse substrate with cover (Symons & Heland, 1978). Deep or slow-moving water, particularly when associated with a sand or silt substrate, does not support resident juvenile salmonids. The fact that the Copper River is tidal at this location precludes the presence of juvenile Atlantic salmon in the lower reaches of the river as the channel is flooded during times of high tide. Moreover, Atlantic salmon require very good water quality, and water quality in the lower reaches of the Copper River is unsuitable / suboptimal for juvenile Salmon, given its apparent unsatisfactory condition. Likewise, the section of the Copper River within the study area is not considered an important habitat for juvenile brown / sea trout *Salmo trutta* based on reasons given above for salmon. Neither Atlantic salmon nor lamprey use the Copper River as a migratory corridor.

5.4.12 Fauna Survey Results (Terrestrial Invertebrates)

A small number of common butterflies were recorded including small white *Pieris rapae*, large white *Pieris brassicae*, speckled wood *Parage aegeria,* meadow brown *Maniola jurtina*, and Real's wood white *Leptidea reali*. All are Least Concern on the Irish red-list (Regan *et al*., 2010). Only a small portion of the footprint of the proposed development overlaps potential feeding or breeding habitat for these species. Site surveys found there to be no potential for marsh fritillary within the ZoI (in this case the footprint of the development) as the species larval food plant devil's bit scabious *Succisa pratensis* was absent from the survey area.

5.4.13 Fauna Survey Results (Aquatic Invertebrates and Water Quality)

Overall macroinvertebrate diversity was low upstream and downstream of the Copper River Bridge. The macroinvertebrate community was dominated by pollution-tolerant brackish species including the ubiquitous amphipods *Corophium volutator* and *Gammarus* sp. The lower reaches of the Copper River (encompassing Site 1 and Site 2, see Appendix 5.7) are not suitable with regard to assigning a Q-rating using the EPA biological water quality rating system as it is not a truly aquatic stretch of river.

The riffled part of the Copper River upstream of the tidal influence was also dominated by pollution tolerant species (*Gammarus* sp., and *Baetis rhodani*). Very tolerant indicators were well represented including the leech *Glossiphonia complanata* and the bladder snail *Physa fontinalis*. There was a paucity of less sensitive macroinvertebrates, limited to cased caddisfly larvae of Limnephilidae. Using the EPA freshwater biological water quality rating system (Toner *et al,* 2003), biological water quality in the upstream reach of the river outside the ZoI was rated 'Q3, Moderately Polluted' corresponding to Water Framework Directive 'Poor' status.

5.5 Ecological Valuation and Identification of Key Ecological Receptors

Table 5-9 summarises the ecological evaluation, taking into consideration legal protection, conservation status and local abundance. Key Ecological Receptors (KER's) are identified in grey in the table. Designated sites are listed in the table below and also assessed separately in the Natura Impact Statement in Appendix 5.9.

Table 5-9: Summary Valuation of Key Ecological Receptors (KERs highlighted in pink)

Ecological Feature Type	European protection	Sligo BAP Feature	Ecological Importance as per NRA, 2009	Key Ecological Receptor (s)?
Designated sites				
Cummeen Strand / Drumcliff Bay cSAC	Yes	N/A	International	Yes

Ecological Feature Type	European protection	Sligo BAP Feature	Ecological Importance as per NRA, 2009	Key Ecological Receptor (s)?
Cummeen Strand SPA	Yes	N/A	International	Yes
Cummeen Strand / Drumcliff Bay pNHA	Yes	N/A	National	Yes
Other Designated Sites	Varies	N/A	Varies	No
Habitats and Flora				
Mudflats and sandflats	*Mudflats and sandflats (1140).*	N/A	International	Yes Already assessed under Cummeen Strand SPA / cSAC *The NPWS CO has this area mapped as mudflats and sandflats (1140). However, surveys indicated that the area of Estuary immediately adjacent to the proposed development comprised mixed sediment (LS3) / Sheltered Rocky Shores (LR3). This area is unlikely to support significant benthic communities associated with this QI habitat.*
Mixed sediment (LS3) / Sheltered Rocky Shores (LR3)	QI *Estuaries* (1130)	Yes	International	Yes As above.
CM1 Lower Saltmarsh / CM2 Upper salt marsh mosaic	*Atlantic salt meadows 1330 / Mediterranean salt meadows* (1410) mosaic.	Yes	County	Yes (*Valued at County rather than national value as probably non-viable to stochastic climate change)*
CW2 Tidal River (Copper River)	None	Yes	International	Yes
GS2 Dry meadows and grassy verges	None	Yes	Local (Higher value)	Yes
GS4 Wet grassland	None	Yes	Local (Higher value)	Yes
WD1 Mixed broadleaved woodland	None	No	Local (Higher value)	Yes
WD5 Scattered trees and parkland	None	No	Local (Higher value)	Yes

Ecological Feature Type	European protection	Sligo BAP Feature	Ecological Importance as per NRA, 2009	Key Ecological Receptor (s)?
WS1 Scrub	None	No	Local (Higher value)	Yes
WL2 Treeline	None	Yes	Local (Higher value)	Yes
WL1 Hedgerows	None	Yes	Local (Higher value)	Yes
Invasive - Japanese Knotweed	N/A	N/A	N/A	Yes
Rare Flora – Endangered Velvet feather moss	None	No	County	Yes
Rare Flora – Wild leek	None	No	Local-County	Yes
BL1 Stonewalls	None	No	Local (Lower value)	No – insufficient value
GA2 Amenity grassland	None	No	Local (Lower value)	No – insufficient value
Species				
Breeding birds of conservation concern (one meadow pipit and grey wagtail territory of high concern; several house sparrow territories of medium concern)	No	No	Local (Higher value)	Yes
Wintering birds excluding designated SPA populations already assessed above.	Yes	No	Local (Higher value)	Yes
Pygmy shrew (presumed present)	No	No	Local (Higher value)	Yes
Foraging / Commuting bats (At least three species)	Yes	Yes	Local (Higher value)	Yes
Otter (Low intensity foraging on Garavogue shoreline; no holts within ZoI)	Yes	Yes	International if associated with Lough Gill cSAC	No – no holts within ZoI; no usage of copper river corridor ; any temporary displacement effects to feeding or commuting animals in Garavogue estuary will not be significant
Badger (Low intensity foraging in rank grasslands; no setts within ZoI)	N/A	No	Local (Higher value)	No – no setts within ZoI; no usage of copper river corridor
Fish (excluding lamprey and salmonid cSAC populations, already assessed above) in the Copper River (eel, common goby, flounder)	No	No	Local (Lower value)	No – insufficient value
Hedgehog	No	No	Local (Lower value)	No – insufficient value
Kingfisher in Carton Stream	N/A	No	Local-County	No – outside ZoI

Ecological Feature Type	European protection	Sligo BAP Feature	Ecological Importance as per NRA, 2009	Key Ecological Receptor (s)?
Invertebrates including several common butterflies and aquatic species in Copper River	N/A	No	Local (Lower value)	No – insufficient value
Common frog and smooth newt	N/A	No	Local (Higher value))	None within ZoI

5.5.1 Ecological Features Scoped out from the Assessment

In accordance with best practice guidance (NRA, 2009 and CIEEM, 2016), **amenity grassland, stonewalls, invertebrates**, and **fish including eel, common goby, flounder eel** were scoped out from the impact assessment because they were not of sufficient value.

Despite its conservation status, the very small population of **juvenile eel** in the Copper River is not considered important. The species occurs in almost every rivulet, brook, stream, river and lake in Ireland to which they can gain access according to King *et al*., 2011. Atlantic salmon and lamprey have been scoped out as there is no habitat for either species in the Copper River and they do not use the river as a migratory corridor. Although fish were scoped out, pollution mitigation for the construction phase has been proposed to comply with IFI requirements, and to protect aquatic habitats and non-fish species.

Kingfisher and hedgehog were scoped out because although present or potentially present in the locality, there were no known breeding or resting sites, or significant feeding sites within the ZoI of significant effects. There was no potential for **common frog, smooth newt, and common lizard** to occur, and these were also scoped out.

Field evidence indicated low levels of **otter and badger** use of the adjacent Garavogue Estuary and in the field directly northeast of the Copper River, respectively used for feeding / commuting. However the Copper River was excluded as a potential commuting route for either species, and there were no breeding or resting sites (or potential habitat for same) in the urbanised environs of the proposed development. Temporary disturbance or displacement to small numbers of feeding / commuting animals was not considered significant, and both species were scoped out from the assessment.

5.6 Impact Assessment

5.6.1 Predicted Impacts of the Proposed Development

5.6.1.1 Do Nothing Scenario

The baseline status of relevant habitats and species in the absence of the proposed development are discussed below. There are no major changes predicted to the baseline condition of ecological features for the 'Do Nothing' scenario within the ZoI of the proposed development

5.6.1.2 Do Nothing – Protected sites

There are ongoing pressures from water pollution, aquaculture, disturbance from recreational shoreline and boat use, and sea-level rise. However the conservation status of estuarine and mudflat habitats is good, according to the Natura Standard Data forms for Cummeen Strand cSAC (NPWS, 2014). The conservation status of QI wintering bird populations is excellent, according to the Natura Standard Data forms for Cummeen Strand SPA (NPWS, 2014). Having consulted with SCC, no major reclamation projects are currently known (see Cumulative Impacts). In the absence of the proposed development, the ecological functioning of designated estuarine habitats and population structure of wetland bird populations is unlikely to change significantly from the existing baseline. However, in the medium-to-long term, it is possible that continued sea temperature rises linked to global warming could threaten the conservation status of Atlantic salmon and lamprey which are QIs of the Lough Gill cSAC.

5.6.1.3 Do Nothing – Habitats and Flora

Over the short-to-medium term, the rare archaeophyte plant wild leek may be lost through the natural succession of habitats below Salmon Point from grassland to scrub, while the large unmanaged field to the east of the existing road will develop from rank grassland into scrub. If left untreated, Japanese knotweed and non-native bluebell invasives will spread to adjacent areas. In the medium-to-long term, climate change triggering sea level rise is likely to result in the loss of some of the saltmarsh habitats from the Garavogue Estuary shoreline.

5.6.1.4 Do Nothing – Fauna

The transition from grassland to scrub habitats above will influence and alter the constituent bird, mammal, and invertebrate communities present. An increase in scrub could favour breeding bird abundance, but reduce the abundance of invertebrate food plants, and extent of mammal foraging area. The value of the area to foraging bats would remain low, given the existing lighting from the N4-N15 road carriageway.

5.6.2 Identification of Designated Sites Potentially Impacted

Having identified a preliminary list of sites in Section 5.4.3, the source-pathway-receptor conceptual model was applied, given the characteristics of the proposed development, to identify which designated sites, and specific features within sites, should be scoped into the impact assessment, see Table 5-10.

Table 5-10: Identification of designated sites potentially affected

Site and Code	Distance	Reason for Designation (* = Priority Habitat)	Potential Source-~Pathway-Receptor Link?	Scoped into assessment?
Cummeen Strand SPA (4035)	0 m	Common redshank	Yes – potential disturbance of roosting and / or feeding birds during construction.	Yes
		Light-bellied brent goose	No – desktop and field survey indicates no populations within ZoI of disturbance or other potential impacts.	No
		Oystercatcher	Yes – potential disturbance of roosting and / or feeding birds during construction.	Yes
		Wetlands and Waterbirds	Yes – potential pollution effects during construction.	Yes
Cummeen Strand / Drumcliff Bay cSAC (627)	0 m	Estuaries	Yes – potential pollution effects during construction. Potential short-term impacts during construction associated with movement of machinery across the cSAC.	Yes
		Mudflats and sandflats	Yes – potential pollution effects during construction only. Potential short-term impacts during construction associated with movement of machinery across the cSAC. The NPWS CO has mapped this as mudflats and sandflats (1140). However, surveys indicated that the habitat immediately adjacent to the proposed development was in fact the habitat: mixed sediment (LS3) / Sheltered Rocky Shores (LR3).	Yes
		River lamprey	Yes – potential pollution effects during construction.	Yes
		Sea lamprey	Yes – potential pollution effects during construction.	Yes
		Embryonic shifting dunes	No – desktop and field survey indicates no habitat within the ZoI of disturbance or other potential impacts.	No
		Fixed dunes	No – see Embryonic shifting dunes.	No
		Juniperus communis communities	No – see Embryonic shifting dunes.	No
		Petrifying springs	No – see Embryonic shifting dunes.	No
		Shifting dunes with *Ammophila arenaria*	No – see Embryonic shifting dunes.	No

Site and Code	Distance	Reason for Designation (* = Priority Habitat)	Potential Source-~Pathway-Receptor Link?	Scoped into assessment?
		Harbour seal *Phoca vitulina*	No – desktop and field survey indicates no populations within ZoI of disturbance or other potential impacts.	No
		Narrow-mouthed whorl snail *Vertigo angustior*	No – see Embryonic shifting dunes.	No
Cummeen Strand / Drumcliff Bay pNHA (627)	0 m	Same as cSAC and SPA	Yes – potential pollution effects during construction.	Yes
Lough Gill cSAC (1976) / pNHA	0.4 km (upstream)	Otter *Lutra lutra*	No – The Copper River was excluded as a potential commuting route for the species due to the absence of field evidence over numerous visits, many of which did not follow heavy rain which washes away field evidence. There is no likelihood for use of the Copper River bridge culvert to access the estuary due the existing trash screen and the culvert of the existing culvert, and there were no breeding or resting sites (or potential habitat for same) in the urbanised environs of the proposed development. Temporary disturbance or displacement to small numbers of feeding / commuting animals was not considered significant, and the species was scoped out from the assessment.	No
		Alluvial forests*	No – the nearest habitat is upstream and outside the ZoI of disturbance or other potential impacts.	No
		Natural eutrophic lakes	No – the nearest habitat is upstream and outside the ZoI of disturbance or other potential impacts.	No
		Old sessile oak woods	No – the nearest habitat is upstream and outside the ZoI of disturbance or other potential impacts.	No
		Atlantic salmon *Salmo salar*	No – the fisheries desktop and field surveys concluded the Copper River is highly unlikely to support the species due to its small size, degraded nature and apparently poor water quality, and is not of importance to the migration of this species.	No
		River Lamprey	No – the fisheries desktop and field surveys concluded migratory lampreys do not occur in the Copper River due to its small size and general lack of soft substrates, and that the intertidal mixed muddy substrate at Salmon point was unsuitable due to its transitional nature.	No
		Sea lamprey		

Site and Code	Distance	Reason for Designation (* = Priority Habitat)	Potential Source-~Pathway-Receptor Link?	Scoped into assessment?
		White-clawed crayfish *Austropotamobius pallipes*	No – desktop and field survey indicates no populations within the ZoI of disturbance or other potential impacts.	No
Colgah Lough pNHA (1658)	4.5 km	Lake with invertebrates and waterfowl including whooper swan *Cygnus cygnus*	No – the nearest habitats are upstream and outside the ZoI of disturbance or other potential impacts. Although the proposed development is within the core foraging range of this species (5 km; Appendix 5.1), there is no suitable habitat for the QI within the ZoI.	No
Ballintemple and Ballygilgan SPA (4234)	13 km	Barnacle Goose *Branta leucopsis*	No – Although the proposed development is within the core foraging range of this species (5 km; Appendix 5.1), there is no suitable habitat for the QI within the ZoI.	No
Ardboline Island and Horse Island SPA (4135)	14 km	Barnacle Goose *Branta leucopsis*	No – Although the proposed development is within the core foraging range of this species (5 km; Appendix 5.1), there is no suitable habitat for the QI within the ZoI.	No
All other sites are scoped out, because they are not within the ZoI of any significant effects, including in-combination effects, given the nature of the proposed development, and the scientifically-supported zones of influence in Appendix 5.1.				

5.6.3 Construction-Phase Impacts

Potential impacts during construction may arise from the following source-pathway-receptor linkages:

- Overland run-off or controlled discharge of contaminated surface water to the Copper River, Garavogue River and / or Garavogue estuary, potentially affecting estuarine species and habitats;
- Removal / damage to habitats within and adjacent to road infrastructure during soil stripping, vegetation clearance, movement of machinery over vegetation, or use of temporary storage and temporary haul routes;
- Mortality or injury of terrestrial species during vegetation clearance;
- Disturbance to bats from construction lighting;
- Disturbance to other fauna (specifically birds) from vibration, noise, and / or human presence;
- Spread of invasive species during earthworks; and
- Disturbance to QI estuary habitat associated with the movement of machinery.

5.6.3.1 Potential Impacts to Designated Sites

5.6.3.1.1 European sites

There will be no overlap of the proposed infrastructure associated with the proposed development with the QI of the Cummeen Strand cSAC.

There is potential for movement of construction machinery including piling rigs across cSAC intertidal areas to access the seawall to install sheet piling during retaining wall construction (approx. Ch. 250 to 350 m). Movement of construction machinery will be for 8 weeks with approx. six vehicle movements per day on for setting up / removing shuttering, concrete to be poured from road side so no need for movement in the estuary. Although this rocky intertidal area is QI estuary habitat, site surveys found this area to comprise rocky shore / mixed sediment unlikely to contain significant benthic communities, in contrast to NPWS CO mapping indicating it is mudflat (Sections 5.4.3 and 5.4.5).Potential impacts from compaction of benthic communities will be avoided by the use of timber bog mats during construction and are therefore predicted to be non-significant. Winterbird surveys conducted between September 2015 and January 2016 recorded two QI species of the Cummeen Strand SPA. Peak counts for oystercatcher (4; <1% of SPA designation threshold) and redshank (3; <1% of SPA designation threshold) were extremely low when compared to the designation threshold for the site Potential disturbance impacts to feeding and roosting birds are not significant due to the absence of significant roosting or feeding populations within the ZoI of the proposed development. In the absence of mitigation temporary potential impacts to estuarine bird habitats from surface water generated during construction would be significant at the Local geographic scale.

5.6.3.1.2 National sites

The Cummeen Strand / Drumcliff Bay pNHA (627) is entirely coincident with European site boundaries. All impacts to the Cummeen Strand / Drumcliff Bay cSAC and SPA could equally affect the pNHA, although the impact significance would be at national geographic scale. There will be no potential impacts to other national sites.

5.6.3.2 Potential Impacts to Habitats and Flora

5.6.3.2.1 Water Pollution

There were no freshwater habitats downstream of the proposed development containing highly sensitive spawning salmonids or spawning lamprey. However, there is potential for oils, fluids, paints, concrete washings, etc. to enter the Copper River and / or other undesignated habitats such as the saltmarsh fringe along the Garavogue shoreline fringe, either after being washed overland (e.g. across hardstanding) or via the temporary drainage network established for the construction stage. Depending on the volumes and contaminants

concerned, potential impacts could be significant at local to county geographic scales of significance (i.e. the maximum ecological value of saltmarsh habitat). Potential impacts from sediment generated during earthworks, and instream works for the replacement of the Copper River Bridge, are predicted not to be significant because the fish present in the Copper River will be habituated to estuarine waters with heavy sediment loading, and salt marsh would not be significantly impacted by increases in sediment in tidal waters.

5.6.3.2.2 Habitat Loss

Table 5-11 summarises potential habitat loss impacts. All impacts are permanent and significant at local geographic scale.

Table 5-11: Predicted Habitat Loss from the Proposed Development

Habitat Type	Extent of habitat within footprint (m^2)	Ecological Importance of receptor within survey area	Potential Impact Significance
CW2 Tidal River	None	N/A	N/A
GS2 Dry Meadows and Grassy Verges	600 m^2	Local Importance (Higher value)	Local
GS4 Wet Grassland	150 m^2	Local Importance (Higher value)	Local
WD5 Scattered Trees and Parkland	700 m^2	Local Importance (Higher value)	Local
Mixed sediment (LS3) / Sheltered Rocky Shores (LR3)	None	International	N/A
Upper saltmarsh (CM2) / Lower saltmarsh (CM1)	None	County	N/A
WS1 Scrub	3740 m^2	Local Importance (Higher value)	Local
WL1 Hedgerows	250 m (linear length)	Local Importance (Higher value)	Local
WL2 Treelines	120 m (linear length)	Local Importance (Higher value)	Local

5.6.3.2.3 Rare flora

The populations of wild leek plants (located 20 m northwest of Ch. 150 m) and velvet feather moss (located 45 m southwest of Ch. 300 m) will not be impacted by the proposed development as they are outside the proposed development boundary.

5.6.3.2.4 Invasive Flora

Japanese knotweed (located adjacent the proposed development boundaries northwest of Ch. 500 m and east of Ch. 500 m to Ch. 510 m) is highly invasive and can disperse over large distances, potentially spreading from finger-nailed sized fragments. Hybrid bluebell (located on the proposed development boundary north west of Ch. 500 m) spreads by discarded bulbs in garden waste. As a highly fertile hybrid, it can also spread by seed to local areas. Both species occur in isolated areas within and on the fringes of the proposed development. In the absence of mitigation, potential impacts could be long-term and significant at Local to County geographic scale depending on the areas impacted.

5.6.3.3 Potential Impacts to Fauna

Potential impacts to kingfisher, hedgehog, badger, otter and bats, and all other protected species were scoped out (see Section 5.5.1).

5.6.3.3.1 Wintering Birds (Excluding SPA populations)

QI species including Light-bellied brent goose was not recorded within the ZoI during winter bird surveys, while extremely low numbers of oystercatcher (4) and redshank (3) were recorded. Disturbance impacts to QI bird are considered not significant. Disturbance to other wetland birds including but not limited to gulls and snipe during the non-breeding season is likely to temporarily displace them from intertidal feeding areas, or shoreline roosting habitats to nearby intertidal areas or inland pasture. This could include a high tide roost of at least ten snipe and small numbers of other waders and waterfowl on Salmon Point (50 m west of proposed development boundary at Ch. 150 m). Potential impacts could be temporary to short-term and significant at Local geographic scale given the populations concerned.

5.6.3.3.2 Breeding Birds

The nest of a single pair of breeding grey wagtail could be located in the Copper River Bridge or the adjacent rock armour within the footprint of the proposed development (west or east of Ch. 460 to 470 m). The species is of high conservation concern. A small colony of house sparrows of medium conservation concern nest in scrub woodland within the proposed development (Ch. 400 to 450 m) where the Copper River meets the estuary. A small number of other populations breeding in close proximity to the proposed development including one territory of meadow pipit of high conservation concern (on Salmon Point, west of Ch. 140 m), could suffer indirect disturbance impacts during construction. The geographic scale of potential impact significance will not exceed local levels for any of the populations affected, due to the small number of territories involved. None of the populations affected would constitute 1% or more of the County Sligo population.

5.6.3.3.3 Bats

The main potential impact to bats during the construction phase is the temporary disturbance to foraging bats along the Copper River during the construction of the new bridge due to displacement by temporary lighting around the site, see Appendix 5.6. As the area is in an urban setting, the river is likely already subject to a level of light pollution from existing street lighting. The presence of additional temporary lighting may therefore lead to the site becoming temporarily unsuitable for bats. Leisler's bats are not negatively impacted by artificial lighting (Mathews *et al*., 2015). No buildings or trees confirmed as bat roosts from previous surveys will be destroyed as part of the proposed development. Overall the potential impact would be regarded to be significant at a local geographic scale.

5.6.3.3.4 Pygmy shrew

Pygmy shrew is presumed present in rank grassland habitats. Site clearance at any time of year, including invasive species treatment measures, could result in injury or mortality. Population impacts would be greatest when juveniles would be present in nests (April-October). Site clearance could result in mortality of small numbers of pygmy shrews with impacts significant at Local geographic scale in the short-term.

5.6.4 Operation-Phase Impacts

5.6.4.1 Potential Impacts to Designated sites

Given the embedded treatment system described in Chapter 2 there will be no significant impacts on designated sites relating to water pollution. Disturbance to QI birds species during the operational phase is also considered non-significant as there will be little to no change from the existing baseline.

5.6.4.2 Potential impact to Flora and Fauna

There will be no impacts on flora and fauna during the operational phase. The Copper River is not currently used by commuting mammals to cross the existing roadway, so there is no predicted impact from the changes to bridge dimensions, or works to complete same. The proposed Copper River bridge dimensions will be increased at the upstream end, relative to the existing (8000 mm X 3000 mm box culvert replacing twin 1700 mm pipes). The Copper River is not an important migratory corridor for fish, however, works on the Copper River Bridge are likely to improve on existing conditions for fish passage. The minor scale of the proposed road improvements, and the existing urban setting where existing noise and lighting levels are high, means there will be no significant increase in lighting or noise disturbance to birds, mammals, or other species resulting from the proposed development.

5.6.4.3 Potential Impacts to Air Quality and Ecology

There will be no significant air pollution impacts arising from operation of the proposed development. The Annual Average Daily Traffic is predicted to increase by 10% from 25,679 in 2015 to 28,278 by 2032 with the proposed development in place. The impact of the proposed development is predicted to lead to an increase in NOx concentrations within the Cummeen Strand / Drumcliff Bay pNHA / cSAC, Cummeen Strand SPA, and Lough Gill cSAC / pNHA of at most 1.01 µg/m^3. This is below the 2 µg/m^3 change triggering an ecological assessment in accordance with the Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009). On this basis, no significant air quality impacts are predicted.

5.7 Proposed Mitigation and Avoidance Measures

5.7.1 Characteristics of mitigation proposed

In accordance with best practice guidance (CIEEM, 2016), sufficient information has been included for effective implementation of mitigation. Specifically, alternative mitigation options have been provided to ensure flexibility in response to the potential unpredictability in construction programming and/or health and safety considerations of the construction-stage contractor. Potential impact significance was assessed with embedded mitigation, i.e. the mitigation that has been incorporated into the design of the proposed development.

5.7.2 Construction-Phase Mitigation

5.7.2.1 Designated Sites

5.7.2.1.1 Appointment of an Ecological Clerk of Works

An Ecological Clerk of Works (ECoW) will be appointed during the construction phase to:

- Review the contractor's method statements relating to environmental protection (e.g. relating to pollution control measures, movement of machinery across the SAC);
- Site visit at the start of construction phase (and once every two months thereafter) to ensure all elements of environmental protection outlined in method statements are adhered to; and
- Supervision of pilling works / movement of machinery across SAC (at the start of these works) to ensure timber bog mats are in place and the movement of machinery is kept as close as possible to the shore.

5.7.2.1.2 Erosion and Sedimentation Control Plan

A preliminary Erosion and Sedimentation Control Plan (pESCP) has been developed in conjunction with the EAR, see Appendix 6.5. This details specific pollution prevention measures to be employed during construction and will be binding on the appointed contractor and actively monitored by SCC and the appointed ECoW. No additional measures are required to mitigate the significance of potential pollution effects.

5.7.2.1.3 Protection of intertidal habitats

Timber bog mats will be deployed in intertidal habitats to enable construction machinery to safely move across the cSAC / SPA while limiting impacts on these intertidal habitats. These provide an effective method of ensuring heavy plant and equipment can traverse soft terrain without being impeded or causing excessive damage to the habitats underfoot. The contractor will develop a method statement approved by the ECoW for this work.

5.7.2.2 Habitats and Flora

5.7.2.2.1 Pollution

The pESCP provided in Appendix 6.5, outlines how pollution impacts to undesignated habitats and species will be mitigated.

5.7.2.2.2 Habitat Loss

Species-rich native grass seed mixes, of a composition similar to the 'Traditional Wildflower Meadow Mixture' (Code WF02; available online from wildflowers.ie) will be used to landscape all roadside verges, and the above-ground containment tank facing the estuary to mitigate loss of wet grassland and dry meadow habitat (as illustrated in Figure 10.2 Landscaping Mitigation). This will result in a net gain in biodiversity as the existing verges are species-poor and highly managed. The flower-rich habitat could also benefit invertebrate species of conservation known to occur in Sligo such as the bee *Bombus barbutellus.*

Small losses of scrub, woodland, and hedge will be partially mitigated by planting of a species-rich native scrub hedgerow mix inside the fence-line of the proposed development. Hedges will be native, and species-rich, to include willow *Salix cinerea* which is locally abundant, in addition to at least three other native woody species. Although existing, ash will not be replanted due to concerns associated with ash dieback. Ash will be replaced by alder *Alnus glutinosa*. There is no mitigation available for the small losses of salt marsh habitat.

The site compound will be located within an area of existing hardstanding (the Valet Depot) on Ballast Quay. This will minimise damage to areas outside the boundary of the proposed development during construction.

5.7.2.2.3 Invasive and Noxious Species

No construction will take place within any area affected by Japanese knotweed until it has been successfully treated or removed. SCC commenced treatment of Japanese knotweed by stem injection in October 2016. This multi-annual treatment is being managed by SCC and undertaken as part of TII's wider invasive species treatment programme across the national road network. It is estimated that successful treatment will take up to four years. In the event that construction is required to commence within four years, or in the event that any invasive species material remains after treatment, the material will be removed under an advance works contract (which shall be subject to a separate invasive species management plan). In any event, specialist with relevant expertise in the area of invasive species will verify the removal of all knotweed-related material prior to any construction commencing.

5.7.2.3 Fauna

5.7.2.3.1 Wintering Birds

No mitigation is proposed. Restricting construction to periods when wintering birds are not present is not considered necessary, given the small numbers of QI birds present within the ZoI, and their likely habituation to the high levels of existing disturbance on the bridge.

5.7.2.3.2 Breeding Birds

Vegetation including scrub and grassland will not be removed, where practicable, between March and August inclusive. The Wildlife Acts provide an exemption from this seasonal restriction for road construction but there is no exemption for nest destruction. Where the construction programme does not allow this seasonal restriction to

be observed, vegetated areas will be inspected by a suitably qualified ecologist for the presence of breeding birds prior to clearance. Where nests are found within the area to be cleared, or within the potential ZoI of indirect disturbance (i.e. at least 50 m for most common passerines) the appointed ecologist will advise the Contractor if a licence is required from the NPWS to permit disturbance and / or removal of the nest.

Areas found not to contain nests must be cleared within 3 days of the survey, or further surveys will be required. Grey wagtail may nest in stonewall habitats rather than vegetation. If works to the Copper River Bridge overlap the breeding bird season, a geotextile membrane will be installed on the rock gabion within 50 m of the Copper River works to prevent grey wagtail nesting in the area of disturbance.

5.7.2.3.3 Bats

The installation of temporary lighting during the construction works for the Copper River Bridge works will be monitored by a suitably qualified ecologist prior to continuous use to ensure that any light spill into dark areas especially near the river are minimised. Adjustment to light orientation and height may be required to minimise the net change in illumination to previously dark areas.

5.7.2.3.4 Pygmy shrew

Implementation of breeding bird mitigation will restrict vegetation removal during the shrew breeding season (March-August inclusive).

5.7.2.3.5 Fish

Although fish were scoped out from the assessment, IFI have requested best-practice design in accordance with *Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters* (IFI, 2016). Accordingly, a method statement for instream works will be submitted to IFI. As per IFI's requirements, and the NRA Guidelines for crossing of watercourses during construction, the bridge structure will be designed:

- Without trash screens or with types of screen which permit fish passage;
- With the level of the culvert bottom (invert) about 500 mm below the level of the natural stream bed;
- With a constant slope throughout its length which does not exceed 1%; and
- With a grade allowing the upstream invert to remain drowned (by back-watering) under low-flow conditions, to a depth suitable for the easy passage of the largest species frequenting the stream.

5.7.3 Operation-Phase Mitigation

5.7.3.1 Designated Sites

The embedded treatment system and pollution control measures describe in Section 5.1.4 has been put in place to mitigate for impacts on designated sites during the operational phase of the proposed development.

5.7.3.2 Flora and Fauna

No significant impacts identified therefore no mitigation is proposed.

5.7.3.3 Monitoring and Adaptive Management

Pre-construction survey and potential licencing requirements have been proposed for breeding birds, in the event where vegetation clearance cannot avoid the breeding season.

Water quality monitoring has been proposed in Chapter 6.

5.8 Residual Impacts

With implementation of mitigation as outlined above, and in Figure 10.2 Landscaping Mitigation, there will be no residual impacts above Local level at either construction or operation phase.

5.9 Cumulative Impacts

Existing or proposed projects or plans impacting the same key ecological receptors as the proposed development could lead to impacts of a higher level of significance when assessed cumulatively.

5.9.1 Methodology

The study area for the cumulative impact assessment was defined separately for each receptor, using the zones of influence defined for the proposed development alone. For instance, the potential ZoI from the proposed development alone to groundwater dependent habitats was 250 m, and the cumulative impact assessment study area for these habitats was also 250 m. For wintering bird disturbance, the ZoI was 500 m for the proposed development alone, and therefore also for the cumulative assessment. All ZoIs are provided in Appendix 5.1. The cumulative assessment identified any existing or proposed projects or plans that could give rise to the types of effects known to threaten the conservation status of the key ecological receptors scoped into the assessment (see Table 5.12: Known threats of Key Ecological Receptors to inform the cumulative impact assessment). Existing or proposed projects were identified using online data sources such as county development plans and SCC's planning portal (eplanning.ie/sligo) and SCC was also consulted. N4 Collooney / Castlebaldwin.

Table 5-12: Known threats of Key Ecological Receptors to inform the cumulative impact assessment). There are no known proposals for development within the ZoI. There are two road projects under active consideration by SCC at present namely the:

- N16 Sligo to County Boundary Realignment; and
- N4 Collooney / Castlebaldwin.

Table 5-12: Known threats of Key Ecological Receptors to inform the cumulative impact assessment

Ecological Feature Type	Known Threats	Conservation Status
Cummeen Strand / Drumcliff Bay cSAC (mudflats and estuaries)	Grazing, coastal defences forestry, aquaculture, fertilisation, outdoor recreation, golf courses, erosion, urbanization, industry, fertilization, leisure fishing	Good
Cummeen Strand SPA (Redshank and Oystercatcher)	Aquaculture, fertilisation, urbanisation, reclamation, industry pollution, roads, shipping lanes	Excellent
CM1 / CM2 salt marsh mosaic	Intensive grazing, paths, invasive species, erosion, climate change	Unfavourable (inadequate)
CW2 Tidal River (Copper River)	None published, but likely to include pollution, instream works, changes to tidal regime, and alteration of riparian habitats.	None available
GS2 Dry meadows	None published, but likely to include abandonment of agricultural practices, and urbanization.	None available
GS4 Wet grassland	None published, but likely to include abandonment, and urbanization.	None available
WD1 Broadleaved woodland	None published, but likely to include urbanization and invasive species.	None available
WD5 Scattered trees / parkland	None published but likely to include urbanization	None available

Ecological Feature Type	Known Threats	Conservation Status
WS1 Scrub	None published; urbanization and abandonment likely factors.	None available
WL2 Treeline	None published; urbanization and agricultural intensification.	None available
WL1 Hedgerows	None published but likely to include urbanization and agricultural intensification.	None available
Japanese Knotweed	N/A	N/A
Breeding birds (House sparrow),	Declines of availability of nest sites in urban areas, and invertebrate prey declines, potentially linked to air pollution	Medium conservation concern
Breeding birds (Meadow pipit),	Agricultural intensification and extreme weather.	High conservation concern
Breeding birds (Grey wagtail),	Extreme weather (e.g. cold winters resulting from climate change).	High conservation concern
Wintering birds excluding designated SPA populations already assessed above.	Aquaculture, fertilisation, urbanisation, reclamation, industry pollution, roads, shipping lanes	Various from Low to High Conservation Concern
Bats		Near Threatened for Leisler's ;All others Least Concern
Pygmy shrew (presumed present)	Pesticides, predation, extreme weather (e.g. cold winters resulting from climate change).	Least Concern

For individual European sites, activities with positive and negative impacts were reviewed from the relevant Natura Standard Data Forms. For European protected habitats and non-bird species, existing pressures and potential future threats were obtained from the national conservation status assessments (NPWS, 2013 a; b). Threats to nationally protected species were obtained from the relevant red data lists. Threats to bird species were identified using the Bird Atlas 2007-2011 (Balmer *et al*., 2014) and the online resources of Bird Life International. There is no known database of threats to habitats not protected under Annex 1 to the Habitats Directive (e.g. to non-Annex examples of grassland or scrub habitats). In this case, professional judgement was applied. Wherever potential cumulative impacts were identified, the impact significance from the proposed development alone was reviewed to identify any potential increases in the geographical scale of impact significance. The final judgement over potential cumulative impact significance had regard for the conservation status of the species nationally, in the context of potential effects from existing or proposed developments.

5.9.2 Pollution Effects

The magnitude of potential cumulative pollution impacts will depend to a significant degree on the assimilative capacity of the receiving waters. Assimilative capacity may be defined as the long-term mass removal capacity per unit area by wetlands, of pollutants including nutrients that is transformed and absorbed into the system with no significant ecosystem changes in internal structure or function or in downstream output (Richardson and Qian, 1999). The water quality of the Garavogue Estuary upstream and downstream of the proposed outfall is "unpolluted" according to the EPA. The Water Framework Directive status is "good". There are no dumping at sea sites within 4 km according to the EPA. According to the Natura Standard Data forms for Cummeen Strand / Drumcliff Bay cSAC (NPWS, 2014), which is also designated as QI wetland bird in the Cummeen Strand SPA (NPWS, 2014), the conservation status of both estuary and mudflat habitats in the receiving environment is Good. Any proposed transport or industrial projects with significant potential for pollution effects will be subjected to a Screening for Appropriate Assessment, if not an Environmental Impact Statement, in addition to

licencing and monitoring of industrial discharges by the bodies such as the EPA. These regulatory processes will impose appropriate protective water pollution mitigation.

There is no predicted increase in the impact significance from the proposed development alone, due to in-combination effects.

5.9.3 Habitat Loss Effects

There are no proposed developments or planning applications likely to result in habitat loss within the vicinity of the proposed development. There are no reclamation proposals along the Garavogue Estuary shoreline which could act in-combination with the small losses of scrub woodland habitat for the proposed development alone. However, the rank grassland field to the east of the existing road and north of the Copper River, a portion of which is being acquired to accommodate the proposed development, is zoned for 'commercial and mixed land-uses', in the Sligo and Environs Development Plan 2010-2016 and could be lost to future urbanization.

Despite the potential for loss of the rank field to future urbanization, there is no predicted increase in the impact significance from the proposed development alone, due to in-combination effects.

5.9.4 Wintering Bird Disturbance Effects

A single fisherman was observed on one occasion line-fishing from the north of Hughes Bridge in September 2015. The fishing was in close proximity to the existing human traffic along the bridge to which local birds are likely to be habituated. There is frequent use of a path along the northern shore of the estuary by pedestrians and dog walkers, and the author observed small numbers of ducks and waders being 'flushed' here in response to disturbance from walkers throughout winter 2015 / 2016. The NPWS recorded an absence of any significant bird disturbance regime in their disturbance assessment of the two bird count sectors overlapping the ZoI (NPWS, 2013d). There are no known proposals for recreational development of the shoreline in the online planning portal of SCC. The planning permission for a promenade along the southern shoreline dating from 2006 has since expired. There are no green corridor or playground objectives along the Garavogue Estuary shoreline in the Sligo and Environs Plan. Bird disturbance could act in combination with the proposed development, should the 'open space' zoning of the southern and eastern shoreline be used to develop public parks and playgrounds. However, any such development would be subject to screening for AA, and if necessary AA, triggering the need for mitigation (e.g. bunds or visual barriers to the estuary), to prevent adverse effects from bird disturbance. There is also a suite of specific policies relating to the standards of assessments, and protection applicable to designated sites in both the Sligo and Environs Development Plan 2010-2016, and Sligo County Development Plan 2011-2017.

There is no predicted increase in the impact significance from the proposed development alone, due to in-combination effects.

5.9.5 Breeding Bird Disturbance Effects

There are no proposed developments or planning applications within the ZoI of potential habitat loss or disturbance impacts from the proposed development.

There is no predicted increase in the impact significance from the proposed development alone, due to in-combination effects.

5.10 Summary of Potential Impacts

Potential Impacts during construction are summarised in Table 5-13, along with residual and cumulative impact significance. There are no significant potential impacts predicted during operation.

The following ecological features were scoped out from the impact assessment as per Section 5.5.1, and are not included in summary impact tables:

- Habitats: amenity grassland, stonewalls;

- Invertebrates: aquatic and terrestrial;
- All fish including lamprey, salmonids, eel, goby, flounder;
- Birds: kingfisher;
- Mammals: badger , hedgehog, otter; and
- Amphibians and reptiles: common frog, common lizard, smooth newt.

Table 5-13: Summary of Potential Construction-Phase Impacts

Ecological Feature	Valuation (Importance)	Potential Impact Type	Potential Impact Significance without mitigation	Mitigation Proposed	Residual Impact Significance of Proposed Development	Cumulative Residual Impact Significance
Cummeen Strand / Drumcliff Bay cSAC / pNHA	International	Pollution	Significant (see also 5.2.1.3)	Yes	Not significant	Not significant
		Compaction of benthic invertebrates by the movement of machinery over intertidal areas	Not significant	Yes	Not significant	Not significant
Cummeen Strand SPA	International	Pollution	Significant (see also 5.2.1.3)	Yes	Not significant	Not significant
		Bird disturbance	Not significant	No	Not significant	Not significant
		Compaction of benthic invertebrates by the movement of machinery over intertidal areas	Not significant	Yes	Not significant	Not significant
Mixed sediment (LS3) / Sheltered Rocky Shores (LR3)	Assessed under Cummeen Strand SPA					
CM1 / CM2 Upper and Lower Saltmarsh	County	Pollution	Significant (see also 5.2.1.3)	Yes	Not significant	Not significant
		Direct habitat loss	Not significant	No	Not significant	Not significant
CW2 Tidal River (Copper River)	Local (Higher value)	Pollution	Significant (see also 5.2.1.3)	Yes	Not significant	Not significant
		Direct habitat loss	Local	No	Not significant	Not significant
GS2 Dry meadows	Local (Higher	Direct habitat /	Local	Yes	Local	Local

Ecological Feature	Valuation (Importance)	Potential Impact Type	Potential Impact Significance without mitigation	Mitigation Proposed	Residual Impact Significance of Proposed Development	Cumulative Residual Impact Significance
and grassy verges	value)	invasive species spread				
GS4 Wet grassland	Local (Higher value)	Direct habitat / invasive species spread	Local	Yes	Local	Local
WD1 Mixed broadleaved woodland	Local (Higher value)	Direct habitat loss	Local	Yes	Local	Local
WD5 Scattered trees and parkland	Local (Higher value)	Direct habitat loss	Local	Yes	Local	Local
WS1 Scrub	Local (Higher value)	Direct habitat / invasive species spread	Local	Yes	Local	Local
WL2 Treeline	Local (Higher value)	Direct habitat loss	Local	Yes	Local	Local
WL1 Hedgerows	Local (Higher value)	Direct habitat loss	Local	Yes	Local	Local
Invasive species - Japanese Knotweed	N/A	Spread of invasive species	N/A	Yes	Not significant	Not significant
Rare wild leek plant	Local-County	Direct habitat loss	Local-County	Yes	Not significant	Not significant
Rare velvet feather-moss plant	County	Direct habitat loss	County	Yes	Not significant	Not significant
Breeding birds including meadow pipit, wagtail, and house sparrow populations of	Local (Higher value)	Mortality / Disturbance	Local	Yes	Local	Local

Ecological Feature	Valuation (Importance)	Potential Impact Type	Potential Impact Significance without mitigation	Mitigation Proposed	Residual Impact Significance of Proposed Development	Cumulative Residual Impact Significance
conservation concern						
Bats (foraging only; at least three species)	Local (Higher value)	Disturbance from lighting	Local	Yes	Local	Local
Pygmy shrew (presumed present)	Local	Mortality	Local	None available	Local	Local
Wintering birds	Local	Disturbance	Local	No	Local	Local

5.11 Difficulties Encountered in Compiling Information

No significant difficulties were encountered.

5.12 References

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6. Surface Water

6.1 Introduction

This chapter considers and assesses the existing surface water environment and the potential significant impacts associated with both the construction and operation of the proposed development.

The potential impacts on various surface water aspects such as water quality, flooding, geomorphology / hydromorphology and amenity value, likely to be caused by the proposed development, have been identified as a result of:

- Water quality impact on receiving rivers and streams from routine carriageway runoff (heavy metals, organics, nutrients, hydrocarbons, suspended solids, and to a lesser extent coliforms, etc.) and from accidental spillages (e.g. agricultural spillage i.e. milk, oil / chemical spillages, bulk liquid cement);
- Increased flood risk as a result of reducing the conveyance of the existing watercourse and/ or increasing runoff rates and volume; and
- Construction work in or adjacent to watercourses including construction of the Copper River Bridge.

The Chapter also provides a high level assessment of the compliance of the proposed development with the Water Framework Directive (WFD), including a combination of biological, physico-chemical (water quality) and geomorphological elements of the water bodies. The biological elements are discussed fully in Chapter 5 Flora and Fauna. A summary of the Compliance Assessment is provided in Section 6.13.

6.2 Legislation and Guidance

The EU Water Framework Directive (2000/60/EC) established a framework for the protection of both surface and ground waters. The overarching objective of the WFD is to enable all water bodies in Europe to attain good or high ecological status / potential. Also, under the legislation, any modification to a water body should not lead to deterioration in the status of a water body or any of the quality elements. Transposing legislation (SI 792 of 2009, European Communities Environmental Objective (Surface Water) Regulations 2009 as amended) outlines the water protection and water management measures required in Ireland to maintain high status of waters where it exists, prevent any deterioration in existing water status and achieve at least 'good' status for all waters. A number of River Basin Management Plans (RBMPs) were developed to address the requirements of the Water Framework Directive (WFD). The RBMP of relevance to this assessment (the Western RBMP 2009-2015) was adopted in 2009 and includes a programme of measures required to facilitate the achievement of the WFD objectives. This programme of measures included full implementation of existing legislation including the Water Pollution Acts, Water Services Act, Bathing Water Quality Regulations, Integrated Pollution Prevention and Control (IPPC) Regulations, Urban Wastewater Treatment Regulations, the Foreshore Acts and the Birds and Habitats Directives (particularly the Appropriate Assessment process).

The second cycle of the river basin management planning is currently underway and the second consolidated RBMP[14] is currently under development and is due to be published by the end of 2017.

Other important pieces of EU and national legislation pertaining to the surface water environment include:

- S.I. 792 of 2009, European Communities Environmental Objective (Surface Water) Regulations 2009 as amended;
- S.I. 350 of 2014, European Union (Water Policy) Regulations 2014;
- The EU Floods Directive 2007/60/EC;
- S.I. 122 of 2010 European Communities (Assessment and Management of Flood Risks) Regulations;
- S.I. 81 of 1988, European Community Environmental (Quality of Surface Water Intended for Human Consumption) Regulations 1984 as amended; and

[14] The Eastern, South Eastern, South Western, Western and Shannon River Basin Districts will be merged to form one national River Basin District.

- SI 293 of 1988, European Communities (Quality of Salmonid Waters) Regulations 1988.

This assessment was undertaken having regard to the following guidance documents:

- Environmental Protection Agency (EPA) Guidelines on the Information to be contained in the Environmental Impact Statement (EPA, 2002);
- EPA Advice notes on current practice in the preparation of Environmental Impact Statement (EPA, 2003);
- NRA Environmental Impact Assessment for National Road Schemes– A Practical Guide (NRA, 2008);
- NRA 2010 Project Management Guidelines (NRA, 2010);
- NRA Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA, 2009);
- NRA Design Manual for Roads and Bridges (NRA DRMB); Volume 4: Geotechnics and Drainage, Section 2: Drainage, Part 1: NRA HD45/15 Road Drainage and the Water Environment (Including Amendment No. 1);
- Highways Agency Design Manual for Roads and Bridges (HA DMRB) Volume II, Section 3: Environmental Assessment Techniques, Part 10 Road Drainage and the Water Environment; and
- Office of Public Works (OPW) Guidelines for Planning Authorities (GPA) 20: The Planning System and Flood Risk Management (OPW and Department of Environment, Heritage and Local Government, 2009).

6.3 Baseline Data Gathering

6.3.1 Desk Study

A desk study was carried out to collate the available information on the surface water environment of the study area with the following data sources referenced:

- Ordnance Survey of Ireland (current and historic mapping);
- Environmental Protection Agency (EPA) - Water Quality Monitoring Database and Reports;
- Geological survey of Ireland (GSI) – to establish the geological component of the fluvial audits;
- Aerial photography;
- EPA flow and water level measurements (EPA Hydronet System);
- Water Framework Directive Ireland Database (http://www.wfdireland.ie/);
- The Western River Basin District Management Plan (WRBDMP);
- The Garavogue Water Management Unit (WMU) Action Plan (2010);
- Western River Basin District Transitional and Coastal Waters Action Programme (2010);
- National Parks and Wildlife Service (designated sites);
- Sligo County Development Plan 2011-2017;
- Sligo and Environs Development Plan 2010-2016;
- Inland Fisheries Ireland (IFI);
- Office of Public Works (OPW) - www.floodmaps.ie; and
- The Western River Basin District Catchment Flood Risk Assessment and Management Study (CFRAMS) (OPW ongoing).

6.3.2 Hydrological Field Surveys

A number of field studies have been undertaken in order to gain an understanding of the hydrological environment in the vicinity of the proposed development.

Walkover assessments were carried out in May 2015 and October 2016 within the proposed development footprint and extended as required to include other relevant hydrological aspects. Visual inspections were made of the Garavogue River and Estuary and the Copper River.

A geomorphological reconnaissance survey of the two watercourses was undertaken by a geomorphologist in April 2016. The survey assessed the baseline condition of the channels potentially affected by the proposed development. The survey provided an understanding of existing geomorphological conditions and the condition of the channel upstream and downstream (where possible). A photographic record of the general character of the watercourse was also collected.

Site specific topographical surveys undertaken in December 2015 on the Copper River were used to inform the design, and for use in this surface water assessment.

6.3.3 Baseline Water Quality Monitoring

Baseline water quality monitoring was undertaken in line with the NRA Guidelines in May and November 2015. Water quality samples were taken at five locations; see Figure 6.1. The following physico-chemical parameters were analysed for collected samples in an internationality accredited laboratory[15]:

- pH;
- Conductivity;
- Dissolved Oxygen (DO);
- Transparency;
- Biochemical Oxygen Demand (BOD);
- Ammoniacal Nitrogen;
- Suspended Solids;
- Nitrate;
- Orthophosphate;
- Total Hardness;
- Zinc (total);
- Copper (dissolved); and
- Petroleum Hydrocarbons.

6.3.4 Consultation

Consultation on the surface water impact assessment was undertaken with the following organisations:

- Inland Fisheries Ireland (IFI); and
- The National Parks and Wildlife Service (NPWS) through the ecological assessment.

Consultation was undertaken with the IFI in December 2015 to discuss the proposed development. The IFI made a number of recommendations as outlined in Appendix 6.2. The IFI noted the importance of Sligo Harbour and the Garavogue Estuary as a migratory route for a number of fish species. There are four known red data book fish species present in the area: Brook Lamprey; River Lamprey; Sea Lamprey; and Atlantic Salmon. They further noted that the Copper River provides habitat for salmonids but that the fish stock status of the river was unknown.

See Chapter 5: Flora and Fauna for consultation undertaken as part of the terrestrial and aquatic ecological impacts assessment.

[15] ALS Environmental Ltd accredited laboratory for a range of parameters

6.4 Description of the Existing Environment

6.4.1 The Study Area

The study area lies within the Western River Basin District, Hydrometric Area 35 within the Garavogue and the Transitional and Coastal Water Management Units. The catchment of this hydrometric area is drained by the Garavogue River with all associated watercourses entering tidal Garavogue Estuary to the west. In line with the *NRA Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2009)*, the study area extends 250 m beyond the landtake boundary of the proposed development. Where required the study area extends beyond this to account for potential impacts outside this 250 m extent.

The main surface water feature within the study area is the Garavogue River and Estuary as shown in Figure 6.1. The Garavogue River discharges the waters of Lough Gill which is situated some 4.5 km upstream.

There is one minor watercourse in the study area, the Copper River, see Figure 6.1. This watercourse lies to the north of the Garavogue River. It discharges to the Garavogue Estuary and is connected to the Garavogue River some 3km upstream in the townland of Hazelwood Demesne.

Both the Garavogue Estuary and the Copper River will receive road runoff from the proposed development.

Table 6-1 provides a summary or the Water Features (WF) and their associated reference number used in the impact assessment. A further detailed description of these WFs is provided in Section 6.4.4 Geomorphology.

Table 6-1: Summary of Water Features in the Study Area

No.	Water Feature Name	Location of Water Features
WF1	Garavogue River	Located south of the proposed development. The Garavogue River discharges the waters of Lough Gill to the Garavogue Estuary.
WF2	Garavogue Estuary	Located west of the proposed development.
WF3	Copper River	Located north of the Garavogue River and flows to join the Garavogue Estuary.

6.4.2 Surface Water Quality

6.4.2.1 Water Quality and the Water Framework Directive Classification

The current WFD status of the Garavogue River and its estuary is “good” see Table 6-2. Neither water body is classed as a heavily modified water body (HMWB).

Table 6-2: WFD Overview of Status

Water Body (WFD name)	HMWB	Waterbody Code	Type	Current Status[16]	Element causing less than good	Achieve Good Status by
Garavogue River (Gill, Trib of Garavogue)	No	IE_WE_35_4183	River	Good	N/A	N/A
Garavogue Estuary	No	IE_WE_470_0100	Estuarine	Good	N/A	N/A

6.4.2.2 Water Quality and EPA Classification

The status of individual estuarine and coastal water bodies is assessed by the EPA using their Trophic Status Assessment Scheme (TSAS). This is the assessment required under the Urban Waste Water Treatment

[16] Status taken from EPA Envision Mapper May 2013

Directive (91/271/EEC) and Nitrates Directive (91/676/EEC). The TSAS 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 (EPA, 2011). Table 6-3 summarises the status of the water quality of the estuarine water of relevance to this assessment.

Table 6-3: EPA Coastal and Estuarine Water Quality Details

Waterbody	Eutrophic 07-09
Garavogue Estuary	Unpolluted

The EPA assesses the water quality of rivers and streams across Ireland using a biological assessment method. The EPA assigns biological river quality (biotic index) ratings from Q5-Q1 to watercourse sections. Q5 denotes a watercourse with good water quality and high community diversity, whereas Q1 denotes very low community diversity and a bad water quality. The nearest monitoring station to the study area is some 600 m upstream on the Garavogue River. Table 6-4 provides details of the current Q water quality status of the Garavogue River.

Table 6-4: EPA Monitoring Station Locations and Current Status

EPA Station No	Location	Easting	Northing	Q Value	Status
35012	Garavogue River	169396	35963	Q4	Good

6.4.2.3 Baseline Water Quality and macroinvertebrate monitoring results

Baseline water quality monitoring was undertaken in May and November 2015 at various locations along the Copper River and the Garavogue Estuary see Figure 6.1, in line with the *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*. The results of this monitoring are detailed in Appendix 6.3. Where available, these results are compared to the standards in the European Communities Environmental Objective (Surface Water) Regulations, S.I. 272 of 2009. Physico-chemical analysis results for the water samples show few exceedances of the guideline limits and there is no indication of pollution within the watercourses. Suspended solids results are all under the 25 mg/l annual average for salmonid waters S.I. No. 293/1988: European Communities (Quality of Salmonid Waters) Regulations, 1988.

Qualitative sampling of benthic (or bottom dwelling) macroinvertebrates was undertaken at three locations on the Copper River: 10 m downstream, 10 m upstream and approximately 400 m upstream of the Copper River Bridge. Macroinvertebrates were sampled at these sites using kick / sweep sampling (Toner *et al.*, 2005); see full details of the aquatic survey in Appendix 5.7. Using the EPA freshwater biological water quality rating system (Toner *et al,* 2003), biological water quality at this site was rated 'Q3, Moderately Polluted' corresponding to WFD 'Poor' status.

6.4.3 Flow Measurements

Flow measurements are taken throughout the Republic of Ireland by the OPW and the EPA. Within the study area the EPA measure water level and flow on the Garavogue River at station no. 35012. For the purpose of this assessment low flows (Q95) were estimated for the Garavogue River / Estuary and the Copper River, water features due to receive road runoff from the proposed development; these are presented in Table 6-5.

Table 6-5: Low Flow Estimates in the Garavogue & Copper River

Water course	Derived Catchment Area (km^2)	Q95 (m^3/s)	Comment
River Garavogue at Hughes Bridge	369.6	2.033	Equivalent to 5.5 l/s/km^2 specific Q95 from Station 35012 (Garavogue

Water course	Derived Catchment Area (km^2)	Q95 (m^3/s)	Comment
			upstream at New Bridge).
Copper River at Bundoran Rd.	0.95	0.00277	Equivalent to 2.92 l/s/km^2 specific Q95 from the ungauged FDC generated by EPA HydroTool software package.
Copper River at Cartron Hill	0.97	0.00283	Equivalent to 2.92 l/s/km^2 specific Q95 from the ungauged FDC generated by EPA HydroTool software package.

6.4.4 Geomorphology

Aerial photography of the Garavogue River upstream of Sligo confirms a wide meandering river passing through agricultural land with some lengths of woodland. The channel appears to have undergone some deposition close to the banks, likely to be finer sediment. The river then appears to narrow as it flows into the urban area of Sligo. Here a large weir spans the width of the river approximately 500 m within the town. The river is crossed by a limited number of clear span bridges, with another weir demarking the upstream extent of the study area. This is located approximately 300 m upstream of Hughes Bridge.

Within the study area the river was noted to be heavily influenced by urban development along both banks see Image 6.1. The left bank (looking downstream) was observed as artificial, with sheet piling forming the banks and houses to the edge of the bank, see Image 6.2. The right bank was recorded as artificial from the weir downstream towards Hughes Bridge. Upstream of Hughes Bridge the bank becomes an earth embankment, likely built to protect the R870 Markievicz Road. A small grassed area was recorded, used to moor boats present at the toe, see Image 6.1. The bank alongside Hughes Bridge was observed to become reinforced with a large expanse of rip rap, see Image 6.2. As the river issues from under Hughes Bridge (with piers located in the channel) it was observed to flow into an estuarine area, heavily influenced by the tide. In low tides the river bed is known to be exposed with a large area of mud flats present. In higher flow this becomes covered.

The Copper River is located in the northern part of the study area. The river was noted to have its source in the woodland area some 3 km to the east of Sligo City in the townland of Hazelwood Demesne, just north of the Garavogue River. The river then flows westward to the Garavogue River estuary area. The channel is predominantly artificially straightened. The surrounding land use is typically urban, with approximately 300 m of the river located within rural areas. The river was then observed to flow into a pond feature at the eastern extent of Sligo and noted to become wider and more modified downstream from this point. The N16 borders the south bank of the river with playing fields and semi-improved grassland typically along the north bank.

Within the study area the river was observed to be artificially straightened, see Image 6.4. The banks were found to be shallow and poached upstream of Ballytivnan Road, becoming significantly steeper downstream. The south bank was observed to be reinforced where the industrial area (the Feehily's Funeral Home and Tubs and Tiles) came up to the top of the bank. Large rip rap was found placed along the entire width of the bank, see Image 6.5. Minimal erosion was observed. Numerous outfalls were noted entering the channel from sources including rural land, roads and industrial estates.

The bed substrate was observed to be typically composed of cobbles and coarse gravels but these were recorded as covered by a layer of silt and mud, particularly in reaches influenced by tidal processes. In higher tide conditions, no depositional features were observed with the exception of a single riffle feature downstream of the Ballytivnan Road bridge.

The channel under the Copper River Bridge was noted to act as a slight barrier to morphological processes, with minimal sediment transfer occurring at both high and low tides. Downstream the river was seen to enter into the Garavogue estuary area. At low tide large mud flats were recorded with a narrow channel leading to the Garavogue, see Image 6.6. At high tide, the bay area was found to be submerged and a large ponded area created.

Image 6.1 : Garavogue River upstream of Hughes Bridge, showing artificial south bank and earth north bank

Image 6.2 : Rip rap present on Garavogue River upstream of Hughes Bridge

Image 6.3 : Downstream of Copper River Bridge in low tide

Image 6.4 : Straightened Copper River channel planform

Image 6.5 : Copper River bank reinforcement on the south bank and earth banks on the north bank

Image 6.6 : Copper River downstream of the Copper River Bridge at low tide

The geomorphological vulnerability of the two watercourses identified within the study area is considered to be Medium vulnerability for the Garavogue River and Low vulnerability for the Copper River.

6.4.5 WFD Baseline

The Garavogue River (referred to as the Gill, Trib of Garvogue[17] water body in the WFD RBMP) and Estuary are designated under the WFD, the following tables summarise the current status and quality elements for both.

Table 6-6: WFD status for Gill, Trib of Garvogue

Water Body ID	IE_WE_35_4183
Water Body Name	Gill, Trib of Garvogue
Overall Status	Good
Overall Objective	Protect
Heavily Modified	No
Status Information	
Macroinvertebrate	High
General physico-chemical status	Good
Hydromorphology status	Good

Table 6-7: WFD status for Garavogue Estuary

Water Body ID	IE_WE_470_0100
Water Body Name	Garavogue Estuary
Overall Status	Good
Overall Objective	Protect
Heavily Modified	No
Status Information	
Fish	Good
Chemical	Pass
Hydromorphology	Good
Dissolved Inorganic Nitrogen	High
Molybdate Reactive Phosphorus	High
Dissolved oxygen as per cent saturation	Good
Biochemical Oxygen Demand (5-days)	High
Macroalgae - phytobiomass	High
Angiosperms - Seagrass and Saltmarsh	High

6.4.6 Water Supply Sources

Drinking water is not abstracted from within the study area. There are two main sources of water supplying Sligo namely Kilsellagh Reservoir and Lough Gill. There is a water treatment plant at Kilsellagh and two plants treating water from Lough Gill – Cairns Hill and Foxes Den. Kilsellagh largely serves northern parts of Sligo City, while Cairns Hill and Foxes Den largely serve the south side of the City. The study area is likely to be served from the Cairns Hill and Foxes Den area.

[17] WFD spelling of Garavogue

6.4.7 Discharges and IPC Licences

Irish Water operate a Waste Water Treatment Plant (Licence no. D0014-01) approximately 1.5 km in Finisklin townland west of the study area. Cold Chon (Galway) Ltd operating under IPC licence (P0073-01) discharges to the Estuary approximately 1.4 km west of the study area.

6.4.8 Ecological Designations

There are three international and one nationally designated site within 5 km of the proposed development. Full details of all the designated areas are included in Chapter 5: Flora and Fauna.

- Cummeen Strand / Drumcliff Bay (Sligo Bay) Special Area of Conservation (SAC, site code: 000627) and proposed Natural Heritage Area (pNHA site code: 000627); and
- Cummeen Strand Special Protection Area (SPA, site code: 004013).

The Garavogue River / Estuary forms part of the Cummeen Strand / Drumcliff Bay (Sligo Bay) SAC / pNHA and Cummeen Strand SPA. The Cummeen Strand SPA and Cummeen Strand / Drumcliff Bay SAC are located immediately adjacent to the proposed development and part of the SPA / SAC is located within the footprint of the proposed development. However, this footprint also includes existing hardstanding of the N4 and rock armour. The Cummeen Strand / Drumcliff Bay (Sligo Bay) SAC which includes the Garavogue River and Estuary is designated for River and Sea Lamprey.

6.4.9 Fisheries

Sligo Harbour and the Garavogue Estuary are considered an important migratory route for a number of fish species. There are four known red data book fish species present in the area: Brook Lamprey, River Lamprey, Sea Lamprey and Atlantic Salmon.

Consultation was undertaken with the IFI specifically in relation to the Copper River which is known to provide habitat for salmonids but the fish stock status of the river was unknown. Therefore an aquatic ecology survey of the Copper River in the environs of the Copper River Bridge was undertaken in March 2016, see full detail in Appendix 5.7. The aquatic ecology survey found that the Copper River within the study area was of low ecological importance for fish.

6.4.10 Surface Water Amenity Areas

One water-related amenity area has been identified within the study area. The Salmon Point amenity area (a green space with walking trail adjacent to the Garavogue Estuary) is located on Salmon Point, adjacent to the proposed development.

6.4.11 Flooding

With reference to the OPW National Flood Hazard Mapping, five historical flood events were identified within the Sligo area and are tabulated in Table 6-8.

Table 6-8: Flood events recorded within the area from the OPW Flood Hazard Mapping Report

Ref. No.	Date of Flood Event	Address	Description of Event / Comments
1	Recurring	Fish Street, Sligo	Occurs during periods of extreme spring tides and high onshore winds
2	Recurring	Lower Quay Street, Sligo	Occurs during periods of extreme spring tides and high winds
3	Recurring	Near Sligo Hospital	Road flooding during periods of heavy rain due to low point in the road combined with lack of capacity in surface water network

Ref. No.	Date of Flood Event	Address	Description of Event / Comments
4	Recurring	Near Sligo Institute of Technology	Land flooding during high tides combined with debris build backing up
5	Recurring	Sligo Institute of Technology	Historical flooding of college due to blockage in discharge to the sea

It is noted that the level of detail for the events referenced above is quite poor and that the exact locations of the events are, in some cases, unknown.

Sligo City is one of the areas under assessment in the Western RBD Catchment Flood Risk Assessment and Management Study (CFRAMS) and is therefore considered to be potentially at risk from flooding.

The Western River Basin District Flood Risk review undertaken as part of the CFRAM study indicated that there is limited evidence of frequent fluvial flooding in the Sligo area but there is evidence of tidal flood risk. The report references that the Sligo River (Copper River) is more prone to flooding than the Garavogue River. Historically flooding on the Copper River occurs upstream of the N4 as a result of a blockage beneath the road. In terms of tidal flooding, the report identifies the downstream limits of the Garavogue and Copper rivers, and areas along the coastline, as the areas of flood concern.

The Western CFRAM Study Flood Extent and Depth Maps are available online however they are currently in draft format to be used solely for consultation purposes. Regard has been taken to the maps for the purposes of this assessment. Full detail of the flooding history in the study area is contained in Appendix 6.1.

6.5 Description of the Proposed Development

Full details of the proposed development are provided in Chapter 2 but elements of relevance to the surface water impact assessment are provided below.

6.5.1.1 Copper River Bridge

There are a number of structures that could impact surface water features as part of the proposed development as listed in Table 6-9.

Table 6-9: Structure Locations and details

Watercourse	Details
Copper River	Located between Ch. 450-460. The existing twin metal culverts to be replaced by a single concrete box structure, see Figure 2.2. The older masonry twin arches are to be retained.
Garavogue Estuary	Located between Ch. 75-140 (northbound). Retaining wall to retain widened road carriageway and minimise infringement on designated area, see Figure 2.2.
Garavogue Estuary	Located between Ch. 250-325 (northbound). Retaining wall to retain widened road carriageway and minimise infringement on designated area, see Figure 2.2.

6.5.1.2 Drainage

6.5.1.2.1 Overview of the Existing Road Drainage System

The existing N4-N15 carriageway runoff is discharged through a number of outfalls (providing no treatment or attenuation) directly to the Copper River and the Garavogue Estuary.

6.5.1.2.2 Overview of the Proposed Drainage Design

The drainage network will be split into three separate catchments and will outfall at three locations as detailed in Table 6-10. Two of these will discharge to the Copper River and the third will discharge into the Garavogue Estuary on the southern side of the R870 Markievicz Road and on the upstream side of Hughes Bridge. Figure 2.2 depicts the drainage outfall locations for the proposed development.

Table 6-10: Detail of the Drainage Networks and Discharge Rates

No.	Outfall Location	Contributing Impervious Area (m^2)	Outfall Discharge Rates (l/s)	Attenuation Volumes (m^3)
A1	Upstream of Hughes Bridge	6300	80.3 l/s	0
A2	Downstream Copper River	10875	136.3 l/s	0
A3	Downstream Copper River	10603	10.5 l/s	403

The entire impermeable area being drained by the proposed development is approximately 2.8 hectares. There will be a limited increase in impermeable area due to the proposed development. Five outfalls (four on the Garavogue Estuary and one on the Copper River) will be decommissioned as part of the proposed development. Petrol interceptors will be provided at the three replacement outfall locations between the carriageway drainage outfall and watercourse within each drainage network. These will also serve to buffer any potential impacts of accidental spillage on the road from entering a watercourse, allowing time to organise remedial measures. In addition, Outfall A3 will be provided with an attenuation treatment pond, the provision of which is based on the findings of the cumulative assessment undertaken under the Highways Agency Risk Assessment Tool (HAWRAT) assessment which was found to 'fail' the HAWRAT for soluble copper without attenuation, prior to discharge of run-off to the Copper River. Full details of the HAWRAT methodology is provided in Section 6.6 and the assessment results are presented in Section 6.7.

6.6 Appraisal Method used for Assessment of Impacts

The following hydrological impact assessment methodology is in accordance with the Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA 2009), specifically Section 5.6. Impact quality, type, magnitude / significance and duration are considered relative to the importance of the hydrological attribute; see Table 6-11 to Table 6-13. Reference has also been made to the NRA standard HD45/15 and the HA standard, HD 45/09.

Table 6-11: Criteria for Rating Site Attributes - Estimation of Importance of Hydrology Attributes

Importance	Criteria	Typical example
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations,1988.
Very High	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Quality Class A (Biotic Index Q4, Q5) Flood plain protecting more than 50 residential or commercial properties from flooding Nationally important amenity site for wide range of leisure activities
High	Attribute has a high quality or value on a local	Salmon fishery Locally important potable water source supplying >1000 homes

Importance	Criteria	Typical example
	scale	Quality Class B (Biotic Index Q3-4) Flood plain protecting between 5 and 50 residential or commercial properties from flooding Locally important amenity site for wide range of leisure activities
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2-3) Flood plain protecting between 1 and 5 residential or commercial properties from flooding
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities Local potable water source supplying <50 homes Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding Amenity site used by small numbers of local people

Table 6-12: Criteria for rating Impact Significance – Estimation of Magnitude of Impact on Hydrology Attributes

Magnitude of Impact	Criteria	Examples
Large Adverse	Results in loss of attribute and / or quality and integrity of attribute	Failure of both soluble and sediment-bound pollutants in HAWRAT (Method A, Annex I) and compliance failure with EQS values (Method B) Loss or extensive change to a waterbody or water dependent habitat Increase in predicted peak flood level >100 mm Extensive loss of fishery Calculated risk of serious pollution incident >2% annually Extensive reduction in amenity value.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Failure of both soluble and sediment-bound pollutants in HAWRAT (Method A, Annex I) but compliance with EQS values Increase in predicted peak flood level >50 mm Partial loss of fishery Calculated risk of serious pollution incident >1% annually Partial reduction in amenity value.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Failure of either soluble or sediment-bound pollutants in HAWRAT Increase in predicted peak flood level >10 mm Minor loss of fishery Calculated risk of serious pollution incident >0.5% annually Slight reduction in amenity value
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No risk identified by HAWRAT (Pass both soluble and sediment-bound pollutants) Negligible change in predicted peak flood level Calculated risk of serious pollution incident <0.5% annually.
Minor Beneficial	Results in minor improvement of attribute quality	HAWRAT assessment of either soluble or sediment-bound pollutants becomes Pass from an existing site where the baseline was a Fail condition Reduction in predicted peak flood level >10 mm Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually.
Moderate Beneficial	Results in moderate improvement of attribute quality	HAWRAT assessment of both soluble and sediment-bound pollutants becomes Pass from an existing site where the baseline was a Fail condition Reduction in predicted peak flood level >50 mm Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually.

Magnitude of Impact	Criteria	Examples
Major Beneficial	Results in major improvement of attribute quality	Reduction in predicted peak flood level >100 mm.

Table 6-13: Rating of Significant Environmental Impacts

	Magnitude of impact				
Importance of Attribute		Negligible	Small	Moderate	Large
	Extremely High	Imperceptible	Significant	Profound	Profound
	Very High	Imperceptible	Significant / Moderate	Profound / Significant	Profound
	High	Imperceptible	Moderate / Slight	Significant / Moderate	Profound / Significant
	Medium	Imperceptible	Slight	Moderate	Significant
	Low	Imperceptible	Imperceptible	Slight	Slight / Moderate

6.6.1.1 Highways Agency Risk Assessment Tool

The NRA Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes recommend using the methodology in the Highways Agency (HA) 216/06 (UK DMRB). However, the Highways Agency (HA) standard, HD 45/09, was published in November 2009 which replaced HA 216/06. TII subsequently published Volume 4: Geotechnics and Drainage, Section 2: Drainage, Part 1: NRA HD45/15 Road Drainage and the Water Environment (Including Amendment No. 1). Both HD45/09 and HD45/15 centre on the use of the HAWRAT.

The HAWRAT methodology is derived from a collaborative research programme undertaken by the HA and the Environment Agency (EA) which investigated the effects of routine road runoff on receiving waters and their ecology. The toxicity thresholds determined through the research programme, and which are used by the tool, have been designed to prevent adverse ecological effects in the receiving water. Equally, in artificial and heavily modified water bodies, the thresholds have been designed to prevent adverse effects on ecological potential. The thresholds are consistent with the requirements of the WFD.

The HAWRAT assessment is a staged process, comprising three steps as detailed in Table 6-14.

Table 6-14: Stages of Assessment in HAWRAT

Stage of Assessment	Inputs	Outputs
Step 1 Runoff quality - Considers runoff quality only	• Traffic volume • Geographic location • 10 years of rainfall data, ~1000 rainfall events (embedded in HAWRAT)	• Runoff concentrations of soluble pollutants and sediment-bound pollutants for each event • Pass / Fail standards
Step 2 In river - Takes the output from the previous step to assess potential impacts to	• Outputs from Step 1 • Area draining to outfall • Characteristics of receiving watercourse	• Concentration of soluble pollutants after dilution • Stream velocity at low flow • Deposition index (extent of sediment

Stage of Assessment	Inputs	Outputs
the receiving watercourse		coverage) • Pass / Fail standards • Percentage settlement required to comply with deposition index • Annual average concentrations of soluble pollutants
Step 3 After mitigation - Considers the effect of mitigation if required	• Outputs from Steps 1 and 2 • Existing and proposed mitigation Measures • Treatment of soluble pollutants • Flow attenuation • Settlement of sediments	• Concentration of soluble pollutants after treatment • Concentration of soluble pollutants after further dilution • Pass / Fail standards • Annual average concentrations of soluble pollutants after mitigation

6.6.2 Geomorphology Impact Assessment

The appraisal method used for geomorphology is in accordance with the Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA, 2009), specifically Section 5.6.

The guidelines recommend that geomorphological impacts are considered within the Hydrology section of an EIS. This should include reference to the EU WFD (2000/60/EC) hydromorphology elements. Geomorphology is considered as a mechanism (pathway) by which receptors in topics such as water quality, hydrology and aquatic ecology could potentially be affected by the proposed development. Potential impact on geomorphological forms and processes is determined by the 'vulnerability to change' as a result of the proposed development.

There is currently no prescribed or standard method for assessing the geomorphological and hydromorphological impacts of road developments, therefore the geomorphological principles in the guidelines have been followed where applicable. Geomorphological impacts are considered at reach scale, whereas the hydromorphological impacts are captured at a water body scale.

The assessment method selected takes each of the baseline geomorphology and hydromorphology elements documented in Section 6.4.4 and determines whether:

- There could be a direct impact on any geomorphological feature or hydromorphological element; and
- There could be a change in geomorphological function / process affecting the geomorphology or hydromorphological element over time.

The vulnerability of each riverine environment to change (low, moderate, high) has been assessed as part of the baseline. A classification of the magnitude of potential impacts on each area was then made using a scale of negligible, small, moderate and large, culminating in a significance of imperceptible, slight, moderate, significant or profound as part of the impact assessment. The determination of a potential impact has been undertaken by considering whether elements of the proposed development create a 'pressure' on the environment, leading to a change in the magnitude, frequency, duration or location of geomorphological and hydromorphological processes.

The assessment process is primarily qualitative. It was based on a site walkover of the watercourses in the proposed vicinity of the road, supplemented by a baseline desk study. Consideration of impact type, magnitude, significance and duration was then made relative to the geomorphological vulnerability to change identified for each of the watercourses. Although there are no published guidelines for the assessment of geomorphology and hydrology the guidelines quoted above and the significance matrix in Table 6-13 have been used.

6.6.3 Flood Risk

A Flood Risk Assessment (FRA) in line with the *Guidelines for Planning Authorities (GPA) 20: The Planning System and Flood Risk Management (OPW, 2009),* has been conducted for the proposed development. GPA20 outlines the key principles that should be used to assess flood risk and recommends a staged approach as follows:

- Stage 1: Flood Risk Identification: to identify any flood risks that may warrant further investigation;
- Stage 2: Initial Flood Risk Assessment: to confirm sources of flooding, to appraise the availability of existing information and to assess the potential for mitigation measures; and
- Stage 3: Detailed Flood Risk Assessment: to allow design of the proposed development and assess the effectiveness of proposed mitigation measures.

An FRA Stage 1 and Stage 2 were carried out as part of the assessment of the proposed development to provide an overview of the potential flood risks to the proposed site and to assess the potential impact of the different options under consideration, see Appendix 6.1. A summary of the outputs of this FRA are contained in Section 6.7 of this chapter.

6.6.4 Attribute Importance

Table 6-15 summarises the importance of the attributes identified within the study area based on the *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*.

Table 6-15: Attribute Importance within the Study Area

Attribute	Attribute Importance	Key Rationale
Garavogue River	Extremely High	Part of the Cummeen Strand / Drumcliff Bay (Sligo Bay) SAC
Garavogue Estuary	Extremely High	Part of the Cummeen Strand / Drumcliff Bay (Sligo Bay) SAC
Copper River	High	Connection to the Cummeen Strand / Drumcliff Bay (Sligo Bay) SAC

6.7 Predicted Impacts of the Proposed Development

6.7.1 Construction Impacts

The construction period for the proposed development will be approximately 12 months. During the construction phase there is the potential for pollution of surface water features due to sediment loading and associated anthropogenic polluting substances entering watercourses as a result of surface water runoff and / or spills on-site. Potential sources during the construction phase of the proposed development include:

- Works on the bridge structure over the Copper River;
- Construction works include retaining walls within and adjacent to watercourses including the Garavogue Estuary;
- Excavations including those associated with the provision of drainage works;
- Site clearance works;
- Reconstructive and resurfacing works;
- Stockpiling of materials;
- Accidental spillage of anthropogenic polluting substances in or adjacent to watercourses; and
- Construction plant and vehicle washing.

The proposed development will require the installation of a replacement road bridge structure over the Copper River. The construction of this structure will likely require the following elements as outlined below a however it is noted that the final design and construction sequencing will be up to the appointed construction contractor:

- The existing masonry arch on the estuary side is to be retained;
- The existing river channel is to be closed using temporary dams with over pumping of retained flow from the Copper River;
- The first section of the existing 1.7 m diameter culverts will be demolished and excavated to foundation level;
- The first phase of precast boxes will be placed and backfilled;
- Pavement layers will be constructed over new section;
- Southbound traffic shifted onto new structure (single lane only);
- Demolition of next section of existing 1.7 m diameter culverts and excavation to foundation level;
- Second phase of precast boxes will be placed, backfilled and pavement layers constructed;
- Northbound traffic shifted onto new structure (single lane only) with two southbound lanes;
- Remaining section of existing 1.7 m diameter culverts demolished and excavation to foundation level;
- Third phase of precast boxes will be placed, backfilled and pavement layers constructed;
- Rosses Point traffic shifted onto new structure. All traffic lanes northbound and southbound operational;
- Demolition of existing chamber between masonry arch and steel culverts and excavation to foundation level;
- Construction of in situ box stitch between precast box structure and existing masonry arch;
- Construction of finishes to structure including northbound pedestrian and cycling facilities over retained masonry arch structure; and
- Removal of temporary dams and reopening of Copper River channel.

Chapter 2 details the proposed drainage design for the proposed development and Figure 2.9 shows the locations of the new attenuation pond / wetland system adjacent to the Copper River.

Some other general construction activities e.g. site clearance works and machinery movement will be undertaken in close proximity to the watercourses along the proposed development.

6.7.1.1 Water Quality Impacts

In terms of the physico-chemical parameters relating to water quality, the main potential contaminant during the construction phase will be suspended solids. Suspended solids concentrations could cause aquatic ecological problems which include clogging fish gills, smothering spawning grounds, reducing light penetration for flora growth, and adding bacteria and algae to the water. Nutrients are often associated with the solids (inorganic nutrients such as phosphorus and organic such as hydrocarbons and sewage if present) and in turn can cause the deterioration of water quality and damage to aquatic life due to eutrophication of the water environment and eventually to fish-kills due to lowering of oxygen supply. Potential impacts from the construction works in the absence of construction phase mitigation measures on the various sensitive receptors are described below.

There will be general construction works including the provision of two retaining walls and one outfall in the vicinity of Garavogue River (WF1) and the Garavogue Estuary (WF2), see Figure 2.9. WF1 and WF2 form part of the Cummeen Strand / Drumcliff Bay SAC / pNHA and the Cummeen Strand SPA and therefore are considered to be attributes of extremely high importance using the NRA guidelines classification. Any potential impacts associated with increased sediment release during construction could have an impact on these watercourses. This may result in direct, temporary, negative and profound impacts on WF1 and WF2. Any impacts on the water quality of these attributes associated with the release of anthropogenic polluting substances (particularly a large or hazardous spillage) during construction is considered to be direct

(construction of retaining walls and outfall) and indirect (runoff, spills), indirect, temporary, negative and profound due to the proximity of the construction works to these watercourses and the fact that they form part of the SAC and SPA.

The Copper River (WF3) discharges to the Cummeen Strand / Drumcliff Bay SAC / pNHA and the Cummeen Strand SPA and is considered to be an attribute of high importance due to this connectivity. Any impact associated with increased sediment release or anthropogenic polluting substances during construction including work on the Copper River Bridge as described above could have an impact on these sites. Ecological Impacts on the designated sites are considered in full in Chapter 5. Impacts on water quality of WF3 from the construction of the proposed development are considered to be direct (construction of Copper River Bridge and outfalls) and indirect (runoff, spills), temporary, negative, and significant.

6.7.1.2 Geomorphology Impacts

Table 6-16 provides an overview of the works that would potentially impact on geomorphological and hydromorphological receptors.

Table 6-16: Works with potential impact on the geomorphological receptors

Works / Watercourse	Garavogue River & Estuary	Copper River
Construction of carriageway/earthworks	✓	✓
Copper River Bridge construction works	×	✓
Tie in to existing Bridge	✓	×
Outfall	✓ (x1)	✓ (x2)

During construction, the movement of construction vehicles could lead to soil compaction, potentially impacting the speed of surface water runoff. Soil excavation / removal and the removal of areas of riparian vegetation would be likely to create surfaces of bare earth within the construction area and adjacent to watercourses WF1, WF2 and WF3. This could potentially alter surface water runoff and drainage processes within the study area and ultimately the watercourse catchment, leading to possible impacts on the downstream receiving watercourses and the Garavogue Estuary.

Bare earth surfaces, storage areas of construction materials or stockpiles of top soil could cause an increase in the fine sediment loading of the watercourses receiving runoff from the site. This would have the potential to increase the amount of deposition within a channel altering existing in-channel features and further smothering aquatic habitats. Deposition of silt from the construction site would cease at the end of construction however the effects could potentially continue into the medium to long term. Bare earth surfaces could also increase the amount of erosion and deposition within a channel through increased runoff, potentially altering in-channel features.

The construction of proposed structures (such as outfalls and bridges) on watercourses would be likely to require removal of riparian vegetation and replacement of natural bank material with artificial material. This could potentially alter the surface water runoff to the channel as well as impact upon lateral connectivity of a channel with its floodplain. In addition, any potential in-channel works would be likely to cause a disturbance to the existing channel bed substrate, resulting in the resuspension of fine sediment in particular. The works also have the potential to affect fluvial processes and sediment transfers. Physical alteration of channel cross-sections could also impact on channel processes.

Therefore, without considering mitigation there is considered to be a:

- Direct, temporary, negative and significant impact on WF1;
- Direct, temporary, negative and profound impact on WF2; and
- Direct, temporary, negative and profound impact WF3.

6.7.1.3 Other Potential Impacts

The Garavogue River and Estuary as a whole is considered to have an amenity value of high importance. However, amenity in the study area and surrounds are limited due to the nature of the existing area which is primarily urban in nature. The Salmon Point amenity area is located adjacent to and overlooking the Estuary therefore impacts on amenity in the area during construction will be indirect, short term, negative and slight due to restricted access during the construction phase, see also Chapter 4: Human Beings and Socio Economics.

There is limited recreational fishing and there are no known fishing spots in the vicinity of the proposed development. Therefore, impacts on recreational fishing during construction will be indirect, short term, negative and negligible. Chapter 5: Flora and Fauna details the impact on key ecological receptors with regards to fish during the construction of the proposed development

The construction phase impacts are summarised in Table 6-22.

6.7.2 Operation Impacts

6.7.2.1 Water Quality Impacts - Normal Operation

During routine operation pollutants, for example oils and hydrocarbons from fuel combustion and salts or herbicides from road maintenance, will be deposited on the road surfaces. The implications for water quality relate to the potential for these pollutants to be transported in surface run-off and enter the water environment via the road drainage system. The impact will depend on the volume and type of traffic using the road, the provision of pollution control measures, and the sensitivity of the receiving watercourse.

The concentration of contaminants is widely accepted to be dependent on traffic volumes experienced on the carriageway. The UK Design Manual for Roads and Bridges (DMRB-UK, 1998) suggests that “pollution impacts on receiving waters appear to be restricted primarily to roads carrying more than 30,000 vehicles per day (AADT), although for roads carrying less than 15,000 vehicles per day the level of pollution associated with runoff to sensitive waters could be of concern”. Traffic figures and scenarios are detailed in Chapter 3: Outline of Alternatives and are summarised here as follows:

- In 2015 the highest AADT along the proposed development is c. 25,700;
- By 2032 this increases to c. 26,200 in the Do-Minimum[18] situation; and
- By 2032 with the proposed development in place the AADT is estimated to be c. 28,300 with reduced queuing traffic compared to the do nothing.

The HAWRAT was used to assess the carriageway runoff from the proposed development on the receiving water features. Two assessment types - cumulative and non-cumulative - were undertaken as outlined in Table 6-17.

Table 6-17: HAWRAT Assessment Type

Outfalls	Attribute	Assessment Type
A1	Garavogue River	Non-cumulative assessment - soluble acute impact and sediment chronic impact.
A1	Copper River	Non-cumulative assessment - soluble acute impact and sediment chronic impact.
A3	Copper River	Non-cumulative assessment - soluble acute impact and sediment chronic impact.
A2 & A3	Copper River	Cumulative for outfalls along a river stretch within 100 m - soluble acute

[18] The Do Minimum scenario looks at the network wide implications of the opening of the Eastern Garavogue River crossing and other associated roadworks

Outfalls	Attribute	Assessment Type
		impact and sediment chronic impact

Table 6-20 and Table 6-21 detail the HAWRAT Assessment results for the non-cumulative and cumulative Assessments. The provision of the treatment pond for outfall A3 is based on the findings of the cumulative assessment undertaken under the HAWRAT assessment which found that the assessment would 'fail' for soluble copper without attenuation, prior to discharge of run-off to the Copper River. Table 6-20 and Table 6-21 show the percentage removal of pollutants required to achieve the required water quality objectives and whether the proposed drainage designs achieve these values. It can be seen that with the provision of the treatment pond for outfall A3 that the proposed measures are adequate and that no additional mitigation measures are required. Full details of the assessment are provided in Appendix 6.4.

The outputs (annual average concentrations for soluble pollutants, dissolved copper and dissolved zinc) were also compared against the Environmental Quality Standards (EQS) in the European Communities Environmental Objective (Surface Water) Regulations 2009 and in all cases levels are significantly below the Annual Average AA-EQS.

Based on the HAWRAT assessment results, the potential impacts to water quality from the operational phase specifically to those waterbodies receiving road runoff (Garavogue River and the Copper River) are assessed as described below.

The results of the non-cumulative (outfall A1) indicate that the impacts to the water quality of the Garavogue River / Estuary from the operational phase of the proposed development would be considered to be direct, long term, imperceptible.

The results of the non-cumulative (outfall A2 and outfall A3) and cumulative assessments (outfalls A2 and A3 combined) indicate that the impacts to the water quality of Copper River from the operational phase of the proposed development would be considered to be direct, long term, imperceptible due to pollutant removal in the proposed development drainage system.

6.7.2.2 Accidental Spillage Risk Assessment

There is a risk of hydrocarbon and other dangerous substance contamination as a result of accidental spillage by vehicles using the proposed development during the operational phase of the proposed development. The HA considers that in circumstances where an outfall discharges within close proximity (i.e. within 1 km) to a protected area for conservation, or which could affect important drinking water supplies or other important abstractions, a higher standard of protection will be required such that the risk of a serious pollution incident has an annual probability of less than 0.5%.

The probability of accidental spillage has been calculated for each link using the HA Method D Spillage Risk Assessment and the outputs are included in Appendix 6.5. Table 6-18 shows the probability of an accidental spillage occurring is less than 0.5% in all cases therefore the likelihood of a serous pollution incident is low.

Table 6-18: Accidental Spillage Risk Assessment Results

Outfall	Attribute	Probability	Acceptable risk
A1	Garavogue River	0.002%	Yes
A2	Copper River	0.002%	Yes
A3	Copper River	0.002%	Yes

6.7.2.3 Geomorphology Impacts

As part of the proposed development, outfall structures, a bridge replacement / extension at Copper River Bridge and a tie in to the existing Hughes Bridge would be required, impacting the two geomorphological

receptors during the operational phase. The following section details potential impacts associated with these structures and the implementation of the proposed development.

Outfall structures are required on both the Garavogue Estuary and Copper River. The headwalls of the outfalls are likely to require a portion of the bank to be replaced with hard reinforcement (such as concrete) and the attenuation pond on the Copper River will remove a small proportion of the vegetated riparian zone. Impacts from the operation of outfalls include but are not limited to:

- Changes to flow and sediment dynamics due to outfall discharges and potential changes to channel cross-section;
- Replacement of natural banks with concrete headwalls, reducing the vegetated riparian zone, enhancing areas of erosion upstream and downstream of the structure and reducing lateral connectivity; and
- Increasing suspended sediment input into the river potentially disturbing existing geomorphological features (including riffles, pools and areas of deposition).

The existing Copper River Bridge will be modified and extended to accommodate the widened carriageway as a result of the proposed development. Extension of the bridge would remove a section of the existing channel bank; part of this bank is already artificial (rip rap) in nature. The bridge would alter the channel bed and banks and lateral connectivity of the channel with its floodplain. The following are some of the key potential impacts that could result from the use of bridges:

- Changes in flow velocities, altering flow patterns within a channel;
- Changes to the hydraulic roughness of a channel, i.e. altering the bed substrate, flow dynamics and sediment transport processes;
- Changes in the amount of surface water runoff (including riparian drainage) reaching a channel, potentially affecting the flow regime;
- Increased potential for blockage with knock-on effects both upstream and downstream;
- Potential alteration of downstream processes, including bed and bank stability;
- Changes to patterns of erosion and sedimentation (both upstream and downstream), including disturbance to existing bed forms (e.g. pools and riffles); and
- Changes to the cross-sectional size and shape of a channel, creating a uniform, artificial channel.

The tie in of the proposed development to Hughes Bridge would result in alterations to the current boardwalk. This would be unlikely to have any impacts on the flow of water under the bridge as the bridge structure is already present and no changes would be made to it or the existing piers and abutments.

The proposed development would increase the area of impervious surfaces, potentially altering the local drainage network, increasing surface water runoff. Bed and bank stability could be locally affected by these changes; however this is unlikely to be significant as increased runoff would be largely attenuated.

The overall effects on the geomorphological receptors, the Garavogue River and Estuary and the Copper River, have been assessed to be imperceptible with the mitigation detailed in Section 6.9 being an inherent part of the proposed development design.

6.7.2.4 Flood Risk

A flood risk assessment (FRA) in line with the Office of Public Works (OPW) Guidelines for Planning Authorities (GPA) 20: The Planning System and Flood Risk Management (OPW, 2009), has been undertaken. The full report is contained in Appendix 6.1. The primary objective of the FRA was to construct a hydraulic model of the proposed development to assess the flood risk in the existing situation and with the proposed development in operation. The assessment found that the flood risk to the proposed development is low from all potential sources and concluded that both flood risks and impacts associated with the proposed development are low and negligible, and the Justification Test has been satisfied see Appendix 6.1.

Table 6-19: Summary of flood risk from the proposed development

Flood Risk	Impact	Notes	Mitigation Required
Coastal	No Impact	Proposed site development will not impact existing coastal flooding risk.	No
Fluvial	Negligible Impact	Proposed site development will have an negligible impact to existing river flooding risk.	No
Estuarial	Negligible Impact	Proposed site development will have a negligible impact to existing estuarial flooding risk.	No
Pluvial	No Impact	Appropriate drainage design systems shall be accommodated in the new road development to remove any impact on pluvial flooding.	No
Artificial Drainage Systems	No Impact	Proposed site development will not impact existing Artificial Drainage Systems flooding risk.	No
Groundwater	Negligible Impact	Proposed site development will have a negligible impact to existing river flooding risk. Proposed site development is unlikely to significantly impact on existing groundwater aquifers / tables.	No
Climate Change	N/A	The impact from the proposed development on Climate Change is considered non-applicable.	No

6.7.2.5 Other Potential Impacts

The Garavogue River and Estuary as a whole is considered to have an amenity value of very high importance. However, amenity in the study area and surrounds is limited due to the nature of the existing area i.e. agricultural land and residential properties. Access to the existing slipway will be maintained in the proposed development. Impacts on amenity in the areas during operation will be indirect, long term, neutral, imperceptible.

Chapter 5: Flora and Fauna details the impacts on key ecological receptors with regards to fish during the operation of the proposed development. No impact on recreational fishing during operation is anticipated.

The operational phase impacts are summarised in Table 6-22.

Table 6-20: HD 45/09 HAWRAT Assessment Results Summary Non -Cumulative Assessment

Assessment Type	Outfall	Attribute	% removal required for dissolved pollutants	Minimum % of removal required for sediment	Proposed Attenuation / Treatment	Additional measures required?	AAEQS (ug/l) in line with SI 792 of 2009	Comparison with AAEQS
Non - Cumulative Assessment	1	WF1	0	0	Oil Interceptor and grease trap	N	Copper 5 or 30[19] Zinc 8 or 50 or 100[20]	Below: Copper = 0.00037 Zinc = 0.0011
	2	WF3	0	0	Oil Interceptor and grease trap	N		Below: Copper = 0.37 Zinc = 1.15
	3	WF3	0	0	Oil Interceptor and grease trap plus attenuation treatment pond	N		Below: Copper = 0.36 Zinc = 1.12

Table 6-21: HD 45/09 HAWRAT Assessment Results Summary Cumulative Assessment

Assessment Type	Outfalls	Attribute	Assessment type (Sediment / Soluble)	% of mitigation required sediment	% of mitigation required for dissolved pollutants	Proposed Attenuation / Treatment	Additional measures required?	AAEQS (ug/l) in line with SI 792 of 2009	Comparison with AAEQS
Cumulative Assessment	2 & 3	WF3	Sediment & Soluble	0	17 for Copper 0 for Zinc	Oil Interceptor and grease trap on outfall 2 & 3 plus attenuation treatment pond outfall 3	N	Copper 5 or 30 Zinc 8 or 50 or 100	Below Copper = 0.65 Zinc = 2.02

[19] In the case of Copper the value 5 applies where the water hardness measured in mg/l CaCO3 is less than or equal to 100; the value 30 applies where the water hardness exceeds 100 mg/l CaCO3.

[20] In the case of Zinc, the standard shall be 8 µg/l for water hardness with annual average values less than or equal to 10 mg/l CaCO3, 50 µg/l for water hardness greater than 10 mg/l CaCO3 and less than or equal to 100 mg/l CaCO3 and 100 µg/l elsewhere.

Table 6-22: Summary of Impacts on water quality for each attribute during the construction phase (prior to mitigating measures) and the operation phase (based on NRA, 2009)

Attribute	Importance	Source of Effect	Effect Summary Description	Potential Highest Effect Unmitigated		
				Magnitude	Significance	Impact Type
Garavogue River and Estuary	Extremely High	Direct impact on watercourse from construction of the retaining walls, outfall and indirect impacts associated with the transport of sediment or accidental release during construction entering the River / estuary. Carriageway run-off and accidental spillage during operation.	**Construction** Potential increased siltation, release of suspended solids, and spillage of contaminants in general area during construction works which could impact on the SAC.	Moderate	Profound	Direct and Indirect negative temporary
			Operation Potential for pollutants to be transported in surface run-off and enter the water environment via the road drainage system.	Negligible (no risk identified by HAWRAT and accidental spillage risk below threshold)	Imperceptible	Direct negative long term
Copper River	High	Direct impact on watercourse from construction of bridge, outfalls and indirect impacts associated with the transport of sediment or accidental release during construction entering the River System. Carriageway run-off and accidental spillage during operation.	**Construction** Potential increased siltation, release of suspended solids, and spillage of contaminants in general area during construction works which could impact on the SAC.	Moderate	Significant	Indirect negative temporary
			Operation Potential for pollutants to be transported in surface run-off and enter the water environment via the road drainage system.	Negligible (no risk identified by HAWRAT and accidental spillage risk below threshold)	Imperceptible	Direct negative long term

6.8 Do-Nothing Scenario Impact

The “do nothing” scenario is the outcome that would be achieved if the proposed development was not constructed. The physico-chemical status of the Copper River (WF3) could potentially decrease with increased traffic levels with increased incidence of queuing, and subsequent increased pollutant load entering the river via an unattenuated / untreated drainage system on the existing road. In the absence of the proposed development it is anticipated that the baseline water quality of all other watercourses (WF1 & WF2) would remain in their current condition.

6.9 Proposed Mitigation and Avoidance Measures

6.9.1 Construction Phase Mitigation

To avoid the pollution of watercourses during the construction phase all construction works will be completed in line with the recommendations of the following guidelines:

- ‘Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes’ (NRA, 2005);
- CIRIA C649 Control of Water Pollution from Linear Construction Projects: Site Guide (Murnane *et al*., 2006);
- ‘Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors’ (CIRIA, 2001);
- Inland Fisheries Board Guidance Document (formerly developed by Eastern Fisheries Board) “Requirements for the protection of fisheries habitat during Construction and development works at river Sites”; and
- UK Environment Agency:
  - PPG5 Pollution Prevention Guidelines Works and Maintenance in / or near Water;
  - PPG21 Incident Response Planning;
  - PPG22 Dealing with Spills; and
  - PPG26 Drums and Intermediate Bulk Containers.

To avoid the pollution of watercourses during the construction phase a preliminary Erosion and Sediment Control Plan (pESCP) is contained in Appendix 8.5. This pESCP is intended to be a working document and will be updated by the contractor to form the detailed Erosion and Sediment Control Plan (dESCP) which will form part of the contractors Environmental Operating Plan (EOP) for the construction of the proposed road development. The construction contractor will prepare the dESCP prior to commencing the construction works. To prevent or reduce the amount of sediment released into watercourses, the sediment / silt control plan will include the following measures to be implemented by the contractor; full details are provided Appendix 8.5:

- Constructing structures during periods of low flow (typically during summer months) to reduce the risk of scour and erosion around a structure or to the disturbed river bed;
- Provision of measures to prevent the release of sediment concentrations over baseline conditions to WF1-WF3 during the construction works will include but not be limited to silt fences, silt curtains, settlement lagoons and filter materials;
- Provision of measures to prevent the displacement and subsequent erosion and release of large volumes of soft sediment, particularly from bridge works over WF3. These measures will include but not be limited to an over pump regime on the copper river during construction, settlement tanks, silt curtains and / or sediment fences;
- Temporary construction surface drainage and sediment control measures will be in place before earthworks commence;

- Provision of exclusion zones and barriers (sediment fences) between earthworks, stockpiles and temporary surfaces and watercourses to prevent sediment washing into the watercourses;
- Measures will be provided to ensure that all works associated with the Copper River Bridge construction are protected against the 1:100 year return period fluvial flood event and the 1:200 year return period coastal flood to ensure that there is no hydraulic connectivity between the temporary works and the Copper River during construction;
- Limiting the extent of vegetation clearance and thereby minimising the potential release of sediment from bare ground following clearance;
- Precast concrete will be used in preference to pouring concrete where possible;
- Pouring of concrete for the works will be carried out in the dry and allowed to cure for 48 hours before re-flooding. Pumped concrete will be monitored to ensure no accidental discharge. Mixer washings and excess concrete will not be discharged to surface water; and
- No storage of hydrocarbons or any toxic chemicals will occur within 50 m of any watercourse. Fuel storage tanks will be bunded to a capacity at least 110% of the volume of the storage tank. Re-fuelling of plant will not occur within 50 m of any watercourse and only in bunded refuelling areas. Emergency procedures and spillage kits will be available and construction staff will be familiar with emergency procedures.

The contractor shall liaise with SCC, the NPWS and IFI in relation to the dESCP and shall include their recommendations as appropriate in this regard.

- The contractor shall ensure that the construction methodologies used will ensure no wastes will be discharged to the watercourses.

Consultation will be undertaken with the above stakeholders prior to works including any advanced works.

6.9.1.1 Pre- construction Monitoring

Pre-construction water quality monitoring will be undertaken by the contractor once every two weeks for a four month period, prior to the commencement of the construction works. Samples will be taken for total suspended solids (TSS), turbidity, pH, temperature, dissolved oxygen (DO) and hydrocarbons up and downstream of the Copper River Bridge to build upon the baseline monitoring carried out at the Environmental Assessment stage and in order to further establish the baseline water quality conditions prior to the construction phase. Samples for turbidity, pH, DO and temperature will be taken in situ; samples for TSS and hydrocarbons will be sent to an accredited laboratory for analysis.

6.9.1.2 Monitoring During Construction

The contractor will monitor the levels of TSS, turbidity, pH, temperature, DO and hydrocarbons at the same locations up and down stream once a week for the duration of the following works:

- Site clearance works, earthworks movements and stockpiling;
- Excavations including those associated with the provision of drainage works;
- Construction of the Copper River Bridge; and
- Construction works within watercourses.

The construction monitoring results will be compared with those results established in pre-construction monitoring. In the event of an elevation above pre-construction levels an investigation will be undertaken by the contractor and remediation measure will be put in place in agreement with SCC.

In addition, daily visual inspections of the surface drainage and sediment control measures and the watercourses will be undertaken by the contractor. Indicators that water pollution may have occurred include the following:

- Change in water colour;

- Change in water transparency;
- Increases in the level of silt in the water;
- Oily sheen to water surface;
- Floating detritus; or
- Scums and foams.

These inspections shall be recorded. In the event that such indicators are observed, works will cease, sampling will be immediately undertaken as described for the weekly monitoring and an investigation of the potential cause will be undertaken by the contractor in consultation with SCC.

Where the works are identified as the source causing the exceedance the following will apply:

- Contact will be made with the SCC;
- SCC will liaise with the NPWS and IFI on the issue;
- Works capable of generating sediment and all discharges shall be stopped immediately; and
- The contractor will be required to take immediate action to implement measures to ensure that such discharges do not re-occur.

The above monitoring will alert the contractor to any detrimental effects that particular construction activities may have on water quality in order that appropriate remedial action can be taken as quickly as possible and allow the contractor to demonstrate the success of the mitigation measures employed in maintaining any sediment release within the trigger value established.

6.9.2 Operation Phase Design and Mitigation

6.9.2.1 Water Quality

Measures to attenuate and treat the carriageway runoff in order to avoid significant impacts have been incorporated into the drainage design of the proposed development.

The likelihood of a serous pollution incident is considered low however a penstock, handstop, or an orifice that can be readily blocked in the event of accidental spillage will be provided on the attenuation / treatment pond. If lowered in time prior to discharge of significant quantities, penstocks can potentially retain 100% of spilled material.

In addition, in line with IFI requirement the treatment system used shall ensure a standard of 10-15 mg/l for suspended solids to inform retention time needed. All other requirements of the IFI as set out in their response in Appendix 6.2 will be implemented in the final drainage design.

In order to ensure the drainage system operates to the required standard, SCC will monitor on a twice yearly basis the water quality at the inlet and outlet to the attenuation / treatment pond as undertaken for the EAR and compare these to the standards in the European Communities Environmental Objective (Surface Water) Regulations, S.I. 272 of 2009. If exceedances are found remediation measures will be undertaken.

In order to avoid adverse watercourse impacts due to spills or accident leakages a contaminant spill emergency plan will be put in place to contain, remove or remediate any catastrophic spill before it reaches any surface water receptor. Emergency equipment / spill kits to facilitate the implementation of such plan will be made available in secured locations within the area.

6.9.2.2 Geomorphology

6.9.2.2.1 Outfalls

Outfalls will be installed at locations not excessively altering channel flow and sedimentation patterns. The inclusion of an attenuation pond upstream of one of the outfalls on the Copper River and the provision of an oil interceptor on all outfalls would reduce potential impacts of fine sediment input into the channel and excessive flows discharging from the outfall. Specific mitigation measures include but are not limited to:

- Constructing the attenuation pond to encourage deposition of suspended sediments and minimising sediment input to the river;
- Directing outfalls downstream and away from the banks to minimise the impact to flow patterns and minimising any potential risk of erosion (particularly on the opposite bank); and
- Minimising the size and extent of headwalls where possible, reducing the potential impact on the banks.

6.9.2.2.2 Copper River Bridge (Incl. Culvert)

The following specific mitigation measures and good practice guidance for the operation of culverts will be employed:

- Allowing for the passage of water and sediment for a range of flows (including low flow conditions);
- Avoiding reduction of the river length through shortening the channel planform and maintaining the existing channel gradient, thus reducing potential erosion at the upstream and downstream extent of the culvert;
- Keeping the length of a culvert to a minimum and aligning a culvert with the existing watercourse, retaining natural bed and banks where possible; and
- Depressing the invert of culverts to allow for formation of a more natural bed.

6.9.2.3 Flood Risk

The finished surface levels have been designed to ensure that they are above the 0.5% AEP flood event level plus 1m allowance for climate change for the high end future scenario. The finished road surface profile ranges from 4.190 mOD to 6.604 mOD ensuring that the predicted extreme water level of 4.12 mOD, taking account of climate change, will not impact on the proposed development at present or in the future.

This development will raise the existing road levels reducing the risk of coastal, fluvial, estuarial, artificial drainage systems and pluvial flooding to the development.

The drainage system has been designed to manage the risk of pluvial sources to and from the development. The outfalls are designed to ensure that the rate of discharge does not exceed that of the existing ‘greenfield’ catchment area, minimising the risk of overloading the receiving watercourses. The drainage system is also designed to achieve a maximum outfall level of +2.97 mOD which is above the level of the Highest Astronomical Tide plus a 10% allowance for climate change.

The development may have negligible impacts to the fluvial, estuarine and ground water. These impacts will be limited to areas on the left and right bank of the Copper River upstream of the proposed development which has been zoned as open space.

The negligible impacts to the fluvial and estuarine risk will be limited / mitigated by the design of the reconstructed Copper River Bridge, which will be designed to limit headloss across the structure in accordance with the requirements of Section 50 of the Arterial Drainage Act 1945.

The negligible impacts to the groundwater flood risk will be limited / mitigated in the design of the required earthworks.

6.10 Difficulties Encountered in Compiling Information

No difficulties were encountered during the assessment.

6.11 Residual Impacts

The residual impacts associated with the proposed development after implementation of the mandatory mitigation measures during the construction phase are detailed in Table 6-23.

Table 6-23: Residual Impact after mitigation measures for construction

Attribute	Importance	Significance pre mitigation	Significance post mitigation
Garavogue River (WF1) and Estuary (WF2)	Extremely High	Profound	Negligible
Copper River (WF3)	Extremely High	Significant	Negligible

The drainage design for the proposed development has been considered in the operational impact assessment which has concluded no significant impact as a result of the proposed development in terms of water quality. Residual impacts on the water quality of the proposed development will be negative, long term, negligible.

The residual effects on the geomorphological receptors, the Garavogue River and Estuary and the Copper River, have been assessed to be imperceptible with the mitigation detailed in Section 6.9 being an inherent part of the proposed development design.

The tie in to the boardwalk of the bridge over the Garavogue Estuary is not anticipated to have any impact above the existing baseline conditions. The new outfall to the Garavogue Estuary would remove a small section of earth bank, although this is a man-made embankment. The flows discharging from the outfall could potentially alter the localised flow and sediment dynamics. However, with appropriate placement of the structure it is likely that these impacts would be minimal. As a result, the overall residual effects on the Garavogue Estuary are considered to be imperceptible.

The bridge works and two new outfalls on the Copper River would lead to the loss of channel bank and bed and alter the lateral and longitudinal connectivity. The channel banks within the vicinity of the western outfall and the bridge are already artificial, with rip rap of varying sizes, limiting potential impacts on the river from the new structures. The channel bed was noted to consist of fine sediment which could be disturbed by discharges to the channel or flow regime or completely removed by the culvert. However, due to the size and modified nature of the channel, this is considered to be localised and not expected to significantly impact the river. The eastern outfall would remove a small section of earth bank; however, at the time of survey this appeared to be man-made and modified and would be unlikely to cause a significant impact. Overall, the potential works on the Copper River are proposed on a section of the river that is already modified and as a result, the overall residual effects on the Copper River are considered to be imperceptible.

It has been concluded that both flood risks and impacts associated with the proposed development are low and negligible. Negligible impacts to the fluvial, estuarine flood risk will be mitigated against in the design of the bridge. It is recommended that any negligible impacts to the ground water be mitigated against in the design of the required earthworks. Therefore, as the negligible impacts of flooding can be mitigated, it is recommended that further detailed modelling, i.e. Stage 3 Detailed Risk Assessment, was not required.

6.12 Impact Interrelations & Cumulative Impacts Assessment

Hydrology interrelates to other aspects such as Flora and Fauna and Hydrogeology. Deterioration of surface water quality in the study area as a result of the proposed development can impact on flora and fauna within the study area. In turn, deterioration of the groundwater quality in the study area could impact on the surface water

quality in the study area. These interrelations have been included in the overall impact assessment for each aspect.

There are no known proposals for development within the study area. There are two road projects under active consideration by SCC at present, namely the N16 Sligo to County Boundary Realignment and the N4 Collooney / Castlebaldwin. There are no anticipated cumulative impacts with these other developments due to their current phase (the N16 Sligo to County Boundary Realignment is at route selection phase) and distance from the proposed development the N4 Collooney / Castlebaldwin (planning permission received) is some 10 km away. There are no foreseeable plans at present to progress the N4-N15 Sligo to Borough Boundary scheme. These projects will and have been subject to planning requirements and where required, EIA and Appropriate Assessment to address the impacts.

6.13 Water Framework Directive Compliance

For surface water bodies to achieve overall 'good ecological status' (GES), ecological and chemical parameters must be judged to be at least 'good'. GES refers to situations where the ecological characteristics show only a slight deviation from a natural reference condition. The WFD outlines a number of objectives including:

- Prevent deterioration in the status of water bodies;
- Aim to achieve GES and good surface water chemical status in water bodies by 2015, 2021 or 2027 (depending on feasibility);
- Comply with objectives and standards for protected areas where relevant; and
- Reduce pollution from priority substances and cease discharges, emissions and losses of priority hazardous substances.

Hydromorphology is a key aspect of the EU WFD (2000/60/EC), defined simply as the hydrological and geomorphological condition of surface water bodies. Hydromorphology is taken to subsume geomorphological forms and processes, for which there could be a number of potential sources of impact at a local level arising from the proposed development. It is important to understand these potential local impacts before assessing impact at the scale of an entire water body. In detail, hydromorphology as defined by the WFD for the river water bodies refers to the morphological conditions, river continuity and hydrological regime (flow) of a water body. For river water bodies the morphological conditions are:

- River depth and width variation;
- Structure and substrate of the river bed; and
- Structure of the riparian zone.

And for the hydrological regime:

- Quantity and dynamics of water flow; and
- Connection to groundwater bodies.

The WFD compliance for the Gill, Trib of Garavogue / Garavogue Estuary has been assessed against the quality elements, which include biological, physico-chemical and hydromorphological elements. The biological elements are discussed in Chapter 5 and physico-chemical elements in this Chapter above. The following provides an overview of the hydromorphological aspects of the water body in relation to the operational works of the proposed development.

Table 6-24: Potential impacts on the hydromorphology element of the WFD

WFD Hydromorphological Quality Elements	Operation Impacts
River depth and width variation	The bridge extension and outfall structure are unlikely to have a significant impact on the river depth and width at the water body scale.

WFD Hydromorphological Quality Elements	Operation Impacts
Structure and substrate of the river bed	The outfall structure could potentially remove a small section of channel bed. This is unlikely to have an impact at the water body scale.
Structure of the riparian zone	The outfall structure is located on an existing earth embankment, likely to be man-made or modified historically. However, the earth embankment provides a section of bank that isn't artificial and a small portion would be removed as a result of the outfall. Despite this, the outfall would be unlikely to have a significant impact at the water body scale.
River continuity	No impacts anticipated.
Quantity and dynamics of flow	The outfall would introduce a new source of additional flows to the river. It is anticipated that flow patterns and dynamics could be altered but that these would most likely be very localised. Therefore, it is not anticipated that there would be a significant impact at the water body scale.
Connection to groundwater bodies	No impacts anticipated.

As described above, the proposed development will not cause deterioration of water quality within the water bodies adjacent to the proposed development either during construction (with implementation of appropriate mitigation measures) or during the subsequent operational phase. The proposed development will not result in any significant hydromorphological impacts, while the flora and fauna assessment presented in Chapter 5 concludes that there would be no significant residual impacts to aquatic ecology and fish following implementation of mitigation measures. In considering the development as a whole and the three key quality elements, it is not anticipated that the proposed development would cause deterioration in the WFD water body status provided the prescribed mitigation is implemented. It is therefore considered that there is no risk of non-compliance with the WFD.

7. Geology, Soils and Hydrogeology

7.1 Introduction

This chapter presents an assessment of the proposed development in relation to the impacts on geology, soils and groundwater. This includes impacts to bedrock and superficial geology, mineral extraction, soils, contaminated land, groundwater and associated receptors.

7.1.1 Approach and methods

This assessment has been undertaken based on the guidance contained in 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (National Roads Authority, DMRB Volume 4 Section 2 Part 1 NRA HD 45/15 'Road drainage and the water environment' (Transport Infrastructure Ireland, 2015) and 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements' (Institute of Geologists of Ireland, 2013).

7.1.2 Study Area

The Geology, Soils and Hydrogeology assessment covers a study area extending in a corridor 250 m from the proposed development while impacts on groundwater abstractions have been assessed to a distance of 850 m from the proposed development.

7.1.3 Baseline Data Collection

Baseline conditions were determined through a desk-based review and assessment. Baseline conditions cover the following aspects of ground conditions:

- Bedrock and superficial geology;
- Mineral extraction;
- Groundwater environment and associated receptors, including PWS; and
- Contaminated land.

7.1.3.1 Desk Based Assessment

The desk-based assessment included a review of the following information:

- Environmental Protection Agency (EPA) map viewer;
- Geological Survey of Ireland (GSI) online data sets;
- Geohive data catalogue of historic maps;
- Previous assessments:
    - Report on a Site Investigation for N4-N15 Realignment Sligo to County Border On behalf of Sligo County Council, Report No. 13811 (IGSL, 2008); and
    - N4-N15 Sligo Urban Road Improvement Environmental Impact Statement (WSP, 2011).

7.1.3.2 Consultation

Consultation undertaken as part of the Environmental Assessment is outlined in Chapter 0. Of specific relevance to the Geology, Soils and Hydrogeology chapter is that undertaken with the GSI. A consultation letter was issued to the GSI in October 2015 and a response was received in November 2015, see Appendix 7.1

7.2 Description of the Existing Environment

7.2.1 Soils and Geology

7.2.1.1 Made Ground

The EPA Map Viewer indicates that the entire study area is underlain by made ground.

The geological logs from four boreholes / trial pits available within the study area from the Site Investigation for the previous N4-N15 Realignment indicate made ground ranging in depth from 1.6 mbgl to 2.3 mbgl. It was generally described as sandy gravelly clay, with rubble or cobbles noted in some excavations. Asphalt and concrete was also encountered in one trial pit.

7.2.1.2 Superficial Geology

The GSI Quaternary Geomorphology Viewer characterises the majority of the study area as being underlain by urban deposits, with a small area of till mapped to the northern part of the route between Ash Lane and the N15 Duck Street. Superficial geology is shown to be absent in a small area north-west of St. John's Hospital adjacent to Ballytivnan Road.

Geological logs indicate that most of the superficial deposits across the study area are sandy gravelly clays, locally with silt or cobbles, consistent with glacial till, and indicate that till may be relatively widespread beneath the made ground within the study area. It ranged in thickness from 1 to 3.6 m.

7.2.1.3 Bedrock Geology

Bedrock within the study area is comprised of the Glencar Limestone Formation, described as a dark fine limestone interbedded with calcareous shales see Figure 7.2. Ground investigation data indicate that limestone bedrock was encountered at 5.4mbgl and was described as "grey fine-grained limestone interbedded with black argillaceous limestone". The boundary with the Dartry Limestone formation (Dark fine-grained Cherty Limestone) is present at the south of the study area, approximately 200 m to the south of the southern extent of the road alterations.

7.2.1.4 Mineral Extraction

No active mineral quarries are present within the study area, although historical maps do indicate the presence of a disused quarry (S2) at the extreme northern end of the study area, adjacent to Ballytivnan Road, see Figure 7.5. This quarry was likely to be exploiting bedrock, due to both the nature of the superficial cover (clayey till) and the presence of bedrock outcrop mapped to this area. Though bedrock has been exploited locally in the past the presence of urban infrastructure means mineral extraction is unlikely to occur in the future within the study area.

7.2.1.5 Geotechnical Hazards

The GSI Public Data Viewer does not indicate the presence of any karst features in the vicinity of the proposed development, nor are any known geohazards mapped within the study area.

7.2.1.6 Contaminated Land

Two potential contamination sources have been identified within the study area. Details of identified sources are provided in Table 7-1 and the location of S2 is shown in Figure 7.5, S1 is general Made Ground across the study area.

Table 7-1: Potential Contaminated Land Sources

Source name	Description
S1	General Made Ground across the study area; likely to be associated with the existing development
S2	Disused Quarry, likely to have been backfilled

7.2.2 Groundwater

Details of local hydrogeological characteristics are provided in Table 7-2. The GSI Public Data Viewer does not show an aquifer to be present within the superficial deposits and indicates that the till / made ground is considered a non-aquifer. The Limestone bedrock underlying the study area is categorised as a Locally Important (LI) aquifer, named as the Drumcliff-Strandhill aquifer by the EPA, see Figure 7.1. This is made up of bedrock that is moderately productive only in local areas, and for the most part is poorly productive bedrock.

According to the GSI Public Data Viewer, groundwater vulnerability is generally moderate across the study area with a small area of high vulnerability around the outcrop area mapped to the historic quarry in the north of the study area, see Figure 7.3.

Groundwater level data is not available within the study area. Groundwater strikes from the available ground investigation data indicate that groundwater was encountered in a single rotary core borehole at a depth of 4.7 m, within a horizon of clay and gravel (till). This borehole extended approximately 10 m down into the underlying limestone and recorded no further groundwater strikes indicating that groundwater within the bedrock is at a significant depth, at least at the time of year the borehole was drilled. Groundwater levels within limestone can fluctuate quite widely during the year and so conditions during drilling may not reflect the likely minimum depth to groundwater that could be encountered at a specific location.

Groundwater within the superficial deposits is likely to be perched, with limited local flows. Any groundwater flow occurring is likely to be controlled by local topography and be directed towards surface water features. The direction of groundwater flow within the bedrock is unknown, although given the presence of a layer of cohesive glacial till above bedrock likely to be present over most of the development footprint communication between shallow and deep groundwater bodies is likely to be limited.

Table 7-2: Hydrogeological Characteristics of Superficial and Bedrock Units

Geological / Hydrogeological Unit		Geological Characteristic	Hydrogeological Characteristic
Superficial Geology	Made ground	Generally sandy gravelly clay, locally with gravel, cobbles or tarmac	Poor groundwater potential due to generally low and variable permeable nature.
	Glacial Till	Sandy gravelly clays, locally with silt, gravel or cobbles and occasional peat	Poor groundwater potential due to generally low and variable permeable nature.
Bedrock Geology	Glencar Limestone Formation	fine-grained limestone with interbedded shale	Locally Important (LI) aquifer - mostly poorly productive, with moderate productivity only in local areas. No karstic features are indicated on the GSI Public Data Viewer.

7.2.2.1 Groundwater Quality

No data on groundwater quality was available for the study area, however this is not considered to affect the robustness or outcome of the impact assessment.

7.2.2.2 Abstractions

No groundwater abstractions were identified within 1 km of the study area.

7.2.3 Ecological Receptors with Potential Groundwater Component

Two ecological receptors that could potentially have a groundwater component were identified within the study area and are summarised in Table 7-3 and Figure 7.4.

Table 7-3: Summary of Identified Ecological Receptors with a Potential Groundwater Component within 250 m of the Proposed Development Boundary

Habitat Code (Fossitt, 2000).	Easting (centre of polygon)	Northing (centre of polygon)	Wetland Typology	GW Dependency based on potential NVC comms as per SEPA (2014)	Ecological Value as per CIEEM and NRA
Wet Grassland (GS4)	169284	336739	Wet Grassland	Moderate	Wet Grassland (GS4)
Wet Grassland (GS4)	168916	336502	Wet Grassland	Moderate	Wet Grassland (GS4)

7.2.4 Surface Water Features

Three surface water features have been identified within the study area and are described in detail in Chapter 6. A summary of their assigned importance is summarised in Table 7-4

Table 7-4: Summary of Identified Surface Water Features

Attribute	Importance	Rationale
Garavogue River	Extremely High	Part of the Cummeen Strand / Drumcliff Bay (Sligo Bay) SAC
Garavogue Estuary	Extremely High	Part of the Cummeen Strand / Drumcliff Bay (Sligo Bay) SAC
Copper River	High	Connection to the Cummeen Strand / Drumcliff Bay (Sligo Bay) SAC

7.3 Impact Assessment

Impacts in relation to geology, groundwater and contaminated land have been assessed individually as per the methodologies provided below. The significance of potential impacts has been determined taking into account the importance of the feature / receptor and the magnitude of potential impact.

7.3.1 Geology

For bedrock and superficial geology the importance and magnitude criteria in Table 7-5 and Table 7-6 were used. The impact significance was then determined using Table 7-7.

Table 7-5: Importance Criteria - Geology

Importance	Criteria
Very High	Attribute has a high quality or value on a regional or national scale
High	Attribute has a high quality or value on a local scale
Medium	Attribute has a medium quality or value on a local scale
Low	Attribute has a low quality or value on a local scale

Table 7-6: Magnitude Criteria - Geology

Magnitude	Criteria
Large Adverse	Results in loss of attribute and / or quality and integrity of attribute
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity

Table 7-7: Matrix of Determination of Impact Significance - Geology

Importance of Attribute	Magnitude of Impact			
	Negligible	Small Adverse	Moderate Adverse	Large Adverse
Very High	Imperceptible	Significant	Profound	Profound
High	Imperceptible	Significant / Moderate	Profound / Significant	Profound
Medium	Imperceptible	Moderate / Slight	Significant / Moderate	Severe / Significant
Low	Imperceptible	Slight	Moderate	Significant

7.3.2 Contaminated Land

In line with guidance and best practice (NRA 2008, IGI 2013), the assessment focuses on the potential for impacts on receptors as a consequence of encountering contaminated land using a conceptual site model (CSM) developed for the proposed development. A receptor can be a person (including construction workers), the water environment, flora, fauna or building / structures. The CSM represents a network of relationships between potential sources of contamination from within the study area and exposure of the receptors through different pathways.

The pollutant pathways (PP) and type of receptors used within the assessment are provided in Table 7-8 with individual references for linkages, i.e. PP1 to PP22.

Table 7-8: Potential Pollutant Pathways

Pollutant Pathway	Receptor	Pathway
Construction		
PP1	Human Health (Construction)	Ingestion, inhalation and dermal contact with soils, soil dust, deep and shallow groundwater and surface water.
PP2		Migration of ground gases into shallow pits or site buildings.
PP3	Off-site human Receptors (Local residents and transient traffic (foot, road and rail traffic)).	Ingestion, inhalation and dermal contact with wind-blown dust created during excavation works.
PP4		Migration of ground gases into homes or workplaces through preferential pathways created during construction posing a potential asphyxiation / explosion risk.
PP5	Groundwater – Drift Aquifers	Leaching and migration of contaminants.

Pollutant Pathway	Receptor	Pathway
PP6	Groundwater – Bedrock Aquifers	Migration of contaminants or contaminated shallow groundwater into the deeper rock aquifer.
PP7	Surface Waters	Migration of contaminated shallow groundwater through drift deposits or made ground.
PP8		Runoff from contaminated source(s).
PP9		Migration of contaminated bedrock groundwater towards surface water receptor.
PP10		Discharge of intercepted contaminated groundwater during passive or active dewatering.
PP11	Ecological Receptors (water dependant habitats and agricultural land/livestock)	Inhalation, ingestion and direct contact with contaminated soils / water.
Operational		
PP12	Human Health (Operational)	Ingestion, inhalation and dermal contact with soils, soil dust, deep and shallow groundwater, surface water in the long term during routine maintenance activities e.g. drainage inspections.
PP13		Migration of ground gases into confined spaces e.g. service pits, accommodation buildings creating an asphyxiation / explosion risk.
PP14	Off-site human Receptors	Ingestion, inhalation and dermal contact with wind-blown dust from contaminated soils reused within road features such as embankments and landscaped areas.
PP15		Migration of ground gases into homes or workplaces through preferential pathways remaining following construction thus posing a potential asphyxiation / explosion risk.
PP16	Groundwater – Drift Aquifers	Leaching and migration of contaminants.
PP17	Groundwater – Bedrock Aquifers	Migration of contaminated shallow groundwater into the deeper rock aquifer.
PP18	Surface Water	Migration of shallow groundwater through drift deposits or made ground.
PP19		Runoff from contaminated source(s).
PP20		Migration of contaminated shallow groundwater through drainage channels and associated granular bedding materials or engineered structures.
PP21		Discharge of intercepted contaminated groundwater.
PP22	Ecological Receptors	Inhalation, ingestion and direct contact with contaminated soils / water.

For the purposes of this assessment, the CSM disregards those pathways that are incomplete and therefore cannot pose a risk to any of the identified receptors. Where a source, pathway and receptor combination exists this is referred to as a complete pollutant linkage and a qualitative risk assessment has been undertaken.

Potential impacts are discussed in terms of likelihood as shown in Table 7-9 and magnitude / consequence as shown in Table 7-10. The qualitative risk assessment is then undertaken based on the matrix shown in Table 7-11.

Table 7-9: Likelihood Criteria - Contaminated Land

Likelihood	Definition
High likelihood	There is a complete pollution linkage of an event that either appears very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.
Likely	There is a complete pollution linkage and all the elements are present and available, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over a long-term.
Low likelihood	There is a complete pollution linkage and the circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such an event would take place, and is less likely in the shorter term.
Unlikely	There is a complete pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.

Table 7-10: Magnitude (Consequence) Criteria - Contaminated Land

Magnitude	Definition
Severe	Short-term (acute) damage to human health (significant harm). Pollution of sensitive water resources as a result of short-term exposure. Damage to a particular ecosystem as a result of acute exposure. Catastrophic damage to buildings / property.
Medium	Long-term (chronic) damage to human health (significant harm). Pollution of sensitive water resources as a result of chronic exposure. A significant change in a particular ecosystem, or organism forming part of such an ecosystem.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings / structures / services or the environment.
Minor	Harm (not necessarily significant), which may result in financial loss or require expenditure to resolve. Non-permanent health effects to human health. Easily reparable damage to buildings, structures and services.

Table 7-11: Risk Assessment Criteria - Contaminated Land

Consequence	Likelihood			
	Unlikely	Low Likelihood	Likely	High Likelihood
Severe	Moderate / low	Moderate	High	Very high
Medium	Low	Moderate / low	Moderate	High
Mild	Very low	Low	Moderate / low	Moderate
Mnior	Very low	Very low	Low	Moderate / low

7.3.3 Groundwater

The assessment of the magnitude of impact on the quality and level of groundwater are based primarily on the type of road profile (e.g. cutting, embankment or transition cutting-embankment) facing the receptor. However, where appropriate, the vulnerability of groundwater flow to sub-surface disruptions is also considered to refine the assessment of magnitude of impact. Impacts on groundwater quality and / or flow may also have direct or indirect effects onto groundwater abstractions, ecological receptors with potential groundwater dependency and surface water features.

Criteria for the definition of groundwater importance and magnitude are reported in Table 7-12 and Table 7-13. These consider groundwater importance in the context of hydrogeological conditions including groundwater resources and ecological receptors with potential groundwater dependency.

Importance criteria attributed for surface water quality and flow parameters are the same as defined in Chapter 6.

The impact significance for groundwater aspects was then determined using the matrix as shown in Table 7-14

Table 7-12: Importance Criteria - Hydrogeology

Importance	Criteria
Extremely High	Attribute has a high quality or value on an international scale
Very High	Attribute has a high quality or value on a regional or national scale
High	Attribute has a high quality or value on a local scale
Medium	Attribute has a medium quality or value on a local scale
Low	Attribute has a low quality or value on a local scale

Table 7-13: Magnitude Criteria – Hydrogeology

Magnitude	Criteria
Large Adverse	Results in loss of attribute and / or quality and integrity of attribute
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity

Table 7-14: Matrix of Determination of Impact Significance - Hydrogeology

Importance of Attribute	Magnitude of Impact			
	Negligible	Small Adverse	Moderate Adverse	Large Adverse
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant / Moderate	Profound / Significant	Profound
High	Imperceptible	Moderate / Slight	Significant / Moderate	Severe / Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight / Moderate

7.4 Attribute Importance

Table 7-15 summarises the importance of the attributes identified within the study area based on the NRA *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes* (NRA, 2008).

Table 7-15: Attribute Importance within the Study Area

Attribute	Attribute Importance	Rationale
Made ground	Low importance	Made ground has been identified within the development footprint, however does not have economic value or protected status.
Superficial geology	Low importance	Glacial till (sandy gravelly clay with occasional silt or cobbles) identified within the development footprint, however does not have economic value or protected status.
Bedrock geology	Low importance	Glencar Limestone Formation (dark fine limestone with calcareous bands) identified within the development footprint, however does not have economic value or protected status.
Groundwater (superficial deposits)	Low importance	Poor groundwater potential due to generally low and variable permeable nature.
Groundwater (bedrock)	Medium importance	Locally Important (LI) aquifer - mostly poorly productive, with moderate productivity only in local areas
Wet grassland (ecological receptor with potential groundwater component)	Medium importance	Wet grassland (GS4 category)
Garavogue River	Extremely High	Part of the Cummeen Strand / Drumcliff Bay (Sligo Bay) SAC
Garavogue Estuary	Extremely High	Part of the Cummeen Strand / Drumcliff Bay (Sligo Bay) SAC
Copper River	High	Connection to the Cummeen Strand / Drumcliff Bay (Sligo Bay) SAC

7.5 Predicted Impacts of the Proposed Development

The potential impacts are assessed prior to the implementation of mitigation. Potential mitigation is then identified and described in Section 7.6.

Construction and operational impacts have generally been considered together as the majority of construction effects (such as excavation and removal of material or dewatering effects due to road cuttings) would extend throughout the operational phase. Where differences in impacts are predicted, construction and operational impacts are reported separately.

There are a variety of ways in which road developments can impact on geological resources such as the following:

- Excavating or masking exposures of rocks or drift geological deposits of Natural Heritage Areas (NHA) or Irish Geological Heritage Sites if the features of interest are not reproduced elsewhere in the area;
- Constraint / limitation to existing or potential commercial exploitation of resources;
- Effects on underlying groundwater aquifers, for example, through the dewatering of aquifers as a result of construction works involving excavation;

- Risk of spillage or leakage of fuel or oil from storage tanks or construction plant, which without suitable mitigation measures, can enter aquifers;
- Effects of changes to groundwater flow or quality on secondary receptors such as groundwater abstractions, surface water or groundwater dependant terrestrial ecosystems; and
- Surface runoff from the operational carriageway may contain elevated concentrations of pollutants such as ils, suspended solids, metals (e.g. copper and zinc) and, in winter, salt and antifreeze agents (e.g. ethylene glycol), leading to pollution of the aquifers.

7.5.1 Specific Impacts

The road design does not propose any areas of cutting with most of the route being constructed at grade. Therefore impacts to the subsurface, with the exception of groundwater quality, will be limited to shallow excavation works linked to clearance activities.

7.5.2 Superficial Geology

Given the lack of road cuttings and the likely shallow excavations during the construction of the proposed development any impact on superficial deposits (low importance) including made ground is likely to be of negligible magnitude, resulting in Imperceptible significance.

7.5.3 Bedrock Geology

Bedrock is unlikely to be impacted by the shallow excavations. Any impact is expected to be of negligible magnitude, resulting in an Imperceptible significance.

7.5.4 Mineral Extraction

Mineral extraction within the study area no longer occurs and would be unlikely to occur in the future within the footprint of the proposed development given that it is located in a residential area. The magnitude of impact on the bedrock resource (low importance) is expected to be negligible resulting in a potential impact of Imperceptible significance.

7.5.5 Contaminated Land

The former quarry (S2) is unlikely to be disturbed as part of the works; as such, the following assessment focusses on the existing made ground within the area of the proposed works (S1) which is more likely to be disturbed. The ‘general’ made ground of which S1 comprises may contain chemical contaminants which could affect human health, groundwater and surface water receptors, however it is considered unlikely to be a source of ground gas. A number of potential contamination sources, migration pathways and receptors that may be at risk as a result of the proposed development have been identified. A CSM has been developed to determine the significance of potential risks where complete pollutant linkages have been identified between contamination sources and receptors.

7.5.5.1 Construction Phase – Direct Disturbance

Direct disturbance of potentially contaminated land has the potential to impact on human and water receptors as summarised in Table 7-16.

Table 7-16: Potential Direct Contaminated Land impacts on Environmental Receptors during Construction

Source Ref	Source Name	Pollutant Pathway	Magnitude	Likelihood	Significance
S1	General Made Ground across the study area	PP1 & PP3	mild	likely	Moderate / Low
S1	Made ground excavated from site and temporarily stored	PP1, PP3, PP5 & PP9	medium	likely	Moderate

7.5.5.2 Operation Phase – Direct Disturbance

The same potential contaminated land sources have the potential to be directly disturbed during the operation phase similar to during the construction phase, but with a reduced likelihood, except for made ground potentially re-used on site, as summarised in Table 7-17.

Table 7-17: Potential Direct Contaminated Land impacts on Environmental Receptors during Operation

Source Ref	Source Name	Pollutant Pathway	Magnitude	Likelihood	Significance
S1	General made ground across the study area	PP12 & PP14	Mild	Low	Low
S1	made ground re-used elsewhere on the development	PP12, PP14, PP16 & PP20	Medium	Likely	Moderate

7.5.6 Groundwater

7.5.6.1 Groundwater Quality

In the event of accidental spillage during the construction or operational phases, potential contamination may migrate from the ground surface through the unsaturated zone, reaching the underlying aquifer and impairing groundwater quality, unless appropriate measures for control of discharge and drainage are taken.

The potential magnitude of impact from accidental spillages is considered to be moderate adverse for groundwater within superficial deposits and small adverse for bedrock groundwater, based upon the potential for attenuation and dilution of contamination before it reaches bedrock. The potential significance of impact from accidental spillages on groundwater is summarised in Table 7-18. Hydrogeological units are derived from geological units with similar hydrogeological characteristics as summarised in Table 7-12.

Table 7-18: Impact of Accidental Spillages on Key Hydrogeological Units

Hydrogeological Unit	Importance	Magnitude	Significance
Made ground / Glacial Till	Low	Moderate Adverse	Slight
Glencar Limestone Formation	Medium	Small Adverse	Imperceptible

The proposed new attenuation / treatment pond will be lined. No impact is therefore expected on groundwater quality as a result of the drainage design upgrade.

7.5.6.2 Groundwater Flow

The construction of embankments may result in localised compaction of superficial deposits. This would result in localised potential impacts of negligible magnitude for groundwater flow and has therefore been assessed as being of Imperceptible significance.

No impact is expected on bedrock groundwater.

7.5.6.3 Ecological Receptors with Potential Groundwater Component

Two small areas of a larger wet grassland habitat (high importance) fall within the study area of the proposed development, one of which extends into the development footprint, and their hydrologic functioning may be locally impacted as a result. However, groundwater flow disturbance is expected to be localised and would not threaten the integrity of the site. This is therefore anticipated to constitute a negligible adverse impact magnitude at the scale of the site, resulting in an overall potential significance of Imperceptible.

7.5.6.4 Groundwater Effects on Surface Water

No cuttings are proposed as part of the development so no impacts on surface water features are expected in relation to groundwater.

7.5.7 Do-Minimum Scenario Impacts

In the event that the proposed development will not be constructed, there will be no additional impact on the groundwater regime than the current existing conditions.

7.6 Proposed Mitigation and Avoidance Measures

7.6.1 Geology

Potential geological impacts are of Imperceptible significance and therefore no mitigation measures are required.

7.6.2 Contaminated Land

Where made ground is expected to be intercepted by the proposed development, the contractor will undertake a risk assessment, and mitigation, if required, should be confirmed and specified on a site specific basis. Mitigation measures to include as applicable based on the risk assessment:

- Storage of excavated made ground material using bunded facilities and development of re-use criteria;
- Removal of contaminated soils from site;
- Consolidation for treatment ex-situ; and / or
- Treatment in situ (of soil and / or water).

During construction, safe methods of work will be implemented to protect workers from direct interaction with any potentially contaminated soil, contaminated groundwater or asbestos, using appropriate PPE as a last resort.

Waste management procedures including a Waste Management Plan to form part of the Contractors EOP and to be approved by Sligo County Council, will be put in place by the contractor during construction.

7.6.3 Groundwater

7.6.3.1 Groundwater Flow and Associated Groundwater Receptors

Impacts on groundwater flow are of Imperceptible significance and therefore no mitigation measures are required.

7.6.3.2 Groundwater Quality

Chapter 6: Surface Water provides details on anticipated mitigation to address potential impacts on surface waters. One of the three proposed outfalls will be provided with an attenuation / treatment pond which will mitigate against groundwater pollution by reducing the potential for pollutant release and preventing any contaminated runoff produced by the works from entering groundwater via the unsaturated zone. No attenuation or treatment is proposed for the remaining two outfalls; these are in areas of low permeability deposits which would also protect groundwater receptors against impacts on water quality.

7.6.3.3 Ecological Receptors

Impacts on groundwater flow supporting ecological receptors are of Imperceptible significance and therefore no mitigation measures are required.

7.7 Residual Impacts

The residual impacts associated with the proposed development after adherence to the mitigation measures during construction phase are as follows:

- Residual impacts on geology are expected to be of Negligible significance;
- Residual impacts on groundwater flow are expected to be of Negligible significance;
- Residual impacts on groundwater quality are expected to be of Slight significance;
- Residual impacts on ecological receptor(s) are expected to be of Negligible significance; and
- The implementation of mitigation measures in relation to contaminated land issues and direct / indirect impacts is expected to reduce potential impacts to a residual impact of Low significance during the construction phase and Very Low significance during operation.

7.8 Difficulties Encountered in Compiling Information

The accuracy and level of detail is dependent on the accuracy of sources of information. For example, the identification of potential contamination sources relies on the accuracy of historical mapping. The large scale and limited level of detail available in some mapping means that the detailed characterisation of baseline conditions, and hence a detailed analysis of the potential impacts, is limited at this stage. Similarly, it is possible that quarrying works could have been undertaken and the void(s) backfilled between the recorded years of mapping, such that no map evidence exists.

No site surveys have been undertaken to inform this assessment and so the full and exact extent / depth of the various geological units remains uncertain, although this is unlikely to significantly affect the assessment presented above.

7.9 Cumulative Impacts and Impact Interrelations

The hydrogeology of the area interrelates to other aspects such as local area Hydrology, and Ecology. Deterioration of groundwater quality in the study area as a result of the proposed development can impact on surface water receptors in hydraulic connection with groundwater. In turn, deterioration of the surface water quality in the study area from contaminated soils, perhaps imported for embankment construction, could impact on the groundwater quality. These interrelations have been included in the overall impact assessment for each aspect.

7.10 References

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8. Air Quality & Climate

8.1 Introduction

This chapter of the EAR outlines the assessment of the effects of the proposed development on Air Quality and Climate. The assessment of both "Do Minimum" and "Do Something" scenarios was undertaken in order to quantify the impact of the proposed development in the context of the relative increase in ambient air quality concentrations.

8.1.1 Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, National and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or “Air Quality Standards” are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set (see Table 8-1 and Appendix 8.1).

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate European Commission Directive 2008/50/EC which has set limit values for the pollutants SO_2, NO_2, PM_{10}, benzene and CO (see Table 8-1). Council Directive 2008/50/EC combines the previous Air Quality Framework Directive (96/62/EC) and its subsequent daughter directives (including 1999/30/EC and 2000/69/EC). Provisions were also made for the inclusion of new ambient limit values relating to $PM_{2.5}$.

Table 8-1: Air Quality Standards Regulations 2011 (based on European Commission Directive 2008/50/EC)

Pollutant	Regulation Note1	Limit Type	Margin of Tolerance	Value
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times / year	None	200 µg/m^3 NO_2
		Annual limit for protection of human health	None	40 µg/m^3 NO_2
		Annual critical level for protection of vegetation	None	30 µg/m^3 NO + NO_2
Lead	2008/50/EC	Annual limit for protection of human health	100% Note 2	0.5 µg/m^3
Sulphur dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 24 times / year	150 µg/m^3	350 µg/m^3
		Daily limit for protection of human health - not to be exceeded more than 3 times / year	None	125 µg/m^3
		Annual & Winter critical level for the protection of vegetation	None	20 µg/m^3
Particulate Matter (as PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times / year	50%	50 µg/m^3 PM_{10}

Pollutant	Regulation Note1	Limit Type	Margin of Tolerance	Value
		Annual limit for protection of human health	20%	40 µg/m^3 PM_{10}
$PM_{2.5}$	2008/50/EC	Annual limit for protection of human health	20% from June 2008. Decreasing linearly to 0% by 2015	25 µg/m^3 $PM_{2.5}$
Benzene	2008/50/EC	Annual limit for protection of human health	100% until 2006 reducing linearly to 0% by 2010	5 µg/m^3
Carbon Monoxide	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	60%	10 mg/m^3 (8.6 ppm)

Note 1 EU 2008/50/EC – Clean Air For Europe (CAFÉ) Directive replaces the previous Air Framework Directive (1996/30/EC) and daughter directives 1999/30/EC and 2000/69/EC

Note 2 EU 2008/50/EC states - *'Stage 2 — indicative limit value to be reviewed by the Commission in 2013 in the light of further information on health and environmental effects, technical feasibility and experience of the target value in Member States'.*

8.1.2 Climate Agreements

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in 1997 (Framework Convention on Climate Change, 1999 and Framework Convention on Climate Change, 1997). For the purposes of the EU burden sharing agreement under Article 4 of the Kyoto Protocol, Ireland agreed to limit the net anthropogenic growth of the six Green House Gases (GHGs), under the Kyoto Protocol, to 13% above the 1990 level over the period 2008 to 2012 (ERM, 1998). Ireland met its Kyoto Protocol targets, due in part, to the economic recession. The UNFCCC is continuing detailed negotiations in relation to GHG reductions and in relation to technical issues such as emission trading and burden sharing. The most recent Conference of the Parties (COP21) to the agreement was convened in Paris, France in December 2015. COP21 was an important milestone in terms of international climate change agreements. The "Paris Agreement", agreed by over 200 nations, has a stated aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to GHG emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made on elevating adaption onto the same level as action to cut and curb emissions.

The EU, on the 23 / 24th of October 2014, agreed the "2030 Climate and Energy Policy Framework" (EU, 2014). The European Council endorsed a binding EU target of at least a 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990. The target will be delivered collectively by the EU in the most cost-effective manner possible, with the reductions in the Emission Trading System (ETS) and non-ETS sectors amounting to 43% and 30% by 2030 compared to 2005, respectively. Secondly, it was agreed that all Member States will participate in this effort, balancing considerations of fairness and solidarity. The policy also outlines, under "Renewables and Energy Efficiency", an EU binding target of at least 27% for the share of renewable energy consumed in the EU in 2030.

8.1.3 Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. The initial objective of the Protocol was to control and reduce emissions of Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_X), Volatile Organic Compounds (VOCs) and Ammonia (NH_3). To achieve the initial targets Ireland was obliged, by 2010, to meet national emission ceilings of 42 kt for SO_2 (67% below 2001 levels), 65 kt for NO_X (52% reduction), 55 kt for VOCs (37% reduction) and 116 kt for NH_3 (6% reduction). In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$. In relation to Ireland, 2020 emission targets are 25 kt for SO_2 (65% on 2005 levels), 65 kt for NO_X (49% reduction on 2005

levels), 43 kt for VOCs (25% reduction on 2005 levels), 108 kt for NH_3 (1% reduction on 2005 levels) and 10 kt for $PM_{2.5}$ (18% reduction on 2005 levels).

European Commission Directive 2001/81/EC, the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005 (DoEHLG, 2004). Data available from the EU in 2010 indicated that Ireland complied with the emissions ceilings for SO_2, VOCs and NH_3 but failed to comply with the ceiling for NO_X (EEA, 2012). 'COM (2013) 920 Final' is the "Proposal for a Directive on the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC". The proposal will apply the 2010 NECD limits until 2020 and establish new national emission reduction commitments which will be applicable from 2020 and 2030 for SO_2, NO_X, NMVOC, NH_3, $PM_{2.5}$ and CH_4. In relation to Ireland, 2020-29 emission targets are for SO_2 (65% below 2005 levels), for NO_X (49% reduction), for VOCs (25% reduction), for NH_3 (1% reduction) and for $PM_{2.5}$ (18% reduction). In relation to 2030, Ireland's emission targets are for SO_2 (83% below 2005 levels), for NO_X (75% reduction), for VOCs (32% reduction), for NH_3 (7% reduction), for $PM_{2.5}$ (35% reduction) and for CH_4 (7% reduction).

8.2 Description of the Existing Environment

8.2.1 Meteorological Data

A key factor in assessing temporal and spatial variations in air quality is the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (i.e. traffic levels) (WHO, 2006). Wind is of key importance in dispersing air pollutants and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants derived from traffic sources will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted. In relation to PM_{10}, the situation is more complex due to the range of sources of this pollutant. Smaller particles (less than $PM_{2.5}$) from traffic sources will be dispersed more rapidly at higher wind speeds. However, fugitive emissions of coarse particles (PM_{10}-$PM_{2.5}$) will actually increase at higher wind speeds. Thus, measured levels of PM_{10} will be a non-linear function of wind speed.

The windrose from Clones for the years 2002-2006 is shown in Appendix 8.2. The windrose indicates the prevailing wind speed and direction over the five-year period. The prevailing wind direction is from south to south-westerly in direction, with generally moderate wind speeds, averaging around 4 m/s. Average monthly rainfall ranged from 61.6 mm to 102.7 mm throughout the period of 1978-2007. The average temperature throughout this period was 9.4°C.

8.2.2 Trends in Air Quality

Air quality is variable and subject to both significant spatial and temporal variation. In relation to spatial variations in air quality, concentrations generally fall significantly with distance from major road sources (UK Highways Agency, 2007). Thus, residential exposure is determined by the location of sensitive receptors relative to major roads sources in the area. Temporally, air quality can vary significantly by orders of magnitude due to changes in traffic volumes, meteorological conditions and wind direction.

In 2011 the UK Department for the Environment, Food and Rural Affairs (DEFRA) published research (UK DEFRA, 2011) on the long term trends in NO_2 and NO_X for roadside monitoring sites in the UK. This study marked a decrease in NO_2 concentrations between 1996 and 2002, after which the concentrations stabilised with little reduction between 2004 and 2010. The result of this is that there now exists a gap between projected NO_2 concentrations which UK DEFRA previously published and monitored concentrations. The impact of this 'gap' is that the UK Highways Agency Design Manual for Roads and Bridges (DMRB) screening model can under-predict NO_2 concentrations for predicted future years. Subsequently, the Highways Agency published an Interim Advice Note (IAN 170/12) in order to correct the DMRB results for future years. As the DMRB screening model is applied to road assessment in Ireland, the IAN is taken into account in order to rectify any discrepancies in projected future NO_2 concentrations.

8.2.3 EPA Monitoring Data and Background Concentrations

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality "Air Quality Monitoring Annual Report 2014" (EPA, 2015), details the range and scope of monitoring undertaken throughout Ireland.

As part of the implementation of the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2015). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D. In terms of air monitoring, the region of the proposed development is categorised as Zone C (EPA, 2015).

The long-term monitoring data has been used to determine background concentrations for the key pollutants in the region of the proposed development. The background concentration accounts for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.).

With regard to NO_2, continuous monitoring data from the Environmental Protection Agency (EPA) in the Zone C monitoring stations of Kilkenny Seville Lodge, Portlaoise, Mullingar, Balbriggan, Limerick Park Road, Newbridge and Celbridge show that current levels of NO_2 are below both the annual and 1-hour limit values (see Table 8-2) with average long term annual mean concentrations ranging from 4 to 17 µg/m^3 from 2010 to 2014. Based on these results, a conservative estimate of the background NO_2 concentration in the region of the proposed development in 2016 is 17 µg/m^3.

Table 8-2: Trends in Zone C Air Quality - Nitrogen Dioxide (NO2)

Station	Averaging Period	Year				
		2010	2011	2012	2013	2014
Kilkenny Seville Lodge	Annual Mean NO_2 (µg/m^3)Note 1	-	-	4	4	5
	Max 1-hr NO_2 (µg/m^3)Notes 2	-	-	62	90	57
Portlaoise	Annual Mean NO_2 (µg/m^3)Note 1	-	-	-	-	16
	Max 1-hr NO_2 (µg/m^3)Notes 2	-	-	-	-	74
Mullingar	Annual Mean NO_2 (µg/m^3)Note 1	-	-	7	6	4
	Max 1-hr NO_2 (µg/m^3)Notes 2	-	-	62	68	53
Balbriggan	Annual Mean NO_2 (µg/m^3)Note 1	-	-	9	-	-
	Max 1-hr NO_2 (µg/m^3)Notes 2	-	-	87	-	-
Limerick Park Road	Annual Mean NO_2 (µg/m^3)Note 1	14	12	-	-	-
	Max 1-hr NO_2 (µg/m^3)Notes 2	100	144	-	-	-
Newbridge	Annual Mean NO_2 (µg/m^3)Note 1	17	-	-	-	-
	Max 1-hr NO_2 (µg/m^3)Notes 2	104	-	-	-	-

Station	Averaging Period	Year				
		2010	2011	2012	2013	2014
Celbridge	Annual Mean NO_2 ($\mu g/m^3$) Note 1	12	-	-	-	-
	Max 1-hr NO_2 ($\mu g/m^3$) Notes 2	128	-	-	-	-

Note 1 Annual average limit value - 40 $\mu g/m^3$ (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).

Note 2 1-hour limit value - 200 $\mu g/m^3$ as a 99.8th%ile, i.e. not to be exceeded >18 times per year (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).

Continuous PM_{10} monitoring carried out at the Zone C locations of Galway, Portlaoise, Ennis, Mullingar, Bray, Balbriggan, Celbridge and Newbridge showed average long term annual mean concentrations of 11-27 $\mu g/m^3$, with at most 34 exceedances (in 2010 at Ennis) of the 24-hour limit value of 50 $\mu g/m^3$ (36 exceedances are permitted per year) (EPA, 2015) (Table 8-3). Based on these results, a conservative estimate of the background PM_{10} concentration in the region of the proposed development in 2016 is 20 $\mu g/m^3$.

Table 8-3: Trends in Trends In Zone B Air Quality - PM10

Station	Averaging Period	Year				
		2010	2011	2012	2013	2014
Galway	Annual Mean ($\mu g/m^3$) Note 1	16	17	16	21	15
	24-hr Mean > 50 $\mu g/m^3$ Note 2 (days)	1	4	1	11	0
Portlaoise	Annual Mean ($\mu g/m^3$)	-	-	-	-	12
	24-hr Mean > 50 $\mu g/m^3$ Note 2 (days)	-	-	-	-	2
Ennis	Annual Mean ($\mu g/m^3$) Note 1	27	22	19	20	21
	24-hr Mean > 50 $\mu g/m^3$ Note 2 (days)	34	24	8	8	8
Mullingar	Annual Mean ($\mu g/m^3$) Note 1	-	-	16	15	11
	24-hr Mean > 50 $\mu g/m^3$ Note 2 (days)	-	-	0	0	0
Bray	Annual Mean ($\mu g/m^3$) Note 1	13	13	17	20	17
	24-hr Mean > 50 $\mu g/m^3$ Note 2 (days)	0	2	5	4	1
Balbriggan	Annual Mean ($\mu g/m^3$) Note 1	-	-	17	-	-
	24-hr Mean > 50 $\mu g/m^3$ Note 2 (days)	-	-	0	-	-
Celbridge	Annual Mean ($\mu g/m^3$) Note 1	18	24	-	-	-
	24-hr Mean > 50 $\mu g/m^3$ Note 2 (days)	4	5	-	-	-
Newbridge	Annual Mean ($\mu g/m^3$) Note 1	20	-	-	-	-

Station	Averaging Period	Year				
		2010	2011	2012	2013	2014
	24-hr Mean > 50 µg/m^3 Note 2 (days)	2	-	-	-	-

Note 1 Annual average limit value - 40 µg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).

Note 2 24-hour limit value - 50 µg/m^3 as a 90.4th%ile, i.e. not to be exceeded >35 times per year (EU Council Directive 1999/30/EC & S.I. No. 180 of 2011).

Continuous $PM_{2.5}$ monitoring carried out at the Zone C location of Ennis, showed average levels of 12-16 µg/m^3 between 2010 and 2014. The annual average level measured in Ennis in 2014 was 16 µg/m^3, with an average $PM_{2.5}/PM_{10}$ ratio of 0.76. Based on this information, a ratio of 0.76 was used to generate a background $PM_{2.5}$ concentration in the region of the proposed development in 2016 of 15.2 µg/m^3.

In terms of benzene, the average annual mean concentration in the Zone C locations of Balbriggan, Mullingar and Kilkenny for 2012 to 2014 was 0.35 µg/m^3. This is well below the limit value of 5 µg/m^3 (EPA, 2015, 2016). 2012 to 2014 annual mean concentrations ranged from 0.09-0.5 µg/m^3. Based on this EPA data, a conservative estimate of the background benzene concentration in Sligo in 2016 is 0.5 µg/m^3.

In terms of CO, the average annual mean concentration in the Zone C locations of Balbriggan, Mullingar, Shannon Town, Newbridge and Celbridge for 2010 to 2014 was 0.34 mg/m^3. This is well below the limit value of 10 mg/m^3 (EPA, 2015, 2016). 2010 to 2014 annual mean concentrations ranged from 0.2-0.6 mg/m^3. Based on this EPA data, a conservative estimate of the background carbon monoxide concentration in Sligo in 2016 is 0.6 mg/m^3.

Background concentrations for Opening Year 2017 and Design Year 2032 were calculated. These used 2016 background concentrations and the year on year reduction factors provided by the NRA Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes and UK DEFRA's LAQM.TG (2009).

8.3 Appraisal Method used for Assessment of Impacts

8.3.1 Local Air Quality Assessment

The air quality assessment has been carried out following procedures described in the publications by the EPA (EPA, 2002, 2003) and using the methodology outlined in the policy and technical guidance notes, LAQM.PG(09) and LAQM.TG(09), issued by UK DEFRA (UK DEFRA, 2001, 2009a, 2009b; UK DETR 1998, UK Highways Agency, 2007). The assessment has also been conducted in accordance with the latest advice note on preparing environmental impacts statements (Draft September 2015). The assessment of air quality was carried out using a phased approach as recommended by DEFRA (UK DEFRA, 2009a). The phased approach recommends that the complexity of an air quality assessment be consistent with the risk of failing to achieve the air quality standards. In the current assessment, an initial scoping of key pollutants was carried at sensitive receptors. These sensitive receptors have the potential to have an impact on the concentration of key pollutants due to the proposed development. An examination of recent EPA and Local Authority data in Ireland (EPA 2015, 2016), has indicated that SO_2, smoke and CO are unlikely to be exceeded at locations such as the location of the proposed development and thus these pollutants do not require detailed monitoring or assessment to be carried out. However, the analysis did indicate potential problems in regards to nitrogen dioxide (NO_2) and PM_{10} at busy junctions in urban centres (EPA 2015, 2016). Benzene, although previously reported at quite high levels in urban centres (EPA 2015, 2016), has recently been measured at several city centre locations to be well below the EU limit value (EPA 2015, 2016). Historically, CO levels in urban areas were a cause for concern. However, CO concentrations have decreased significantly over the past number of years and are now measured to be well below the limits even in urban centres (EPA 2015, 2016). The key

pollutants reviewed in the assessments are NO_2, PM_{10}, $PM_{2.5}$, benzene and CO, with particular focus on NO_2 and PM_{10}.

Key pollutant concentrations were predicted for nearby sensitive receptors within these hot-spots for the following scenarios:

- The Existing scenario (2016), for model verification;
- Opening Year Do-Minimum scenario (DM), which assumes no proposed development in place (2017);
- Opening Year Do-Something scenario (DS), which assumes the proposed development in place (2017);
- Design Year of the Do-Minimum scenario, which assumes no proposed development in place (2032); and
- Design Year of the Do-Something scenario, which assumes the proposed development in place (2032).

The assessment methodology involved air dispersion modelling using the UK DMRB Screening Model (UK Highways Agency 2007) (Version 1.03c, July 2007), the NOX to NO2 Conversion Spreadsheet (UK DEFRA, 2014) (Version 4.1), and following guidance issued by the NRA (NRA, 2011), UK Highways Agency (UK Highways Agency, 2007), UK DEFRA (UK DEFRA, 2009a) and the EPA (EPA 2002, 2003).

The NRA guidance states that the assessment must progress to detailed modelling if:

- Concentrations exceed 90% of the air quality limit values when assessed by the screening method; or
- Sensitive receptors exist within 50 m of a complex road layout (e.g. grade separated junctions, hills etc.

The UK DMRB guidance (UK Highways Agency 2007), which the NRA guidance recommends, states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment if:

- Road alignment change of 5 metres or more;
- Daily traffic flow changes by 1,000 Annual Average Daily Traffic (AADT) or more;
- HDV flows change by 200 vehicles per day or more;
- Daily average speed changes by 10 km / h or more; or
- Peak hour speed changes by 20 km / h or more.

Concentrations of key pollutants are calculated at sensitive receptors which have the potential to be affected by the proposed development. Road links which are affected by the proposed development and within 200 m of the chosen sensitive receptors are required for the model. Other data requirements for the air quality model consist of; road layouts, receptor locations, AADT, percentage heavy goods vehicles, annual average traffic speeds and background concentrations. The UK DMRB guidance states that road links at a distance of greater than 200 m from a sensitive receptor will not influence pollutant concentrations at the receptor. Using this input data the model predicts the road traffic contribution to ambient ground level concentrations at the worst-case sensitive receptors using generic meteorological data. The DMRB model uses conservative emission factors, the formulae for which are outlined in the DMRB Volume 11 Section 3 Part 1-HA 207/07 Annexes B3 and B4. These worst-case road contribution are then added to the existing background concentrations to give the worst-case predicted ambient concentrations. The worst-case ambient concentrations are then compared with the relevant ambient air quality standards to assess the compliance of the proposed development with these ambient air quality standards. The NRA Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes (NRA, 2011) detail a methodology for determining air quality impact significance criteria for developments which involve increased traffic flows or road schemes. The degree of impact is determined based on both the absolute and relative impact of the proposed development. The NRA significance criteria have been adopted for the proposed development and are detailed in Appendix 8.1. The significance criteria are based on PM_{10} and NO_2 as these pollutants are most likely to exceed the annual mean limit values (40 µg/m^3). However the criteria have also been applied to the predicted 8-hour CO, annual benzene and annual $PM_{2.5}$ concentrations for the purposes of this assessment. Further description of the air dispersion modelling methodology can be seen in Appendix 8.3.

8.3.2 Regional Impact Assessment (Including Climate)

The impact of the proposed development at a national / international level has been determined using the procedures given by the NRA (NRA, 2011) and the methodology provided in Annex 2 in the UK DMRB (UK Highways Agency, 2007). The assessment focused on determining the resulting change in emissions of volatile organic compounds (VOCs), nitrogen oxides (NO_X) and carbon dioxide (CO_2). The Annex provides a method for the prediction of the regional impact of emissions of these pollutants from road developments. The inputs to the air dispersion model consist of information on road link lengths, AADT movements and annual average traffic speeds.

8.3.3 Conversion of NO_X to NO_2

NO_X (NO + NO_2) is emitted by vehicle exhausts. The majority of emissions are in the form of NO, however, with a greater number of diesel vehicles and some regenerative particle traps on HGV's the proportion of NO_X emitted as NO_2 rather than NO is increasing. With the correct conditions (presence of sunlight and O_3) emissions in the form of NO, have the potential to be converted to NO_2.

The NRA guideline states the recommended method for the conversion of NO_X to NO_2 in the Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (NRA, 2011). The NRA guidelines recommend the use of DEFRAs NO_X to NO_2 calculator (UK DEFRA, 2014) which was originally published in 2009 and is currently on version 4.1. This calculator (which can be downloaded in the form of an excel spreadsheet) accounts for the predicted availability of O_3 and proportion of NO_X emitted as NO for each local authority across the UK. O_3 is a regional pollutant and therefore concentrations do not vary in the same way as concentrations of NO_2 or PM_{10}.

The calculator includes Local Authorities in Northern Ireland and the NRA guidance recommends the use of Craigavon as the choice for local authority when using the calculator. The choice of Craigavon provides the most suitable relationship between NO_2 and NO_X for Ireland. The "All Other Urban UK Traffic" traffic mix option was used.

8.3.4 Ecological Sites

For developments which are within 2 km of a designated area of conservation (either Irish or European designation) the NRA requires consultation with an Ecologist (NRA, 2011). However, in practice the potential for impact to an ecological site is highest within 200 m of the proposed development and when significant changes in AADT (>5%) occur.

The NRA Guidelines for Assessment of Ecological Impacts of National Road Schemes (Rev. 2, Transport Infrastructure Ireland, 2009) and Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities (Department of the Environment, Heritage and Local Government, 2010) provide details regarding the legal protection of designated conservation areas.

If the assessment criteria of a designated area of conservation within 200 m of the proposed development and a significant change in AADT flows is met, an assessment of the potential for impact due to nitrogen deposition should be assessed.

Where the proposed development is predicted to adversely impact concentrations by 2 µg/m^3 or more and causing overall concentrations to be within 10% of the 30 µg/m^3 limit, then the sensitivity of the habitat to NO_X should be assessed by the project Ecologist.

There are two designated areas of conservation within 2 km of the proposed development, the Lough Gill Proposed Natural Heritage Area and Special Area of Conservation (pNHA and SAC) and the Cumeen Strand Proposed Natural Heritage Area, Special Area of Conservation and Special Protected Area (pNHA, SAC and SPA).

8.3.5 Impact Criteria

Although no relative impact, as a percentage of the limit value, is enshrined in EU or Irish Legislation, the NRA guidelines (NRA, 2011) detail a methodology for determining air quality impact significance criteria for road schemes. The degree of impact is determined based on both the absolute and relative impact of the proposed development. The NRA significance criteria have been adopted for the proposed development and are detailed in Table 8-4 to Table 8-6. The significance criteria are based on PM_{10} and NO_2 as these pollutants are most likely to exceed the limit values. However, the criteria have also been applied to the predicted 8-hour CO, annual benzene and annual $PM_{2.5}$ concentrations for the purposes of this assessment.

Table 8-4: Definition of impact Magnitude for Changes in Ambient Pollutant Concentration

Magnitude of Change	Annual Mean NO_2 / PM_{10}	No. days with PM_{10} concentration > 50 µg / m^3	Annual Mean $PM_{2.5}$
Large	Increase / decrease ≥4 µg/m^3	Increase / decrease >4 days	Increase / decrease ≥2.5 µg/m^3
Medium	Increase / decrease 2 - <4 µg/m^3	Increase / decrease 3 or 4 days	Increase / decrease 1.25 - <2.5 µg/m^3
Small	Increase / decrease 0.4 - <2 µg/m^3	Increase / decrease 1 or 2 days	Increase / decrease 0.25 - <1.25 µg/m^3
Imperceptible	Increase / decrease <0.4 µg/m^3	Increase / decrease <1 day	Increase / decrease <0.25 µg/m^3

Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes – (NRA, 2011)

Table 8-5: Air Quality Impact Significance Criteria

Absolute Concentration in Relation to Objective / Limit Value	Change in Concentration		
	Small	Medium	Large
Increase with Development			
Above Objective/Limit Value With Development (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight adverse	Moderate adverse	Substantial adverse
Just Below Objective/Limit Value With Development (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight adverse	Moderate adverse	Moderate adverse
Below Objective/Limit Value With Development (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight adverse	Slight adverse
Well Below Objective/Limit Value With Development (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight adverse
Decrease with Development			
Above Objective/Limit Value With Development (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight beneficial	Moderate beneficial	Substantial beneficial

Just Below Objective/Limit Value With Development (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight beneficial	Moderate beneficial	Moderate beneficial
Below Objective/Limit Value With Development (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight beneficial	Slight beneficial
Well Below Objective/Limit Value With Development (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight beneficial

Note 1 *Where the Impact Magnitude is Imperceptible, then the Impact Description is Negligible*

Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Developments - (NRA, 2011)

Table 8-6: Air Quality Impact significance Criteria for changes to Number of days with PM10 Concentration Greater than 50µg/m3 at A Receptor

Absolute Concentration in Relation to Objective / Limit Value	Change in Concentration		
	Small	Medium	Large
Increase with Development			
Above Objective/Limit Value With Development (≥35 days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Development (32 - <35 days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Development (26 - <32 days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Development (<26 days)	Negligible	Negligible	Slight Adverse
Decrease with Development			
Above Objective/Limit Value With Development (≥35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value With Development (32 - <35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value With Development (26 - <32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value With Development (<26 days)	Negligible	Negligible	Slight Beneficial

Note 1 Where the Impact Magnitude is Imperceptible, then the Impact Description is Negligible

Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Developments – (NRA, 2011)

8.4 Predicted Impacts of the Proposed Development

8.4.1 Construction Phase: Air Quality

Construction dust has the potential to cause local impacts through dust nuisance at the nearest houses. Construction activities such as excavation, earth moving and backfilling may generate quantities of dust, particularly in dry and windy weather conditions. While dust from construction activities tends to be deposited within 200 m of a construction site, the majority of the deposition occurs within the first 50 m (as shown in Table 8-7). The extent of any dust generation depends on the nature of the dust (soils, peat, sands, gravels, silts etc.) and the nature of the construction activity. In addition, the potential for dust dispersion and deposition depends on local meteorological factors such as rainfall, wind speed and wind direction. Vehicles transporting material to and from the site also have the potential to cause dust generation along the selected haul routes from the construction areas.

Table 8-7: Assessment Criteria for the Impact of Dust from Construction with Standard Mitigation in Practise

Source		Potential Distance for Significant Effects		
Scale	**Description**	**Soiling**	**PM_{10}**	**Vegetation Effects**
Major	Large construction sites, with high use of haul roads	100 m	25 m	25 m
Moderate	Moderate sized construction sites, with moderate use of haul roads	50 m	15 m	15 m
Minor	Minor construction sites, with limited use of haul roads	25 m	10 m	10 m

The subject site is within 20 m of the nearest sensitive receptors dwellings. As such, sensitive receptors in the area have the potential to be affected by dust emissions from the main construction works. The likely source-pathway of dust emissions will be those generated by HGV's associated with the construction phase and also regular construction works on site. The most likely impact from the construction phase will be from soiling which may cause nuisance at nearby sensitive receptors. Adequate mitigation measures should be implemented during the construction phase in addition with dust deposition monitoring to ensure the effectiveness of the mitigation measures.

At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

When the dust minimisation measures detailed in the mitigation section of this chapter are implemented, fugitive emissions of dust from the site will be imperceptible and pose no nuisance at nearby receptors.

8.4.2 Construction Phase: Climate

Due to the size and nature of the construction activities, CO_2 and N_2O emissions during construction will have an imperceptible impact on climate.

8.4.3 Operational Phase: Local Air Quality Assessment

Detailed traffic flow information has been obtained for the development and has been used to model pollutant levels under various traffic scenarios and with sufficient spatial resolution to assess whether any significant air quality impact on sensitive receptors may occur. The traffic data is shown in Table 8-8, the traffic data corresponds to the opening year of 2017 and the design year of 2032.

Table 8-8: Traffic data Used in the Assessment

Link Number	Road Name	Base Year	Do-Minimum		Do-Something	
		2016	2017	2032	2017	2032
1	Victoria Road (N4)	25679	24296	26251	26038	28279
2	Duck St (south of / east of Barrack Street)	9454	8102	8063	10267	10900
3	Barrack Street	442	562	714	673	728
4	Duck Street (N16)	10448	9281	9345	11446	12147
5	Markievicz Road (R870)	4880	6302	6424	6652	6676
6	Connaughton Road	6760	4186	4577	3189	3257
7	Teeling Street	14648	13146	13801	12487	12758

Table 8-9: Description of the Sensitive Receptors

Name	Receptor Type	X	Y
R1	Medical	569051	836578
R2	Residential	569122	836634
R3	Medical	569018	836479
R4	Medical	569632	836156
R5	Commercial	569283	835809

8.4.4 'Do Minimum' Modelling Assessment

CO and Benzene

The results of the "do minimum" modelling assessment for CO and benzene in the opening and design years are shown in Table 8-14 and Table 8-15. Concentrations are well within the limit values at all worst-case receptors. Levels of both pollutants are at maximum 35% of the respective limit values in 2017 and 37% in 2032.

PM_{10}

The results of the "do minimum" modelling assessment for PM_{10} in the opening and design years are shown in Table 8-12. Concentrations are well within the annual limit value at all worst-case receptors. In addition, the 24-hour PM_{10} concentration of 50 µg/m^3, which can only be exceeded 35 times per year within the limit, is found to be in compliance at all receptors with no predicted exceedances. Annual average PM_{10} concentrations are no more than 53%, of the limit value in 2017 and 2032.

$PM_{2.5}$

The results of the "do minimum" modelling assessment for $PM_{2.5}$ in the opening and design years are shown in Table 8-13:. The predicted concentrations at all worst-case receptors are well below the $PM_{2.5}$ limit value of 25 µg/m^3. The annual average $PM_{2.5}$ concentration peaks at 55% of the limit value in 2017 and 2032.

NO_2

The results of the "do minimum" assessment of annual average NO_2 concentrations in the opening and design years are shown in Table 8-10 for the Highways Agency IAN 170/12 and Table 8-11 using the DEFRA technique respectively. The purpose of IAN 170/12 was to account for the conclusions of UK's DEFRA's advice

on long term trends in that there is now a gap between current projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality as previously published in DEFRA's technical guidance and observed trends. Hence the projections calculated via the IAN 170/12 technique show a slower than previously predicted reduction between the base year and future year predictions. The concentrations are below the limit value at all locations, with levels ranging up to 53% of the limit value in 2017 and will reduce to 49% by 2032, using the more conservative IAN prediction.

The hourly limit value for NO_2 is 200 µg/m^3 and is expressed as a 99.8th percentile (i.e. it must not be exceeded more than 18 times per year). The one hour maximum 1-hour NO_2 concentrations for the "do minimum" scenario is not predicted to be exceeded in 2017 or 2032.

8.4.5 'Do Something Modelling Assessment'

CO and Benzene

The results of the modelled impact of the proposed development for CO and benzene in the opening and design years are shown in Table 8-14 and Table 8-15 respectively. Predicted pollutant concentrations with the proposed development in place are below the ambient standards at all locations. Future trends indicate similarly low levels of CO and benzene. Levels are up to 35% of the limit value in 2017 and 36% of the limit value in 2032 for CO. For benzene, concentrations are up to 12% of the limit value in 2017 and 13% of the limit value in 2032.

The impact of the proposed development can be assessed relative to "do minimum" levels in 2017 and 2032. Relative to baseline levels, some imperceptible increases in pollutant levels at the worst-case receptors are predicted as a result of the proposed development. With regard to impacts at individual receptors, none of the five receptors assessed will experience an increase in concentrations of greater than 0.56% of the limit value in either 2017 or 2032 and thus the magnitude of the changes in air quality are imperceptible at all receptors based on the criteria outlined in Appendix 8.1 and the EPA Impact Classification Terminology (EPA, 2002).

The greatest impact on CO and benzene concentrations in either 2017 or 2032 will be a decrease of 0.41% of their respective limit values at Receptor 5. Thus, using the assessment criteria for NO_2 and PM_{10} outlined in Appendix 8.1 and applying these criteria to CO and benzene, the impact of the proposed development in terms of CO and benzene is classed as imperceptible in the long and short term.

PM_{10}

The results of the modelled impact of the proposed development for PM_{10} in the opening and design years are shown in

Table 8-12: Predicted annual average concentrations in the region of the proposed development are below the ambient standards at all worst-case receptors, levels are 53% of the limit value in 2017. In addition, the 24-hour PM_{10} concentration of 50 µg/m^3, which can only be exceeded 35 times per year within the limit, is found to be in compliance at all receptors. Future trends with the proposed development in place indicate similarly low levels of PM_{10}. Annual average PM_{10} concentrations are 52% of the limit in 2032.

The impact of the proposed development can be assessed relative to "do minimum" levels in 2017 and 2032. Relative to baseline levels, some imperceptible increases in PM_{10} levels at the worst-case receptors are predicted as a result of the proposed development. With regard to impacts at individual receptors, none of the five receptors assessed will experience an increase in concentrations of over 0.4% of the limit value in 2017 or 2032. Thus the magnitude of the changes in air quality are imperceptible at all receptors based on the criteria outlined in Appendix 8.1 and the EPA Impact Classification Terminology.

The greatest impact on PM_{10} concentrations in the region of the proposed development occurs in 2017 at Receptor 2 where an increase of 0.4% or 0.16 µg/m^3 of the annual limit value. Thus, using the assessment criteria outlined in Appendix 8.1 and the EPA Impact Classification Terminology the impact of the proposed development with regard to PM_{10} is imperceptible in the long and short term at all five of the receptors assessed.

$PM_{2.5}$

The results of the modelled impact of the proposed development for $PM_{2.5}$ in the opening and design years are shown in Table 8-13: Predicted annual average concentrations in the region of the proposed development are below the ambient standards at all worst-case receptors, levels are 55% of the limit value in 2017. Future trends with the proposed development in place indicate similarly low levels of $PM_{2.5}$. Annual average $PM_{2.5}$ concentrations are 54% of the limit in 2032.

The impact of the proposed development can be assessed relative to "do minimum" levels in 2017 and 2032. Relative to baseline levels, imperceptible increases in $PM_{2.5}$ levels at the worst-case receptors are predicted as a result of the proposed development. With regard to impacts at individual receptors, none of the five receptors assessed will experience an increase or decrease in concentrations of over 0.42% of the limit value in 2017 and 2032. Thus, the magnitude of the changes in air is imperceptible in the long and short term at all receptors based on the criteria outlined in Appendix 8.1 and EPA impact classification terminology.

NO_2

The results of the assessment of the impact of the proposed development for NO_2 in the opening and design years are shown in Table 8-10 for the Highways Agency IAN 170/12 and Table 8-11: using the DEFRA technique respectively. The annual average concentration is within the limit value at all worst-case receptors using both the DEFRA and more conservative IAN technique. Levels of NO_2 are 54% of the annual limit value in 2017 and 50% of the annual mean limit 2032 using the IAN technique. Lower values of 51% and 36% of the annual limit value in 2017 and 2032 respectively were predicted using the DEFRA technique for the do-something scenarios. Maximum one-hour NO_2 levels with the proposed development in place are not predicted to exceed using either technique. The impact of the proposed development using the more conservative IAN technique on annual mean NO_2 levels can be assessed relative to "do minimum" levels in 2017 and 2032. Receptor two is predicted to have the highest impact in each of the scenarios, with an increase in concentrations of 2.1% of the limit value, however the impact is still considered small as it is less than 5% of the limit value. With regard to impacts at individual receptors, the remaining receptors assessed will not experience an increase or decrease in concentrations of more than 1.5% of the limit value in 2017 and 2032. Thus, using the assessment criteria outlined in Appendix 8.1 and the EPA Impact Classification Terminology, the impact of the proposed development in terms of NO_2 is negligible in the long and short term at all of the receptors in 2017 and 2032.

Table 8-10: Annual Mean NO_2 Concentrations (µg/m³) (using IAN 170/12V3 Long Term NO2 Trend Projections)

Receptor	Impact Opening Year (2017)					Impact Design Year (2032)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	21.1	21.3	0.22	Imperceptible	Negligible Increase	19.6	19.9	0.30	Imperceptible	Negligible Increase
2	20.9	21.4	0.57	Small	Negligible Increase	19.2	20.0	0.83	Small	Negligible Increase
3	19.3	19.4	0.08	Imperceptible	Negligible Increase	17.8	17.9	0.10	Imperceptible	Negligible Increase
4	17.9	17.6	-0.25	Imperceptible	Negligible Decrease	16.0	15.6	-0.41	Small	Negligible Decrease
5	21.7	21.5	-0.25	Imperceptible	Negligible Decrease	19.8	19.4	-0.46	Small	Negligible Decrease

Table 8-11: Annual Mean NO_2 Concentrations (µg/m³) (using DEFRAs Technical Guidance)

Receptor	Impact Opening Year (2017)					Impact Design Year (2032)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	20.1	2.3	0.21	Imperceptible	Negligible Increase	14.2	14.4	0.22	Imperceptible	Negligible Increase
2	19.9	20.5	0.54	Small	Negligible Increase	13.8	14.4	0.60	Small	Negligible Increase
3	18.4	18.5	0.08	Imperceptible	Negligible Increase	12.4	12.5	0.07	Imperceptible	Negligible Increase
4	17.0	16.8	-0.24	Imperceptible	Negligible Decrease	11.0	10.7	-0.28	Imperceptible	Negligible Decrease
5	20.8	20.5	-0.24	Imperceptible	Negligible Decrease	14.6	14.3	-0.34	Imperceptible	Negligible Decrease

Table 8-12: Annual Mean PM_{10} Concentrations ($\mu g/m^3$)

Receptor	Impact Opening Year (2017)					Impact Design Year (2032)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	20.8	20.9	0.05	Imperceptible	Negligible Increase	20.5	20.6	0.06	Imperceptible	Negligible Increase
2	20.8	21.0	0.13	Imperceptible	Negligible Increase	20.5	20.7	0.16	Imperceptible	Negligible Increase
3	20.5	20.5	0.02	Imperceptible	Negligible Increase	20.1	20.1	0.02	Imperceptible	Negligible Increase
4	20.1	20.1	-0.06	Imperceptible	Negligible Decrease	19.8	19.7	-0.08	Imperceptible	Negligible Decrease
5	21.2	21.2	-0.07	Imperceptible	Negligible Decrease	20.9	20.8	-0.10	Imperceptible	Negligible Decrease

Table 8-13: Annual Mean $PM_{2.5}$ Concentrations ($\mu g/m^3$)

Receptor	Impact Opening Year (2017)					Impact Design Year (2032)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	13.5	13.6	0.03	Imperceptible	Negligible Increase	13.3	13.4	0.04	Imperceptible	Negligible Increase
2	13.5	13.6	0.09	Imperceptible	Negligible Increase	13.3	13.4	0.11	Imperceptible	Negligible Increase
3	13.3	13.3	0.01	Imperceptible	Negligible Increase	13.1	13.1	0.01	Imperceptible	Negligible Increase
4	13.1	13.1	-0.04	Imperceptible	Negligible Decrease	12.9	12.8	-0.05	Imperceptible	Negligible Decrease
5	13.8	13.8	-0.04	Imperceptible	Negligible Decrease	13.6	13.5	-0.07	Imperceptible	Negligible Decrease

Table 8-14: Annual Mean CO Concentrations (µg/m³)

Receptor	Impact Opening Year (2017)					Impact Design Year (2032)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	3.30	3.32	0.016	Imperceptible	Negligible Increase	3.46	3.47	0.018	Imperceptible	Negligible Increase
2	3.31	3.36	0.046	Imperceptible	Negligible Increase	3.47	3.52	0.056	Imperceptible	Negligible Increase
3	3.19	3.20	0.006	Imperceptible	Negligible Increase	3.34	3.35	0.006	Imperceptible	Negligible Increase
4	3.09	3.07	-0.021	Imperceptible	Negligible Decrease	3.25	3.22	-0.028	Imperceptible	Negligible Decrease
5	3.52	3.50	-0.026	Imperceptible	Negligible Decrease	3.69	3.65	-0.041	Imperceptible	Negligible Decrease

Table 8-15: Annual Mean Benzene Concentrations (µg/m³)

Receptor	Impact Opening Year (2017)					Impact Design Year (2032)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	0.59	0.60	0.008	Imperceptible	Negligible Increase	0.61	0.62	0.009	Imperceptible	Negligible Increase
2	0.58	0.59	0.012	Imperceptible	Negligible Increase	0.60	0.62	0.015	Imperceptible	Negligible Increase
3	0.55	0.56	0.004	Imperceptible	Negligible Increase	0.58	0.58	0.004	Imperceptible	Negligible Increase
4	0.52	0.52	-0.005	Imperceptible	Negligible Decrease	0.54	0.54	-0.006	Imperceptible	Negligible Decrease
5	0.61	0.61	-0.006	Imperceptible	Negligible Decrease	0.64	0.63	-0.009	Imperceptible	Negligible Decrease

8.4.6 Air Quality Impacts on Ecosystems

The EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the "Habitats Directive") requires an Appropriate Assessment to be carried out where there is likely to be a significant effect upon a European protected site. Such sites include Special Areas of Conservation (SAC), Special Protection Areas (SPA), candidate SACs and proposed SPAs.

The NRA guidelines (NRA, 2011) state that as the potential impact of a proposed development is limited to a local level, detailed consideration need only be given to roads where there is a significant change to traffic flows (>5%) and the designated site lies within 200 m of the road centre line.

The impact of NOx (i.e. NO and NO_2) emissions resulting from the proposed development on the Cummeen Strand/Drumcliff pNHA / SAC, the Cummeen Strand SPA and Lough Gill pNHA / SAC was assessed. Dispersion modelling and prediction was carried out at typical traffic speeds at the junction of Hughes Bridge and Markievicz Road for the Cummeen Strand pNHA / SAC / SPA and at the shore by Crozon Promenade for the Lough Gill pNHA / SAC. Ambient NOx concentrations predicted for the opening and design years along a transect of up to 200 m within the Cummeen Strand pNHA / SAC / SPA and Lough Gill pNHA / SAC are given in Table 8-16: and Table 8.16. The road contribution to dry deposition along the transect is also given and was calculated using the methodology of the NRA (NRA, 2011).

The predicted annual average NOx level in the Cummeen Strand pNHA / SAC / SPA exceeds the limit value of 30 µg/m^3 for the “do minimum” scenario in 2017, with NOx concentrations reaching 102% of this limit in 2017 and 92% in 2032. Levels with the proposed development in place are similar reaching 105% of the limit value for the “do something” scenario in 2017 and 195% of the limit value in 2032.

The impact of the proposed development leads to an increase in NOx concentrations of at most 1.01 µg/m^3 within the Cummeen Strand pNHA / SAC / SPA. Appendix 8.1 of the NRA guidelines states that where the proposed development is expected to cause an increase of more than 2 µg/m^3 and the predicted concentrations (including background) are close to, or exceed the standard, then the sensitivity of the habitat to NO_X should be assessed by the project Ecologist.

The road contribution to the NO_2 dry deposition rate along the 200 m transect within the Cummeen Strand pNHA / SAC / SPA is also detailed in. The maximum increase in the NO_2 dry deposition rate is 0.05 Kg(N)/ha / yr in 2017 and 0.04 Kg(N)/ha / yr in 2032. This reaches only 1% of the critical load for inland and surface water habitats of 5-10 Kg(N)/ha / yr (NRA, 2011).

The predicted annual average NOx level in the Lough Gill pNHA / SAC is below the limit value of 30 µg/m^3 for the “do minimum” scenario in 2017, with NOx concentrations reaching 69% of the limit value and is below the limit value for the “do minimum” scenario in 2032, with NOx concentrations reaching 61% of this limit. Levels with the proposed development in place are similar reaching 69% of the limit value for the “do something” scenario in 2017 and 60% of the limit value in 2032.

The impact of the proposed development leads to a decrease in NOx concentrations of at most 0.06 µg/m^3 within the Lough Gill pNHA / SAC.

The road contribution to the NO_2 dry deposition rate along the 200 m transect within the Lough Gill pNHA / SAC is also detailed in Table 8-16. There is no increase in the NO_2 dry deposition rate in 2017 or 2032.

Table 8-16: Air Quality assessment of Ecosystems - Assessment of Impact along transect from the junction of Hughes Bridge and Markievicz Road through the Cummeen Strand pNHA / SAC / SPA

Dist. To Road (m)[Note 1]	NO_x Conc. (µg/m^3) - 2017			NO_x Conc. (µg/m^3) - 2032			NO_2 Dry Deposition Rate Impact (Kg(N)/ha/yr)	
	Do minimum	Do Something	Impact	Do minimum	Do Something	Impact	2017	2032
20, 35 & 150	30.51	31.52	1.01	27.62	28.52	0.91	0.05	0.04
30,45 &160	28.10	28.88	0.78	25.27	25.97	0.70	0.04	0.03
40, 55 & 170	26.32	26.93	0.61	23.55	24.09	0.54	0.03	0.03
50, 65 & 180	24.97	25.45	0.48	22.24	22.66	0.43	0.02	0.02
60, 75 & 190	23.92	24.29	0.38	21.21	21.55	0.34	0.02	0.02
70, 85 & 200	23.09	23.38	0.30	20.40	20.67	0.27	0.01	0.01
80, 95 & 200	22.43	22.66	0.23	19.76	19.97	0.21	0.01	0.01
90, 105 & 200	21.90	22.09	0.18	19.25	19.42	0.16	0.01	0.01
100, 115 & 200	21.49	21.63	0.14	18.85	18.98	0.13	0.01	0.01
110, 125 & 200	21.16	21.28	0.11	18.53	18.63	0.10	0.01	0.00
120, 135 & 200	20.92	21.00	0.09	18.29	18.37	0.08	0.01	0.00
130, 145 & 200	20.73	20.80	0.07	18.11	18.18	0.06	0.00	0.00
140, 155 & 200	20.61	20.66	0.06	17.99	18.04	0.05	0.00	0.00
150, 165 & 200	20.53	20.58	0.05	17.91	17.96	0.04	0.00	0.00
160, 175 & 200	20.48	20.52	0.04	17.86	17.90	0.04	0.00	0.00
170, 185 & 200	20.44	20.48	0.04	17.83	17.86	0.04	0.00	0.00
180, 195 & 200	20.36	20.40	0.03	17.76	17.79	0.03	0.00	0.00
190, 200 & 200	20.30	20.33	0.03	17.69	17.72	0.03	0.00	0.00
200, 200 & 200	20.25	20.27	0.02	17.64	17.66	0.02	0.00	0.00

Dist. To Road (m)[Note 1]	NO_x Conc. (µg/m³) - 2017			NO_x Conc. (µg/m³) - 2032			NO_2 Dry Deposition Rate Impact (Kg(N)/ha/yr)	
	Do minimum	Do Something	Impact	Do minimum	Do Something	Impact	2017	2032
Standards	30 µg/m³	30 µg/m³	-	30 µg/m³	30 µg/m³	-	5 - 10 Kg(N)/ha/yr	

Table 8-17: Air Quality assessment of Ecosystems - Assessment of Impact along transect from the shore by Crozon Promenade through the Lough Gil PNHA / SAC junction of Hughes Bridge and Markievicz Road through the Cummeen Strand pNHA/SAC/SPA

Dist. To Road (m)[Note 1]	NO_x Conc. (µg/m³) - 2017			NO_x Conc. (µg/m³) - 2032			NO_2 Dry Deposition Rate Impact (Kg(N)/ha/yr)	
	Do minimum	Do Something	Impact	Do minimum	Do Something	Impact	2017	2032
45	20.72	20.67	-0.046	18.16	18.09	-0.06	-0.002	-0.003
55	20.56	20.53	-0.036	17.99	17.95	-0.05	-0.002	-0.003
65	20.44	20.42	-0.029	17.87	17.83	-0.04	-0.001	-0.002
75	20.35	20.33	-0.023	17.77	17.74	-0.03	-0.001	-0.002
85	20.27	20.26	-0.018	17.69	17.67	-0.02	-0.001	-0.002
95	20.21	20.20	-0.014	17.63	17.61	-0.02	-0.001	-0.001
105	20.17	20.16	-0.011	17.58	17.56	-0.01	-0.001	-0.001
115	20.13	20.12	-0.008	17.54	17.53	-0.01	-0.001	-0.001
125	20.10	20.10	-0.007	17.51	17.50	-0.01	0.000	0.000
135	20.08	20.08	-0.005	17.49	17.48	-0.01	0.000	0.000
145	20.07	20.06	-0.004	17.47	17.47	-0.01	0.000	-0.001
155	20.06	20.06	-0.004	17.46	17.46	-0.01	0.000	0.000
165	20.06	20.05	-0.004	17.46	17.45	0.00	0.000	0.000
175	20.05	20.05	-0.003	17.45	17.45	0.00	-0.001	-0.001

Dist. To Road (m)[Note 1]	NO_x Conc. (µg/m^3) - 2017			NO_x Conc. (µg/m^3) - 2032			NO_2 Dry Deposition Rate Impact (Kg(N)/ha/yr)	
	Do minimum	Do Something	Impact	Do minimum	Do Something	Impact	2017	2032
185	20.0	20.0	-0.003	17.4	17.4	0.00	0.000	0.000
195	20.0	20.0	-0.002	17.4	17.4	0.00	0.000	0.000
200	20.0	20.0	-0.002	17.4	17.4	0.00	0.000	0.000
Standards	30 µg/m^3	30 µg/m^3	-	30 µg/m^3	30 µg/m^3	-	5 - 10 Kg(N)/ha/yr	

8.4.7 Climate

There is also the potential for a number of greenhouse gas emissions to atmosphere during the operational phase of the development. Road traffic and space heating of buildings may give rise to CO_2 and N_2O emissions. However, due to the scale and nature of the development, the impact on climate is considered to be imperceptible in the long and short term.

8.5 Proposed Mitigation and Avoidance Measures

8.5.1 Construction Phase: Air Quality

A dust minimisation plan has been formulated for the construction phase of the development, as construction activities are likely to generate some dust emissions and is contained in Appendix 8.4. An outline of the dust mitigation measures to be included in the dust minimisation plan are below.

- Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic.
- Furthermore, any road that has the potential to give rise to fugitive dust must be regularly watered, as appropriate, during dry and / or windy conditions.
- Vehicles using site roads will have their speed restricted, and this speed restriction must be enforced rigidly. On any un-surfaced site road, this will be 20 kph, and on hard surfaced roads as site management dictates.
- Vehicles delivering material with dust potential (soil, aggregates) will be enclosed or covered with tarpaulin at all times to restrict the escape of dust.
- Public roads outside the site will be regularly inspected for cleanliness, and cleaned as necessary.
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.
- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions

8.5.2 Construction Phase: Climate

CO_2 and N_2O emissions during construction will have an imperceptible impact on climate, therefore no mitigation measures are required.

8.5.3 Operational Phase: Air Quality

The results of the dispersion modelling study indicate that no site-specific mitigation measures are required during the operational phase of the proposed development.

Nevertheless, mitigation measures in relation to traffic-derived pollutants have focused generally on improvements in both engine technology and fuel quality. EU legislation, based on the EU sponsored Auto-Oil programmes, has imposed stringent emission standards for key pollutants (REGULATION (EC) No 715/2007) for passenger cars to be complied with in 2009 (Euro V) and 2014 (Euro VI). With regard to heavy duty vehicles, EU Directive 2005/78/EC defines the emission standard currently in force, Euro IV, as well as the next stage (Euro V) which entered into force in October 2009. In addition, it defines a non-binding standard called Enhanced Environmentally-friendly Vehicle (EEV). In relation to fuel quality, SI No. 407 of 1999 and SI No. 72 of 2000 have introduced significant reductions in both sulphur and benzene content of fuels.

In relation to design and operational aspects of road schemes, emissions of pollutants from road traffic can be controlled most effectively by either diverting traffic away from heavily congested areas or ensuring free flowing traffic through good traffic management plans and the use of automatic traffic control systems (UK DEFRA,

2014). Improvements in air quality are likely over the next few years as a result of the on-going comprehensive vehicle inspection and maintenance program, fiscal measures to encourage the use of alternatively fuelled vehicles and the introduction of cleaner fuels.

8.5.4 Operational Phase: Climate

The impact of the proposed development on climate will be imperceptible. Thus no site-specific mitigation measures are required.

CO_2 emissions for the average new car fleet were reduced to 120 g/km over the period 1995-2012 through EU legislation on improvements in vehicle motor technology and by an increased use of biofuels. This measure reduced CO_2 emissions from new cars by an average of 25% in the period from 1995 to 2008/2009 whilst 15% of the necessary effort towards the overall climate change target of the EU was met by this measure alone (DEHLG, 2000).

Additional measures included in the National Climate Change Strategy (DEHLG, 2000) include: (1) VRT and Motor Tax rebalancing to favour the purchases more fuel-efficient vehicles with lower CO_2 emissions; (2) continuing the Mineral Oils Tax Relief (MOTR) II Scheme and introduction of a biofuels obligation scheme, which enabled Ireland to achieve the EU target of 5.75% biofuels market penetration by 2010 and which help to ensure that the Government target of 10% by 2020 is met; (3) implementation of a national efficient driving awareness campaign, to promote smooth and safe driving at lower engine revolutions; and (4) enhancing the existing mandatory vehicle labelling system to provide more information on CO_2 emission levels and on fuel economy.

8.6 Difficulties Encountered in Compiling information

No difficulties were encountered in compiling information.

8.7 Cumulative Impacts and Impact Interrelations

No cumulative impacts apply to the air quality and climate assessment for the proposed development.

8.8 References

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9. Noise & Vibration

9.1 Introduction

This chapter outlines the assessment of the potential noise and vibration impacts associated with the proposed development.

The chapter has been prepared in accordance with the guidance outlined in the EPAs Advice Notes on Current Practice in the Preparation of EIS (2003) and the draft Advice Notes for Preparing Environmental Impact Statements (September 2015).

9.2 Description of Receiving Environment

An environmental noise survey was conducted in order to quantify the existing noise environment in the vicinity of noise-sensitive locations that may be affected by the proposed development.

A survey of vibration along the proposed development corridor was not undertaken as levels associated with existing roads would not be expected to be of a magnitude sufficient to cause disturbance to people or structural damage to property. Furthermore, vibration was not perceptible at any of the noise survey locations.

9.2.1 Survey Locations

The location reference and a description of each survey position are given in Table 9-1. A measurement location map is provided in Figure 9.1.

Table 9-1: Details of Survey Locations

Location	Description of Survey Location	Co-ordinates (Irish National Grid)	
		X	Y
USL01	Located on the HSE Markievicz House site adjacent Markievicz House	169,049	336,475
S01	Located on the HSE Markievicz House site adjacent the rear of the houses at St Edwards Terrace	169,078	336,398
S02	Located on the grounds of the HSE Primary Care Centre	169,085	336,573
S03	Located adjacent No. 10 Barrack Street	169,146	336,622
S04	Located adjacent the first house on the R291 Rosses Point Road	169,106	336,824

9.2.2 Survey Periods and Weather Conditions

Attended measurement survey measurements were undertaken on 23rd February 2016 between 12:15 hrs and 16:33 hrs. Unattended 24-hour survey measurements were undertaken between 12:00 hrs on 23rd February 2016 and 13:00 hrs on 24th February 2016.

The weather conditions during the survey period were dry and calm with temperatures ranging between 6°C and 8°C for the attended survey and -2°C and 6°C for the unattended survey which was confirmed by reference to the Met Éireann station at Markree Castle, Sligo.

9.2.3 Measurement Procedure

9.2.3.1 Unattended Measurement Procedure

Unmanned continuous measurements were conducted over a 24-hour period at one location, USL01. L_{den} values are derived directly from the measured data. The microphone was mounted on tripod and placed at a height of 4m above ground, equivalent to a typical first floor window.

9.2.3.2 Attended Measurement Procedure

Five specific survey locations were selected as shown in Figure 9.1. Short-term attended measurements were conducted at four of these locations on a cyclical basis with sample periods of 15 minutes. The results were noted onto a survey record sheet immediately following each sample, and were also saved to the instrument memory for later analysis where appropriate. Survey personnel noted all primary noise sources contributing to noise build-up. The microphone was mounted on tripod and placed at a height of 1.5m above ground, which is equivalent to a typical ground floor window.

The survey work was conducted in accordance with the shortened measurement procedure as laid down in the NRA guidance document.

When surveying traffic noise, the acoustical parameters of interest are $L_{A10(1hour)}$ and $L_{A10(18hour)}$, expressed in terms of decibels (dB) relative to $2x10^{-5}$ pa. The value of $L_{A10(1hour)}$ is the noise level exceeded for just 10% of the time over the period of one hour. $L_{A10(18hour)}$ is the arithmetic average of the values of $L_{A10(1hour)}$ for each of the one hour periods between 06:00 hrs and 24:00 hrs.

The shortened measurement procedure involves a method whereby $L_{A10(18hour)}$ and L_{den} values are obtained through a combination of measurement and calculation as follows:

- Noise level measurements are undertaken at the chosen location over three consecutive hours between 10:00 hrs and 17:00 hrs;
- The duration of the sample period during each hour is selected to encompass sufficient traffic flows to ensure reliable results;
- The $L_{A10(18hour)}$ for the location is derived by subtracting 1dB from the arithmetic average of the three hourly sample values, i.e.
- $L_{A10(18hour)} = ((\sum L_{A10(15\ minutes)}) \div 3) - 1$ Db
- The derived L_{den} value is calculated from the $L_{A10(18hour)}$ value, i.e.
- $L_{den} = 0.86 \times L_{A10(18hour)} + 9.86$ dB

9.2.4 Equipment

The continuous measurements were conducted using a Brüel & Kjær Type 2238 Sound Level Meter equipped with a Brüel & Kjær Type 1404 weatherproof microphone housing and environmental enclosure. The short-term measurements were conducted using a Brüel & Kjær Type 2250 sound level meter. The sound level meters were calibrated before and after each survey using a Brüel & Kjær Type 4231 Sound Level Calibrator. The results were saved to the instrument memory for later analysis.

9.2.5 Results

The survey results are presented in terms of the following three parameters:

- L_{Aeq} is the A-weighted equivalent continuous steady sound level during the sample period and it effectively represents an average value.
- L_{A10} is the A-weighted sound level that is exceeded for 10% of the sample period; this parameter gives an indication of the upper limit of fluctuating noise such as that from road traffic.
- L_{A90} is the A-weighted sound level that is exceeded for 90% of the sample period; it is generally used to quantify background noise.

The results for attended survey locations, along with the derived L_{den} values, are presented in Table 9-2. The unattended results for location USL01 are presented in Table 9-3.

Table 9-2: Short Term Attended Survey Results

Survey Location Reference	Survey Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived dB L_{den}	Notes
		L_{Aeq}	L_{A10}	L_{A90}		
S01	12:15 - 12:30	60	63	55	63	Road traffic noise from N4 dominant Road traffic from Markiviez Road Intermittent activity within car park
	13:48 - 14:03	61	64	55		
	15:20 - 15:35	62	66	55		
S02	12:38 - 12:53	70	73	64	72	Road traffic noise from N4 dominant Intermittent road traffic on Barrack Street Intermittent activity within car park
	14:18 - 14:33	70	73	64		
	15:40 - 15:55	71	74	64		
S03	12:59 - 13:14	68	71	62	69	Road traffic noise from N4 dominant Intermittent activity within car park
	14:40 - 14:55	67	70	62		
	16:00 - 16:15	68	70	63		
S04	13:20 - 13:35	69	74	55	72	Road traffic noise from N4 dominant Intermittent road traffic on R291
	14:59 - 15:14	68	73	55		
	16:18 - 16:33	68	73	56		

Table 9-3: Unattended 24-Hour Monitoring Results at Survey Location USL01

Time Period	Measured Noise Levels (dB re.2x10^{-5}Pa)		
	L_{Aeq}	L_{A10}	L_{A90}
12:00 - 13:00	65	68	59
13:00 - 14:00	65	68	59
14:00 - 15:00	65	68	59
15:00 - 16:00	65	68	60
16:00 - 17:00	66	68	61
17:00 - 18:00	66	69	61
18:00 - 19:00	66	69	60
19:00 - 20:00	65	68	58
20:00 - 21:00	63	67	57
21:00 - 22:00	62	66	54
22:00 - 23:00	61	64	52
23:00 - 00:00	60	64	50
00:00 - 01:00	57	61	47
01:00 - 02:00	55	59	44

Time Period	Measured Noise Levels (dB re.2x10^{-5}Pa)		
	L_{Aeq}	L_{A10}	L_{A90}
02:00 - 03:00	55	59	43
03:00 - 04:00	57	62	43
04:00 - 05:00	54	58	41
05:00 - 06:00	56	60	40
06:00 - 07:00	61	65	48
07:00 - 08:00	65	69	55
08:00 - 09:00	67	70	61
09:00 - 10:00	67	69	60
10:00 - 11:00	65	69	58
11:00 - 12:00	68	69	59
12:00 - 13:00	67	69	60
13:00 - 14:00	66	69	60
Day (07:00 to 19:00)			**66**
Evening (19:00 to 23:00)			**63**
Night (23:00 to 07:00)			**57**
L_{den}			**67**

Location S01 Noise levels at this location were dominated by traffic from the N4 and Markievicz Road. Other sources noted were birdsong and occasional local traffic movements within the grounds of the HSE Markievicz House site. Noise levels were in the range 60dB to 62dB L_{Aeq} and 63 to 66dB L_{A10}. The derived L_{den} at this location was 63dB.

Location S02 Noise levels at this location were dominated by road traffic on the N4. Noise levels were in the range 70dB to 71dB L_{Aeq} and 73 to 74dB L_{A10}. The derived L_{den} at this location was 72dB.

Location S03 Noise levels at this location were dominated by traffic movements along the N4 and N16 as well as some intermittent local traffic on Barrack Street. Noise levels were in the range of 67 to 68dB L_{Aeq} and 70 to 71dB L_{A10}. The derived L_{den} at this location was 69dB.

Location S04 Noise levels at this location were dominated by traffic movements along the R291 Rosses Point Road as well as the N4. Noise levels were in the range 68dB to 69dB L_{Aeq} and 73 to 74dB L_{A10}. The derived L_{den} at this location is 72dB.

Location USL01 Noise levels at this location were dominated by traffic from the N4 and Markievicz Road. Other sources noted were birdsong and occasional local traffic movements within the adjacent HSE centre grounds. The measured L_{den} at this location was 67dB.

9.2.6 Summary of Noise Monitoring Data

The noise environment in the vicinity of the proposed development has been characterised by a set of traffic noise surveys. The existing noise levels are typical of the environment adjacent to a busy national road in an

urban setting. Noise levels at those locations close to the existing N4 are dominated by vehicular traffic along theN4.

9.3 Appraisal Method used for Assessment of Noise Impacts

9.3.1 Construction Phase

9.3.1.1 Noise

The NRA guidance document Guidelines for the Treatment of Noise and Vibration in National Road Schemes (NRA, 2004) specifies construction noise levels that are typically deemed acceptable. These maximum noise levels are set out in Table 9-4. Whilst this document is specifically intended for the purposes of new national road schemes, in this instance, the guidelines are still relevant to determine the potential noise impacts of the upgraded N4.

Table 9-4: Maximum Permissible Noise Levels at the Facade of Dwellings during Construction

Days and Times	Noise Levels (dB re. $2x10^{-5}$ Pa)	
	$L_{Aeq(1hr)}$	L_{Amax}
Monday to Friday 07:00 hrs to 19:00 hrs	70	80
Monday to Friday 19:00 hrs to 22:00 hrs	60[1]	65[1]
Saturdays 08:00 hrs to 16:30 hrs	65	75
Sundays & Bank Holidays 08:00 hrs to 16:30 hrs	60[21]	65[1]

In exceptional circumstances there may be a requirement that certain construction works are carried out during night time periods. These instances are addressed further below.

9.3.1.2 Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. In both instances, it is appropriate to consider the magnitude of vibration in terms of Peak Particle Velocity (PPV).

It is acknowledged that humans are particularly sensitive to vibration stimuli and that any perception of vibration may lead to concern. In the case of road traffic, vibration is perceptible at around 0.5 mm/s and may become disturbing or annoying at higher magnitudes. However, higher levels of vibration are typically tolerated for single events or events of short duration.

The NRA Guidelines recommend that in order to ensure that there is no potential for vibration damage during construction, vibration from construction activities be limited to the values set out in Table 9-5: Allowable Vibration during Construction Phase.

Table 9-5: Allowable Vibration during Construction Phase

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	10 to 50Hz	50 to 100Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

21 Construction activity at these times, other than that required for emergency works, will normally require the explicit permission of the relevant local authority.

9.3.2 Operational Phase

9.3.2.1 Noise

In the first instance, it is important to make reference to the Sligo County Council & Sligo Borough Council Noise Action Plan for Sligo County and City (February 2014). The action plan sets out the following onset levels for the assessment of noise mitigation measures for noise due to road traffic:

- 70dB L_{den}, and;
- 57dB L_{night}.

In relation to the development and planning policy, the Noise Action Plans goes on to outline the following guidance in respect of altered sources of noise incident to existing receptors:

> *In the scenario where new, or altered, sources of noise are introduced to existing residential properties, or other noise sensitive locations, there are currently a number of guidance documents which cover some of the situations which may arise, as discussed above. Where existing guidance does not cover the situation under consideration, Sligo Local Authorities will determine the format of assessment that it would consider appropriate.*

The guidance referenced in the Noise Action Plan for road traffic noise is the National Roads Authority (NRA) (now TII) Guidelines for the Treatment of Noise and Vibration in National Road Schemes. Whilst the Noise Action Plan acknowledges that the guidelines are intended for the purposes of new road schemes, in the context of the proposed development, the NRA Guidelines are still deemed to be relevant and as such will be referenced in conjunction with the content of the Sligo Noise Action Plan. The Guidelines for the Treatment of Noise and Vibration in National Road Schemes outlines the following in respect of noise from new national road schemes:

- Design goal of Day-Evening-Night 60dB L_{den} (free field residential façade criterion):
- Noise mitigation measures are deemed necessary whenever all of the following three conditions are satisfied:
  - The combined expected maximum traffic noise level, i.e. The relevant noise level, from the proposed development together with other traffic in the vicinity is greater than the design goal of 60dB L_{den};
  - The relevant noise level is at least 1dB more than the expected traffic noise level without the proposed development in place; and
  - The contribution to the increase in the relevant noise level from the proposed development is at least 1dB.

These conditions will ensure that mitigation measures arising out of this process are only based upon the degree of impact of the proposed development.

This design goal is applicable to new national road schemes and is to be applied to receptors in respect of both the year of opening and the design year, typically 15 years after projected year of opening. In this case, an opening year of 2017 and a design year of 2032 have been assessed.

It is acknowledged that it may not always be sustainable to achieve this design goal. In such circumstances, nevertheless, a structured approach should be taken in order to ameliorate as far as practicable road traffic noise through the consideration of measures such as alignment changes, barrier type (e.g. earth mounds) or low noise road surfaces.

9.3.2.2 Vibration

It has been found that ground vibrations produced by road traffic are unlikely to cause perceptible structural vibration in properties located near to well maintained and smooth road surfaces. Problems attributable to road traffic vibration can therefore be largely avoided by maintenance of the road surface.

9.4 Predicted Impacts of the Proposed Development

9.4.1 Construction Phase

9.4.1.1 Noise

A variety of items of plant will be in use during the construction works. These will include breakers, excavators, dump trucks, and generators in addition to general road surfacing and levelling equipment. The key phases of works will involve ground breaking, earthworks and earthworks haulage, drainage works and surfacing works, construction of a bridge as well as noise associated with the movement of machinery and materials within and to and from the construction compounds. Due to the nature of the activities undertaken on a road construction site, there is potential for generation of high levels of noise at nearby noise sensitive properties.

As per NRA guidance noise levels associated with construction may be calculated in accordance with the methodology set out in BS 5228-1:2009+A1:2014 *Code of Practice for Noise and Vibration Control on Construction and Open Sites-Noise*. This standard sets out sound power levels for plant items normally encountered on construction sites, which in turn enables the prediction of noise levels at selected locations. However, it is often not possible to conduct detailed prediction calculations for the construction phase of a project in support of the assessment. This is due to the fact that the programme for construction works has not been established in detail.

BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Noise sets out typical noise levels for items of construction plant. Table 9-6 and Table 9-7 set out assumed plant items during the key phases of construction with the associated source reference from BS 5228-1:2009+A1:2014. The closest properties to the proposed alignment are at distances of approximately 50 m. Construction noise calculations have been conducted at distances of 50 to 150 m from the works for different work phases, representing the nearest properties to the works.

The calculations assume that plant items are operating for 66% of the time and that all plant items associated with the individual phases are operating simultaneously and at the same distance for any one scenario. A screening correction of 5dB has been included in the calculations, to take account of screening provided by cuttings along the road alignment.

Table 9-6: Indicative construction noise calculations during excavation and fill works

Excavation and Fill Works	Calculated $L_{Aeq,T}$ at distance from road (m)			
	50 m	80 m	100 m	150 m
Tracked excavator (loading dump truck) C1-10	64	60	58	55
Articulated dump truck (dumping rubble) C1-11	59	55	53	50
Wheeled loader C2-26	58	54	52	49
Dozer C.2.10	59	55	53	50
Dump Truck Tipping fill (C2.30)	58	54	52	49
Combined L_{Aeq} from all works	**68**	**63**	**61**	**58**

Table 9-7: Indicative construction noise calculations during road works

Excavation and Fill Works	Calculated $L_{Aeq,T}$ at distance from road (m)			
	50 m	80 m	100 m	150 m
Tracked excavator (C2.21)	50	46	44	41
Dump Truck (C2.30)	58	54	52	49
vibration rollers (C5.20)	54	50	48	45

Excavation and Fill Works	Calculated $L_{Aeq,T}$ at distance from road (m)			
	50 m	80 m	100 m	150 m
Asphalt Paver & Tipping Lorry (C.5.31)	56	52	50	47
Diesel Generator (C4.76)	40	36	34	31
Road Rollers (C5.19)	64	55	53	50
Combined L_{Aeq} from all works	**66**	**60**	**58**	**54**

The reference values outlined in Tables 9-11 to 9-12 indicate that at distances of beyond 50 m from the works, the construction daytime noise limit of 70dB L_{Aeq} can typically be complied with for the scenarios assessed.

It should be noted that the calculations set out in the above tables are indicative only and are used for the purposes of comparison only with the adopted criteria. Where exceedance of the recommended criteria is expected, the use of noise mitigation measures will be used as part of the construction works. It is important to note that the construction phase of the proposed development will be temporary and short term in duration

9.4.1.2 Vibration

The potential for vibration at neighbouring sensitive locations during construction is typically limited to demolition, excavation works and lorry movements on uneven road surfaces.

The more significant of these is the vibration from excavation operations; the method of which will be selected and controlled to ensure there is no likelihood of structural or even cosmetic damage to existing neighbouring dwellings. It is important to note that the works will be temporary in duration. The proposed works have the potential to generate slight impacts during the construction phase.

9.4.2 Operational Phase

9.4.2.1 Noise Model

A computer-based prediction model has been prepared in order to quantify the traffic noise level associated with the operational phase of the proposed development and associated road traffic increases on the surrounding network. This section discusses the methodology behind the noise modelling process and presents the results of the modelling exercise.

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, Brüel & Kjær type 7810 Predictor, calculates traffic noise levels in accordance with Calculation of Road Traffic Noise (CRTN) and TII guidance.

Brüel & Kjær type 7810 Predictor is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. Predictor calculates noise levels in different ways depending on the selected prediction standard. In general, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- The magnitude of the noise source in terms of sound power or traffic flow and average velocity;
- The distance between the source and receiver;
- The presence of obstacles such as screens or barriers in the propagation path;
- The presence of reflecting surfaces; and
- The hardness of the ground between the source and receiver.

9.4.2.2 Prediction of Traffic Noise

Noise emissions during the operational phase of the project have been modelled using Predictor in accordance with CRTN and with application of the relevant conversion factors as detailed in the NRA guidance. The CRTN method of predicting noise from a road scheme consists of the following five elements:

- Divide the road scheme into segments so that the variation of noise within this segment is small;
- Calculate the basic noise level at a reference distance of 10 metres from the nearside carriageway edge for each segment;
- Assess for each segment the noise level at the reception point taking into account distance attenuation and screening of the source line;
- Correct the noise level at the reception point to take account of site layout features including reflections from buildings and facades, and the size of source segment; and
- Combine the contributions from all segments to give the predicted noise level at the receiver location for the whole road scheme.

Note that all calculations are performed to one decimal place. For the purposes of comparison with the design goal of 60dB L_{den}, the relevant noise level is to be rounded to the nearest whole number in accordance with guidance given in the NRA document.

9.4.2.3 Model Inputs

The noise model was prepared using the following data:

- Road alignments, topographical data and background ordnance survey mapping; and
- Central-growth Annual Average Daily Traffic (AADT) for the proposed development for the opening year 2017 and design year 2032, data was provided for the Do Minimum and Do Something scenarios.

Please note that standard road surfacing materials, i.e. hot rolled asphalt has been assumed for the proposed development.

9.4.2.4 Model Outputs

Predictor calculates noise levels for a set of receiver locations specified by the user. The results include an overall level in dB L_{den}.

9.4.2.5 Model Calibration and Validation

The purpose of noise model validation is to ensure that the software is correctly interpreting the input data and providing results that are valid for the scenario under consideration. It should be noted that the purpose of the model validation is not to validate the prediction methodology in use as the CRTN prediction methodology has itself been previously validated.

Given the nature of the scale of the proposed road development in question, it was decided that the most appropriate mechanism for calibration would be to compare the output of a Predictor model scenario, using the AADT traffic flows for the existing road network in 2015, with the measured L_{den} values at the unattended survey location in the vicinity of the existing road network. The reason for choosing the survey location along the existing road network for the purposes of calibration is to ensure that the noise environment was dominated by road traffic noise during the survey period.

The results of the calibration are presented in Table 9-8. The differences between the measured and predicted results are of the order of 2 dB(A), which demonstrates robust correlation and confirms that the model is correctly interpreting the input data.

Table 9-8: Model Calibration

Survey Location	Proximity to Road	Measured L_{den}, dB	Model Predicted L_{den}, dB	Variation (dB)
USL01	15	67	65	2

9.4.2.6 Receiver Locations

Free-field traffic noise levels have been predicted at a number of receptors in the vicinity of the development.

A total of eleven receptors have been considered in the assessment. The receptors were selected on the basis of proximity to the existing and proposed development and include both residential and healthcare[22] receptors. The coordinates of all receptor locations has been provided in Table 9-9.

Table 9-9: Model Receptor Details

Model Receptor Reference	Description	Co-ordinates (Irish National Grid)	
		X	Y
R01	Apartments on Custom House Quay	168,925	336,284
R02	House on St Edwards Terrace	169,075	336,386
R03	Southwestern Façade of Markievicz House	169,095	336,428
R04	North-western Façade of Markievicz House	169,097	336,489
R05	Façade of HSE Primary Care Centre	169,077	336,545
R06	Façade of HSE Primary Care Centre	169,088	336,569
R07	Façade of HSE Primary Care Centre	169,120	336,579
R08	House on Barrack Street	169,160	336,625
R09	House on R291	169,175	336,813
R10	House on R291	169,091	336,817
R11	House on Carton Bay Road	168,921	336,779

As standard, all receptors have been modelled at a height of 4 m above ground level which corresponds to the first floor window of a standard two storey dwelling. The relevant predicted levels have been presented in Appendix 9.1.

9.4.2.7 Predicted Noise Levels

Four scenarios have been considered as follows:

- Year 2017 – Do Minimum (i.e. proposed development is not built);
- Year 2017 – Do Something (i.e. proposed development is not built);
- Year 2032 – Do Minimum; and
- Year 2032 – Do Something.

The results of the traffic noise predictions are presented in Appendix 9.1. Receptors which meet the NRA criteria for mitigation have been extracted and are presented in Table 9-10 for reference.

[22] In this instance, the selected receptors relate to the clinical areas of the HSE Sligo Primary Care Centre and Markievicz Health Centre.

Table 9-10: Receptors requiring mitigation

Receiver Location Reference	Opening Year 2017		Mitigation Required?	Design Year 2032		Mitigation Required?
	Predicted Noise Level			Predicted Noise Level		
	Do Minimum	Do Something		Do Minimum	Do Something	
	L_{den} (dB)	L_{den} (dB)		L_{den} (dB)	L_{den} (dB)	
R05	66	69	Yes	67	69	Yes
R06	68	70	Yes	69	71	Yes

Opening Year 2017
The combined expected maximum traffic noise level from the proposed development together with other traffic in the vicinity (i.e. Do Something scenario), is greater than 60dB L_{den} at seven receptor positions along the proposed development.

At five of these receptor positions, the Do Something level is less than 1dB higher than the Do Minimum level. Mitigation measures are therefore not required at these locations.

At two of the remaining receptors, it can be seen that the contribution of the proposed development to the overall Do Something noise level is also at least 1dB. As such this meets the TII criteria for noise mitigation measures.

Design Year 2032
The combined expected maximum traffic noise level from the proposed development together with other traffic in the vicinity (i.e. the Do Something scenario) is greater than 60dB L_{den} at seven receptor positions.

At five of these receptor positions, the Do Something level is less than 1dB higher than the Do Minimum level. Mitigation measures are therefore not required at these locations.

At two of the remaining receptors the contribution of the proposed development to the overall Do Something noise level is also at least 1dB. As such this meets the TII criteria for noise mitigation measures.

Reference to the Sligo Noise Action Plan Onset Levels
In addition to the TII guidance, it is also prudent to comment on the predicted noise levels in the context of the onset levels for noise mitigation as outlined in the Sligo Noise Action Plan. All predicted levels for each receptor where compared to the NAP onset levels.

In this regard, it can be seen that the predicted noise levels at R06 are equal to or greater than the onset level of 70dB L_{den} during the opening and design years 2017 and 2032 respectively.

In respect of the predicted L_{night} levels, the predicted noise levels were equal to or greater than the onset level of of 57dB L_{night} at receptors R05, R06 and R08 during the opening and design years 2017 and 2032 respectively.

9.5 Mitigation Requirements

9.5.1 Construction Phase

The contract documents will clearly specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of BS5228-1:2009+A1:2014 and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001. These measures will include that:

- No plant used on site will be permitted to cause an ongoing public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.

- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps that is required to operate before 07:00 hrs or after 19:00 hrs will be surrounded by an acoustic enclosure or portable screen.

9.5.1.1 Working Hours

Normal working times will be 07:00 hrs to 19:00 hrs Monday to Friday and 08:00 hrs to 16:30 hrs on Saturdays. Works other than the pumping out of excavations, security and emergency works will not be undertaken outside these working hours without the written permission of Sligo County Council. Such permission will only be granted in circumstances where other alternatives have been assessed and deemed to be impractical. Granted permission can be withdrawn at any time should the working regulations be breached.

Works other than the pumping out of excavations, security and emergency works will not be undertaken at night and on Sundays without the written permission of Sligo County Council. Night is defined as 19:00 hrs to 07:00 hrs.

9.5.1.2 Emergency Work

The emergency works referred to above may include the replacement of warning lights, signs and other safety items on public roads, the repair of damaged fences, repair of water supplies and other services which have been interrupted, repair to any damaged temporary works and all repairs associated maintaining safety on the site of the proposed development and on adjacent public roads.

9.5.1.3 Vibration

Measures will be taken by the contractor to minimise vibration due to plant and machinery on the site and no machine which uses the dropping of heavy weights for the purpose of demolition shall be permitted.

9.5.2 Operational Phase

The results of the noise modelling assessment show that noise mitigation will be required for two receptors along the proposed development. In this instance, these receptors relate to the western façade of the HSE Sligo Primary Care Centre which contains clinical services areas and can therefore be regarded as a sensitive receptor in accordance with the NRA Guidelines.

It is proposed that the mitigation in this case would consist of increasing the height and length of the existing boundary wall when it is reinstated. The wall will be required to extend approximately 70 m along the western boundary adjacent to the HSE Sligo Primary Care Centre. The wall will be required to be constructed to a height of 2.5 m from its existing 0.8 m and 1.5 m. The location of the proposed extension to the wall has been outlined in Appendix 9.3 for reference.

Table 9-11 details the predicted noise levels with the mitigation measures specified in place. With mitigation the predicted noise levels are within the design goal at all of the locations assessed.

Table 9-11: Predicted Noise Levels (Post Mitigation)

Receiver Location Reference	Opening Year 2017		Mitigation Required?	Design Year 2032		Mitigation Required?
	Predicted Noise Level			Predicted Noise Level		
	Do Minimum	Do Something		Do Minimum	Do Something	
	L_{den} (dB)	L_{den} (dB)		L_{den} (dB)	L_{den} (dB)	
R05	66	68	No	67	68	No
R06	68	67	No	69	68	No

In relation to the achievement of the Sligo Noise Action Plan criteria with mitigation in place, it is important to note that the proposed mitigation measures reduce noise levels at R06 to below the 70dB Lden onset level. Additionally, the mitigation measures ensure that no perceptible increase in the predicted night levels occurs at R05, R06 and R08.

The proposed scheme is therefore not deemed to be materially impacting the potential Do Minimum noise climate at these locations, and as such it is appropriate that the examination of mitigation measures at these locations will form part of the future Sligo Noise Action Plan rather than as part of the proposed scheme.

9.6 Residual Impacts

9.6.1 Construction Phase

During the construction phase of the proposed development there will be some slight temporary impacts on nearby residential properties due to noise emissions from site traffic and other construction activities. The application of binding noise limits and hours of operation within the contractors contractual requirements, along with implementation of appropriate noise control measures, will ensure that noise impact is kept to the minimum required to safely carry out the required construction works. The construction impacts will be of a temporary nature given the short length of the proposed development.

9.6.2 Operational Phase

During the course of the noise assessment it was demonstrated that the predicted noise levels at two receptors exceeded the specified NRA Noise Mitigation Criteria. In this instance, mitigation measures have been specified. Once these mitigation measures are implemented, it was shown that all locations comply with the adopted criteria.

On the basis of the above, it is considered that the proposed development complies with the appropriate guidance in relation to noise and that the associated noise impacts are considered acceptable. In conclusion, the noise impact of the proposed development is considered to be negligible for the majority of properties.

9.7 Difficulties Encountered in Compiling Information

No particular difficulties were encountered during the assessment.

9.8 Cumulative Impacts and Impact Interrelations

During the preparation of the noise and vibration impact assessment, interaction and consultations have taken place with several other disciplines in order to ensure that the cumulative impacts of the proposed development have been considered.

10. Landscape and Visual

10.1 Introduction

This chapter of the EAR outlines the assessment of the effects of the proposed development on the existing visual environment and landscape character of the surrounding area.

The assessment provides a description of the existing landscape and visual environment and a statement of the likely significant landscape and visual impacts associated with both the construction and operational phases of the proposed development. Mitigation measures are proposed to avoid or remediate potential impacts, either through the design of the project, or specific measures. The significance of residual impacts remaining after mitigation is also identified.

10.1.1 Assessment Methodology

The methodology used for the landscape assessment entailed:

- A desktop study of the site in relation to its overall local context using OS Mapping and aerial photography;
- Visiting the site and its environs during 2016 to assess the following;
  - Quality and type of views in the area;
  - The extent of the visual envelope, i.e. the potential area of visibility of the site in the surrounding landscape; and
  - The character and quality of the surrounding landscape in relation to the position of the proposed development.

The methodology has regard to Section 50 sub-section 2 and 3 of the Roads Act 1993 as amended, and the following guidance publications:

- EPA: Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) 2003;
- EPA: Guidelines on the Information to be contained in Environmental Impact Statements, 2002;
- EPA: Consultation Draft Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) 2015;
- EPA: Consultation Draft Revised Guidelines on the Information to be contained in Environmental Impact Statements, 2015;
- LI / IEMA: Guidelines for Landscape and Visual Impact Assessment, 2013, 3rd Edition;
- NRA: Environmental Impact Assessment of National Road Schemes - A Practical Guide;
- NRA: A Guide to Landscape Treatments for National Road Schemes in Ireland, 2006;
- NRA: Guidelines for Protection and Preservation of Trees, Hedgerows and Scrub Prior to, during and Post Construction of National Road Schemes; and
- NRA / TII: Design Manual for Roads and Bridges.

The findings and recommendations of other chapters of this EAR have also been considered in the preparation of this assessment. In particular, liaison has taken place in respect of Archaeology and Cultural Heritage, Architectural Heritage, Flora and Fauna, and Noise and Vibration.

- Effects on the landscape character of the locality and on views from a range of visual receptors types, directions and distances are considered in this assessment.

The overall design of the proposed development was part of an iterative design process which was fed by the potential landscape and visual assessment conclusions. The final proposed design and mitigation are based on the principles of avoidance and reduction to minimise any landscape and visual impacts.

10.2 Description of the Existing Environment

10.2.1 Landscape Context & Character

The proposed road development involves the upgrade of a section of an existing major road corridor, located on the northwest side of the Sligo City centre. The direct study area comprises part of the existing N4 Sligo Inner Relief Road from Hughes Bridge on the north side of the river, north to N4 junction and tie-ins with the N15 Donegal Road / the N16 Manorhamiltion Road (at Duck Street Junction) and the R291 Rosses Point Road, a distance of c.670 metres. Hughes Bridge over the River Garavogue, which was originally opened in 1988, has also undergone upgrade and widening for improved pedestrian and cycleway facilities in recent years.

There are a number of features within and along the study area, see Appendix 10.1 for location:

- The existing road is a heavily trafficked corridor located on the urban coastal edge between the city and the bay.
- Hughes Bridge is a wide mule-lane structure which has been recently widened to enhance and provide for pedestrian / cycle facilities.
- Sligo Harbour and Port is located along the south quays (Custom House Quay) west of Hughes Bridge.
- The west side of Hughes Bridge and road offers panoramic views over Sligo Bay and north over Cartron towards Benbulbin and the wider Dartry Mountain range.
- The east side of Hughes Bridge offers views over the mouth of the Garavogue River contained by the built urban development of Sligo City.
- Constance Markievicz House (originally Ardmore House and now a HSE Property) sits prominently on a local height to the immediate north of Hughes Bridge. The house, which is a protected structure, is surrounded by open lawn with some mature windswept trees and the property is enclosed by a high limestone retaining wall. The boundary wall facing Hughes Bridge has been modified and includes a setback section of wall and railing. This setback section also includes a bronze sculpture ‘The Pursuit of Diarmuid and Grainne’ by Robin Buick, dating from 1989.
- A small riverside amenity landscape area raised over a low limestone wall lies at the northeast corner of Hughes Bridge.
- A coastal amenity area provided relatively recently at Salmon Point is located to the north of Hughes Bridge. The amenity area, which was opened in 2009, focuses on the coastal heritage of the city and includes entrance gates, trees in planters, walls, lights, and railings, areas of lawn, nautical art features, including the ‘HOLD-FAST HANG-TEN S.L.I.G.O’ artwork by Stephen Hurrel, as well as bronze plaques noting the following:
    - Sligo Harbour Commissioners 1869;
    - Corporation of Sligo 1612 JR & Sligo Borough Improvement Act 1869;
    - Corporation of Sligo 1612 JR; and
    - Corporation for Improving the Town & Harbour of Sligo.
- The coastal edge surrounding the amenity area is tidal and includes areas of rock facing, with overgrown grass, regenerating bramble, scrub and early mature trees. Signage within the amenity area identifies the Birds of Sligo-Salmon Point.
- The Salmon Point amenity area and Sligo Bay on the west of the study area, is prominently overlooked from the elevated location of Constance Markievicz House located east of the study area.
- The boundary surrounding the new HSE Primary Care Centre-to the north of Constance Markievicz House-comprises a low limestone plinth wall (probably remnants of an originally higher wall that surrounded Constance Markievicz House) with metal railing on top.
- The wall at the northern end of the HSE Primary Care Centre (i.e. N16 Duck Street junction with N4-N15 / Barrack Street) includes a 2004 plaque acknowledging Sligo’s hosting of Gibraltar during the Special Olympics of 2003.

- The N4-N15 bridges the Copper River-a small stream located north of the N16 Duck Street junction.
- On the west side of the proposed development, north of the Copper River, lies a small area of grassland leading to a coastal walk around the north side of the bay at Cartron.
- Further small areas of well-maintained grassland with small trees lie within the layout of the R291 Rosses Point Road junction with the N15.
- From its junction with the N15, the R291 Rosses Point Road leads northwest uphill into the residential area of Cartron Hill. Residential properties between the R291 Rosses Point Road and N15 include mature plantings of deciduous and evergreen trees and shrubs.
- The east side of the N15 is defined by a beech hedgerow backing onto an area of low-lying grassland north of the Copper River (rear of Feehily's Funeral Home). A small amenity grassland area lies between the N15 and Feehily's Funeral Home to the south of the small stream. The area is enclosed by high property boundary walls with bollards along the N16 Duck Street junction.
- The N16 Duck Street junction is overlooked by terraced residential properties at Duck Street-St John's Terrace-Barrack Street.

Appendix 11.1 shows a number of views and landscape elements in the study area. While a variety of landscape features define the edge of the road corridor, the corridor itself is dominated by the volume of traffic; the multi-lane nature of the road; major junctions; Hughes Bridge, and the interface between the N4 / N15 / N16 / R291 and by associated signage, lights, traffic lights etc.

10.2.2 Landscape Character / Sligo County Development Plan 2011-2017

The County Development Plan (the Plan) sets the context for consideration of the existing landscape and visual environment as well as for development itself. At the outset the Plan (Section 2.5) recognises that the county has a '*rich, varied and diverse landscape'* and the need to be aware of '*the significance of maintaining the integrity of sensitive areas*'. It also notes the ongoing challenge of balancing landscape impact with economic growth and development and states that the Council '*will help undertake this challenge by encouraging such development where appropriate but only in a sustainable way'*.

Appendix G of the Sligo Development Plan details the following scenic routes in the vicinity of the proposed development area:

- N15 from Bunduff Bridge (Leitrim County boundary) Views of Atlantic Ocean, Ben Bulben, to Sligo; and
- N16 from Leitrim County boundary to Sligo.

10.2.3 Sligo and Environs Development Plan 2010-2016

The full extent of the study area falls within the parameters of the Sligo and Environs Development Plan 2010-2016. The following aspects covered in the Plan are considered relevant to the landscape and visual assessment.

10.2.3.1 Protected Structures and ACAs

There are no protected structures or architectural conservation areas (ACAs) located directly within the extents of the proposed development. However, Constance Markievicz House is a protected structure which closely overlooks the road corridor. The following table is an extract from the Record of Protected Structures.

Table 10-1: Protected Structures

RPS No.	Map sheet no.	Structure name and / or description	Address
3	1012-07	Markievicz House Detached three-bay two storey over basement with attic, rendered former school building, built c. 1870. Rectangular plan, flat-roofed square porch projecting from west (front) elevation, three bays deep, six-bay three-storey lower return, c. 1920 to northeast.	Barrack Street, Rathquarter Td.

10.2.3.2 Ecological Designations

The following ecological designations are in the study area:

- Cummeen Strand is designated as a Special Protection Area (SPA No.004035); and
- Cummeen Strand / Drumcliff Bay is designated as a Special Area of Conservation (SAC No.000627) and a proposed Natural Heritage Area (pNHA No.000627).

10.2.3.3 Green Corridors, Open Space and Landscape Generally

The Sligo and Environs Development, and specifically Map 3: Open Spaces (of the Development Plan) includes for the following landscape and open space related aspects.

Map 3 of the Development Plan (refer to extract in Image 10.1) indicates a local objective for:

- An integrated trail and greenway system for walking, cycling and jogging to be created as part of the development of the city's park and open space network.
- In addition, it is an objective of Sligo Borough and County Councils to develop a linked green network as indicated on Map 3 of the Development Plan including along the following corridors (refer to dashed green lines on Image 10.1):
  - O-OS-15: Markievicz Road to Standalone Point corridor (along the foreshore at Cartron);
  - O-OS-18: Hyde Bridge to Hughes Bridge and Ballast Quay (i.e. along south quays); and
  - O-OS-20: Along the stream at Duck Lane (Street) and Ash Lane to Ballinode and Hazelwood (i.e. east along the Copper River from the N4 / N15 / N16 / R291 Junction).

Open Space is indicated on Map 3 (Open Spaces) of the Development Plan in the following locations: (refer to green shaded areas on Image 10.1):

- To the west of the proposed development north of Hughes Bridge leading to Cartron. This includes Salmon Point Amenity Area;
- In landscape areas within the junction between the N4-N15 and R291 Rosses Point Road;
- Along the Copper River east and north of the proposed development (rear of Feehily's); and
- Along the river south of the R870 Markievicz Road / Constance Markievicz House at the junction with Hughes Bridge.

The study area is located within the Outer City area as noted under Section 12.6 of Chapter 12 Urban Design. There are no specific listings for protection of scenic routes or views or for protection of trees or other plantings within the study area (other than those listed under 10.2.2 above).

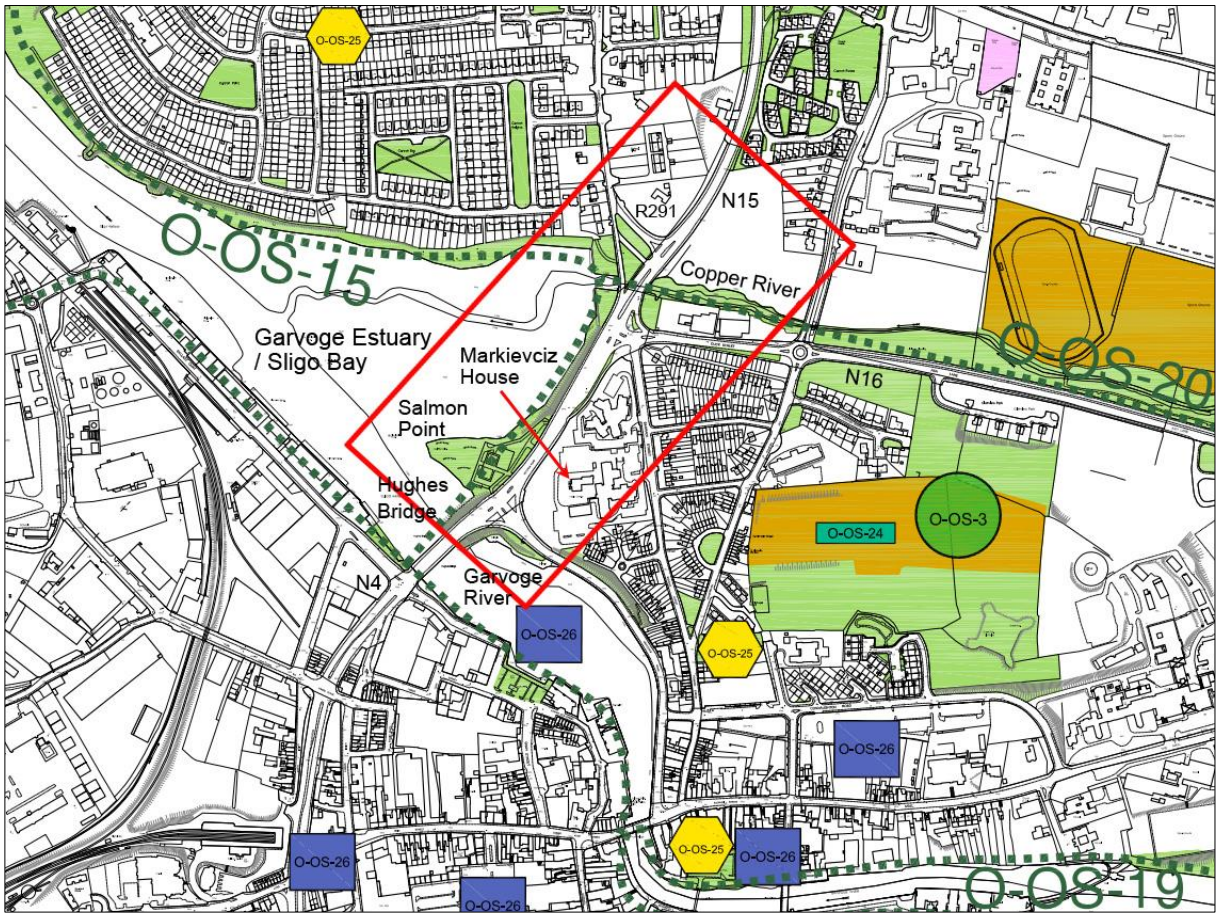

Image 10.1: Annotated extract of Map 3 Open Space Objectives Sligo and Environs Development Plan (with project study area outlined in red)

10.2.4 Significance and Sensitivity of Receiving Environment

The proposed development involves the upgrade of a short section of an existing major road corridor, dominated by heavy traffic, associated signage, public lighting, traffic lights etc. and therefore, the general area is neither particularly significant, nor sensitive, to the nature of development as proposed.

While views from the study area are often long-ranging, especially west to Sligo Bay and north to Benbulbin and the Dartry Mountains, views to the study area are from within the road corridor and from immediately adjoining properties and amenities.

Existing aspects such as the coastal setting; the presence of amenities, including artworks, plaques and features; physical boundaries to immediately adjoining properties, including to a protected structure; the presence of trees and other plantings; and tie-in with planning objectives and policies are the most notable features of the baseline landscape.

10.3 Appraisal Method used for Assessment of Impacts

10.3.1 Introduction

In order to assess the significance and magnitude of potential impacts it is important to fully understand the existing landscape context. Section 10.2 of this study provides an appraisal of the existing landscape condition.

Section 10.4 provides a description of the proposed development in terms of its landscape and visual context and outlines the various impacts and effects of the proposal. These impacts and effects are made with regard to

the vulnerability of the landscape to change and to the location of visual receptors relative to the proposed development. In this way the impact of the proposed development on this existing context is appraised and significant impacts to either the landscape character or visual amenity identified wherever they occur. Section 10.5 provides a description of the mitigation measures to avoid, reduce or remediate any potential negative impacts that have been identified.

10.3.1.1 Landscape

Landscape has two separate but closely related aspects. The first is visual impact, i.e. the extent to which a new structure in the landscape can be seen. The second is landscape character impact, i.e. effects on the fabric or structure of the landscape. Landscape character is derived from the appearance of the land, and takes account of natural and man-made features such as topography, landform, vegetation, land use and built environment and their interaction to create specific patterns that are distinctive to particular localities.

Given the relatively short length of proposed route, the landscape, as well as its character and visual environment is considered as a single unit for the purposes of the assessment. Therefore the landscape impact assessment describes the likely nature, scale and significance of changes to specific landscape elements and characteristics as well as to the landscape and visual environment as a whole.

Landscape planning designations, including National and County designations or listings are considered and assessed for impacts, where appropriate. Likewise cultural features or landscapes and historic properties as defined by the National Inventory of Architectural Heritage (NIAH) are also considered, as are other features identified during site visits or in consultation with the Architectural Heritage consultant.

10.3.1.2 Visual Impact

Visual impacts are categorised under ‘Visual Intrusion’ and ‘Visual Obstruction’ where:

- Visual Intrusion is an impact on a view without blocking; and
- Visual Obstruction is an impact on a view involving blocking thereof.

In reporting on visual impact, three basic assessments are considered:

- Construction Stage: considers the period including the active construction of the road up to completion of the works and opening of the proposed road development.
- Pre-establishment Stage: considers the period including the initial operation of the proposed road development where new landscaping is unlikely to provide effective mitigation. The impact is assessed in the year the proposed road development would open to traffic.
- Post-establishment Stage: considers the impact as assessed ten years after opening. The development of planting to provide effective landscape and visual mitigation usually requires a minimum period of five to seven years after planting.

10.3.2 Standards and Guidelines

The landscape and visual assessment has been undertaken with reference to the main standards and guidelines listed in Section 10.1.1.

The findings and recommendations of other chapters of this EAR have also been considered in the preparation of this assessment. In particular, liaison has taken place in respect of Archaeology and Cultural Heritage, Architectural Heritage, Flora and Fauna, and Noise and Vibration.

10.3.3 Significance Assessment Criteria

The significance criteria as set out in the EPA Guidelines have been used for the purpose of this assessment, see Table 10-2. The significance of landscapes is considered against their designation (i.e. national, county, local, etc.). Where not designated or otherwise protected, landscapes are considered as being of local

significance. Views from properties are all considered on an equal basis without varying degrees of significance.

Table 10-2: Significance of Landscape and Visual Impacts

Significance Level	Criteria
Imperceptible	An impact capable of measurement but without noticeable consequences.
Slight	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate	An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends.
Significant	An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Profound	An impact which obliterates sensitive characteristics

Effects can be considered to be negative, neutral or positive in effect. Impacts are considered where they may be direct, indirect and / or cumulative as appropriate.

Duration of effects is considered as being Temporary (for up to one year), Short-term (from 1 to 7 years), Medium-term (7 to 15 years), Long-term (from 15 to 60 years) or Permanent (over 60 years).

10.4 Predicted Impacts of the Proposed Development

10.4.1 Introduction

The circa 670 m proposed development represents an upgrade of an existing heavily trafficked urban road corridor, see Figure 2.1. The overall effect is to provide for improved road safety and traffic management, and provision of appropriate enhanced footpaths and cycle facilities. These works will necessitate local widening of the road corridor which will have direct effects on various roadside boundaries and immediate lands. The principal elements of the proposed development include:

1. **Ch. 0+100 to 0+160 – N4 & Markievicz Road Junction:** Slight local re-alignment of the junction;
2. **Ch. 0+140 to 0+200:** Widening of the road corridor to the west onto the eastern edge of the Salmon Point Amenity Area. This will result in loss of part of the landscape amenity, removal / relocation of 14no. young trees (*Gingko biloba*) in planters and necessitate the setback of the existing entrance wall, arch and railings by up to c.8.0 m.
3. **Ch. 0+220 to 0+380:** Widening of the road corridor by up to c.5 m (Ch. 0+275) to the east onto lands at the edge of Constance Markievicz House / HSE lands. This will necessitate setback of the existing part retaining / part retaining limestone wall at the southern end of this section. The northern section of low limestone wall and railing will also be setback and it is proposed to replace this section with a full height wall for noise attenuation purposes. The setback of the boundary will require the removal of 4 mature sycamore trees, together with 14 no. other young oak and maple trees fronting the HSE property.
4. **Ch. 0+240 to 0+320:** Localised westward widening of the road corridor of between 1.5 m (northern end) up to c.9 m (at Salmon Point) onto the existing rock embankment coastal edge detail. This will necessitate the provision of a new retaining wall along the coastal edge and the removal of c.400 sqm of tree and scrub vegetation that has regenerated on the coastal stone embankment provided as part of a previous road upgrade project.
5. **Ch. 0+320 to 0+430:** The existing coastal wall to west of the road is to be increased in height to between 1.0 m and 1.4 m.

6. **Ch. 0+400-N4 & Duck Street (N16) Junction:** Slight local re-alignment of the junction.
7. **Ch. 0+420 to End-N4 / N15 / R291 Junction:** Significant local re-alignment of junction, including widening of N4-N15 road corridor to the east, involving:
    - removal of roadside edge of small open space and 2 young trees located south of Copper River;
    - eastwards extension of Copper River culvert;
    - eastward extension of N15 corridor north of Copper River – leading to tie-in to existing road corridor south of Cartron Estate. This will result in removal of c.450 linm. of beech hedgerow and c.10 no. early mature ash and sycamore trees. A new wall and hornbeam hedgerow is to be provided along the widened eastern boundary of the road corridor; and
    - On the east side of the N15 and north of Copper River, a new wetland / attenuation pond feature is to be provided on low-lying lands adjoining the small river.
8. **Ch. 0+460 – Copper River**: While the eastern face of the culvert is to be extended, the existing limestone western (coastal) face is retained. As noted above a new wetland / attenuation pond feature is to be provided on low-lying lands adjoining the small river.
9. **Ch. 0+500 – N4-N15 & R291 Junction**: Significant local re-alignment of the junction with removal of N4 to R291 slip lane, provision of footpath / cycleway connectivity throughout and formalization of T-junction with N4-N15. The existing stone wall boundary wall to the residential property (Kilronan) on the north side of the junction is to be re-constructed at a setback location for sightline reasons. This will also involve the removal of boundary hedgerows and plantings, as well as mature evergreen trees located along the N15 north of the N4 / N15 / R261 Junction. The existing 11 no. trees in landscape areas within the R261 junction (6 young ash and 5 early mature maple) will also be removed. The 7 young trees (*Gingko biloba*) in planters located in the median of the N15 will be removed / relocated.
10. **R291**: A section of the existing part limestone / part masonry boundary wall at Suncroft Villas will also be setback for sight line reasons. The existing driveway access to a property west of the R291 is to be re-aligned.

Given the nature of the baseline environment, changes to traffic flows, and elements such as lighting, traffic lights and signage are not considered significant in a landscape or visual context.

10.4.2 Landscape and Visual Impacts

While the overall project has some limited potential for landscape and visual impacts associated with general construction disturbance and activity, the main aspects of the proposed development that have potential for significant landscape and visual impact are:

1. Loss of grounds at-and impact upon-the coastal amenity of **Salmon Point**;
2. Loss of **regenerated tree and shrub vegetation** along coastal fringe north of Salmon Point;
3. Loss of grounds, mature trees, young trees and setback of boundary wall at **Constance Markievicz House / HSE lands**;
4. Impact of works at and adjoining **Copper River**;
5. Loss of grounds, plantings and setback of boundary wall at **Kilronan property** located off the R291; and
6. **Other Impacts**: generally local effects associated with widening of road corridor; impacts on boundaries; re-alignments of existing roads, junctions, provision of enhanced footpaths and cycleways and loss / relocation of trees in planters, grassland, verges, etc.

Refer also to Chapter 5 for further assessment of impact of proposed development in landscape including trees, shrubs and grasslands.

Construction and operation stage (pre and post establishment) impacts for each of the above are set out in the following on an area by area basis.

10.4.3 Impact on Coastal Amenity of Salmon Point

The works will involve some direct loss of existing amenity lawn, removal of existing tree planting in planters, realignment of existing footpaths, setback of the existing entrance arch, walls and railings, feature lights. This will also involve removal and reinstatement of existing feature plaques (set into entrance walls). It will not be necessary to impact, the 'HOLD-FAST HANG-TEN S.L.I.G.O' artwork, which is displayed throughout the amenity area.

Construction Stage Impact: Construction stage works, which are also likely to close the amenity area during the course of the works, will give rise to a significant local temporary negative impact.

Pre-establishment Operation Stage Impact: At the end of construction works, and notwithstanding the direct loss of some ground, some of the original character of the amenity area will be restored, with existing walls and railings, plaques, lights and artwork all reinstated. Post-construction six of the existing fourteen feature tree planters will be accommodated to the south and north of the amenity.

Nevertheless, the direct impact on the amenity is substantial and the immediate post-construction stage works are likely to give rise to a significant local short-term negative impact.

Post-establishment Operation Stage Impact: Given the roadside context of the amenity area, the landscape and / or visual impact will quickly reduce to slight arising from direct loss of some existing grounds.

10.4.4 Impact at Constance Markievicz House / HSE Care Centre

While works are proposed to front of Constance Markievicz House these are generally limited to works within the existing road corridor and at Salmon Point-as described above. However, further north the existing roadside retaining wall and low wall and railing which provide the boundary to HSE Care Centre is to be setback into the property. This will involve direct loss of grass areas, the removal of four remaining mature sycamore trees and a number of young maple and oak trees. Existing access and parking arrangements and provision will be retained – though some temporary restrictions may be required during the construction works for the new setback wall.

Construction Stage Impact: Construction stage works will give rise to a moderate temporary negative impact for Constance Markievicz House and a locally significant temporary negative impact in the vicinity of the HSE Care Centre.

Pre-establishment Operation Stage Impact: Completion of construction will see the reinstatement of the boundary wall at the setback location and the existing low wall and railing will be replaced by a full height wall thereby giving a more enclosed character to the western end of the property.

Immediately post-construction the loss of a sense of visual permeability at ground level – albeit to a busy road corridor – will be a notable change and is likely to give rise to a significant negative impact.

Post-establishment Operation Stage Impact: With establishment of the completed proposed development, the impact over time will reduce to moderate negative impact.

10.4.5 Impact on Coastal Fringe North of Salmon Point

Significant construction works involving the removal of the existing roadside boundary wall and adjoining coastal trees and shrubs. A new boundary wall of between 1.0 m and 1.4 m in height, is to be provided at setback location.

Construction Stage Impact: Given the location of this section of the Copper River construction stage works will give rise to a locally slight to moderate temporary negative impact.

Pre-establishment and Post-establishment Operation Stage Impact: An initial moderate landscape and visual impact will be balanced by improved views west towards Sligo Bay and longer-term impact will be imperceptible as regeneration of vegetation is also likely to reinstate some of the existing edge character.

10.4.6 Impact on the Copper River and adjoining areas

Significant construction works are proposed in the vicinity of the Copper River and to the Copper River Bridge. On the eastern side, the proposed works will see a c.15 m eastern extension of the culvert, as well as provision of an attenuation pond on low-lying lands to the immediate north of the river. The attenuation / treatment pond is to be enclosed with 2.4 m high paladin-style security fencing.

By contrast the western limestone face of the Copper River culvert is to be retained.

Construction Stage Impact: Given the location of this section of the Copper River construction stage works will give rise to a locally slight to moderate temporary negative impact.

Pre-establishment and Post-establishment Operation Stage Impact: No adverse landscape or visual impact will remain following completion of construction works.

10.4.7 Impact on the Kilronan Property

Construction works will entail setting back the existing boundary wall of the Kilronan property. This property has a mature and well-maintained landscape setting of mature trees, hedge and shrub planting and lawns. The boundary wall is an attractive random limestone feature enhanced by well-maintained hedgerows and other plantings. A line of mature conifers located inside the southeast and east of the property provides evergreen screen planting of the adjoining N15 road corridor.

Construction works will see the direct loss of up to 6 m of garden property frontage along the R291 together with the setback of the property entrance, and up to 12 m of loss of side garden along the N15 side. Works will also involve removal of associated boundary hedge and shrub planting, including a number of mature shrubs, a mature beech tree at the southeast corner of the property as well as a line of mature conifers on the boundary with the N15. However, a line of mixed mature trees located inside the boundary and to the immediate front of the house will be retained. Likewise a group of mature conifers located inside the southeast corner and east of the site will be retained for screening.

For sightline reasons widened verges will be provided outside of the setback boundary together with a roadside footpath, cycleway and verge.

Construction Stage Impact: It is considered that the proposed construction works, including associated disturbance and construction activity, will give rise to significant temporary negative landscape and visual impacts for the property.

Pre-establishment Operation Stage Impact: Completion of construction will see the reinstatement of the boundary wall at the setback location. The immediate post-construction situation will not have the sense of established maturity of the existing situation, however, retention of the internal tree line and conifers will have a significant influence on moderating impacts. Therefore impacts will remain significant and negative immediately after completion of works.

Post-establishment Operation Stage Impact: The longer-term overall impact for the property, which can be mitigated by new planting, is likely to be of a moderate negative nature.

10.4.8 Impact on Amenities

The proposed development provides for a widened road corridor, with enhanced footpath and cycleways, new roadside boundaries, localised junction re-alignments, and new or re-ordered lighting, signage, drainage, attenuation etc.

With the exception of the specific locations described above, for the most part these works take place within the existing road corridor, however, some additional corridor widening is required between Salmon Point and the

Copper River and to the east of the N15 immediately south and north of the Copper River. In both instances a new boundary wall is proposed – that is replacing a beech hedge in the latter location.

A re-aligned access road arrangement is to be provided for the residential property located north of the Copper River and west of the R291 Rosses Point Road junction. Tree planting both in grass areas at the R291 / N15 junction and in planters will be removed, though some opportunity will exist for new tree planting and for re-use of some trees in planters. Likewise a section of the existing part limestone boundary wall at Suncroft Villas is to be setback for sightlines at the entrance to the terrace. In the context of the receiving environment, it is considered that all of these aspects are a relatively minor in nature and as such, construction stage impacts will be slight temporary negative. It is considered that no negative impacts will arise post-construction (*i.e.* at pre or post-establishment assessment stages).

Provision of the appropriate connected footpaths and cycleways will be a positive aspect of the proposed works and these measures are considered to be in-keeping with other more wide-ranging objectives of the planning authority for the development such facilities including of green networks.

10.4.9 Overall Summary of Landscape and Visual Impacts

The proposed development relates to c.670 m long road development upgrade located along an existing road corridor. Despite the short length of road the proposed development will give rise to some significant landscape and visual impacts – most notably associated with construction and relating to widening of the road corridor onto landscape areas at Salmon Point, the HSE Care Centre and at the Kilronan residential property. All of these locations will experience some degree of significant temporary negative impact during construction. Post construction, the significance of the impacts will abate and no significant or medium or long-term impact will arise for most locations. Nevertheless, some moderate to significant longer-term landscape and visual impact will arise locally at Salmon Point, the HSE Property and at the Kilronan residential.

Table10-3: Summary of Landscape and Visual Impacts

Receptor	Construction	Pre-Establishment	Post-Establishment
Salmon Point Amenity Area	Significant	Significant	Slight
Markievicz House / HSE Care Centre	Significant	Significant	Moderate
Coastal Fringe north of Salmon Point	Significant	Moderate	None
Copper River area	Moderate	None	None
Kilronan Property	Significant	Significant	Moderate
Overall Amenity	Slight	None	None / Slight+

10.5 Proposed Mitigation and Avoidance Measures

Mitigation measures for landscape and visual impact are set out separately under construction stage and operation stage.

10.5.1 Mitigation Measures: Construction Stage

The construction stage will be implemented on the basis of an Environmental Operating Plan (EOP) which will be drawn up by the main contractor using the NRA's 'Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan' (EOP). As well as other items, the EOP will incorporate the mitigation measures set out within this chapter.

General mitigation will ensure that the works will have continuous monitoring under the EOP so as to ensure adequate protection of areas outside of the construction works. Specific measures – refer to Figure 10.1 – shall ensure that:

1. Solid temporary site hoarding shall be provided where construction works adjoin particular areas, e.g. HSE Care Centre and Kilronan residential property.

2. In specific areas protective fencing shall be erected at the boundary of proposed works to protect retained landscape, planting, features etc. This includes at Salmon Point Amenity Area; at the HSE care Centre; and at the Kilronan property.
3. Existing features at Salmon Point Amenity Area shall be removed in advance of the works and retained for reinstatement. This includes the plaques, railings, entrance arch, lighting standards and tree planters.
4. Areas and features where no or minimal works are proposed shall be protected during the construction stage. These include: the amenity area at Hughes Bridge (other than provision of an outfall); the wall fronting Markievicz House; the boundary walls of the properties at Barrack Street / N16 Duck Street, and the boundaries of properties west of the R291 Rosses Point Road and opposite Suncroft Villas.
5. The existing bronze sculpture in the wall fronting Markievicz House shall be protected during the works.
6. The existing stone wall and entrance at Kilronan shall be salvaged for re-instatement to match existing in character and style.
7. The limestone wall fronting Suncroft Villas and the R291 Rosses Point Road shall be salvaged and re-used in the new wall located at the setback location.
8. Where possible existing trees shall be retained at the HSE Property, the R291 junction and at the Kilronan Property.
9. Site machinery shall operate within the proposed road development construction area.
10. Storage areas shall be located so as to avoid impacting further on existing residential and other property, woodlands, trees, hedgerows, drainage patterns, or other landscape features.

10.5.2 Mitigation Measures: Operational Stage

Operation stage measures are focused on re-instatement and future maintenance of features and landscapes. Maintenance shall ensure that landscape measures, including seeding and planting establish successfully and that any failures or defects observed within two years of implementation are made good. Specific measures – refer to Figure 10.2 – shall ensure that:

1. The reinstatement works at Salmon Point shall include footpath connections and re-use of an appropriate number of the existing tree planters and trees.
2. The new wall at the HSE Centre shall match the existing retaining wall and shall incorporate the existing Special Olympics plaque in the new construction.
3. A selection of new semi-mature trees of appropriate local species (e.g. oak) shall be planted on the retained grass area immediately north of the location of the existing mature trees which will be lost during construction. The planting shall be discussed and agreed with the property owners / managers in advance of the works.
4. A new planting of hedgerow and shrubs shall be established along the inside of the new boundary wall in agreement with the Kilronan property owner.
5. A line of new evergreen screening shall be established along the new N15 boundary in agreement with the Kilronan property owner.
6. The existing low limestone wall between the existing R291 Rosses Point Road and adjoining coastal amenity area shall be extended north along the full length of the grassland amenity. The wall shall provide for the re-aligned access to the property west of the R291 Rosses Point Road and for pedestrian / cycle access.
7. A selection of new trees of appropriate local species (e.g. oak) shall be replanted at the reconfigured R291 junction to replace those lost by construction works.
8. Proposals will be developed by the contractor to allow for the attenuation pond to develop as an attractive feature of biodiversity, which could at some future stage be incorporated into land uses in the wider area, these proposal shall be agreed with SCC.
9. Locally appropriate planting and seed mixes shall be used in making-good and in reinstatement works.
10. All areas disturbed by construction shall be reinstated insofar as possible to their pre-construction condition at the end of the construction contract.

10.6 Residual Impacts

The proposed development, by means of its very presence, will have a permanent effect and therefore some degree of residual impact on the existing landscape setting. This will be most apparent where the works involve direct impact e.g. at Salmon Point, the HSE Care Centre and the Kilronan property. However, for the most part, the works are located within an existing heavily trafficked road corridor and as such will have little or no residual adverse impact.

In other locations and with mitigation as detailed above, it is considered that residual impact of the proposed development on locations such as the Salmon Point Amenity Area is slight and the HSE Care Centre and the Kilronan property will be moderate and negative in nature.

10.7 Interaction and Cumulative Impacts

Interaction with other environmental aspects, including flora and Fauna and cultural heritage has been considered in the assessment. It is not considered that any significant impacts will arise from interaction of environment aspects with landscape and visual aspects and given the urban / urban edge location, no significant cumulative impacts are expected to arise.

10.8 Difficulties Encountered

No particular difficulties were encountered in the preparation of the landscape and visual assessment.

11. Archaeology, Cultural Heritage and Architectural Heritage

11.1 Introduction

This chapter of the EAR presents the results of the Archaeology and Cultural Heritage, and Architectural Heritage assessments as a result of the construction and operation of the proposed development.

The methodology used in the preparation of this assessment is based on guidance provided in the National Roads Authority's (NRA) 'Guidelines for the Assessment of Archaeological Heritage Impacts on National Road Schemes' (NRA, 2005a), and 'Guidelines for the Assessment of Architectural Heritage Impacts on National Road Schemes' (NRA, 2005b) (the 'NRA Guidelines') respectively.

11.2 Archaeology and Cultural Heritage

11.2.1 Introduction

In its 'Framework and Principles for the Protection of the Archaeological Heritage' (199923), the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs defines archaeology and its importance in the following terms:

- 'Archaeology is the study of past societies through the material remains left by those societies and the evidence of their environment. The archaeological heritage consists of such material remains (whether in the form of sites and monuments or artefacts in the sense of moveable objects) and environmental evidence.'

The Council of Europe, in the Framework Convention on the Value of Cultural Heritage for Society ('Faro', 2005) has defined Cultural Heritage as:

- 'a group of resources inherited from the past which people identify, independently of ownership, as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions. It includes all aspects of the environment resulting from the interaction between people and places through time.'

For the purposes of this assessment, cultural heritage information was used to inform the assessments of importance of sites identified in the archaeological and cultural heritage baseline.

11.2.1.1 Baseline data gathering

In accordance with the guidance provided by the NRA Guidelines (2005a), the study area was defined as extending 50 m from the footprint of the proposed development. For the purposes of this assessment, the footprint of the proposed development was defined as the outline of the earthworks, carriageway and structures.

Baseline information for this area was gathered from the following sources of information:

- Technical reports prepared for the: N4-N15 Sligo Urban Road Improvement Environmental Impact Statement (Ryan Hanley WSP, 2011) and N4 Traffic Improvement Scheme Environmental Appraisal Report - Hughes Bridge Widening (ARUP, 2012). The 2011 Environmental Statement (Ryan Hanley WSP, 2011) included consultation of archival maps held by Trinity College Dublin, the Folklore Commission records held at University College Dublin, and aerial photographs held by the Geological Survey of Ireland. These sources have been used as part of this study;
- The Record of Monuments and Places (RMP) and Sites and Monuments Record (SMR) for information on archaeological sites and excavations;
- The topographical files held at the National Museum of Ireland;
- The Register of Historic Monuments for County Sligo;
- The List of National Monuments in State Care: Ownership and Guardianship (EHLG & NMS, 2009);
- Excavation Bulletins consulted at www.excavations.ie;

[23] Department of Arts, Heritage, Gaeltacht and the Islands

- Sligo and Environs Development Plan (2010-2016) (Sligo County Council (SCC), 2009); Sligo Town Environs Plan 2010-2016; (SCC, 2010);
- Sligo County Development Plan 2011-2017 (SCC, 2011); and
- A site inspection undertaken on 2nd December 2015.

11.2.1.2 Consultation

During the preparation of this report consultation has been undertaken with the National Monuments Service of the Department of Arts, Heritage and the Gaeltacht, The County Sligo Heritage Office, and the Transport Infrastructure Ireland Project Archaeologist. The methodology for this assessment was agreed with the TII Project Archaeologist by email in January and April 2016.

11.2.2 Assessment of Importance

National monuments legislation does not differentiate between archaeological sites on the basis of importance, apart from the special recognition of National Monuments as defined in the National Monuments Act (1930-2004). An assessment of the importance of each archaeological or cultural heritage site within the study area was made on a five-point scale of 'International', 'National', 'Regional', 'Local' and 'Unknown' as set out in Table 11-1, below. These assessments were based on professional judgment and experience guided by the criteria below, as set out in Appendix 2 of the NRA Guidelines (2006a).

Table 11-1: Criteria for the Importance of Archaeological or Cultural heritage sites

Existing Status	The level of protection associated with a monument or complex is an important consideration.
Condition / Preservation	The survival of a monument's archaeological potential both above and below ground is an important consideration and should be assessed in relation to its present condition and surviving features. Well-preserved sites should be highlighted, this assessment can only be based on a field inspection.
Documentation / Historical Significance	The significance of a monument may be enhanced by the existence of records of previous investigations or contemporary documentation supported by written evidence or historic maps. Sites with a definite historical association or an example of a notable event or person should be highlighted.
Group Value	The value of a single monument may be greatly enhanced by its association with related contemporary monuments or with monuments from different periods indicating an extended time presence in any specific area. In some cases it may be preferable to protect the complete group, including associated and adjacent land, rather than to protect isolated monuments within that group.
Rarity	The rarity of some monument types can be a central factor affecting response strategies for development, whatever the condition of the individual feature. It is important to recognise sites that have a limited distribution.
Visibility in the landscape	Monuments that are highly visible in the landscape have a heightened physical presence. The inter-visibility between monuments may also be explored in this category.
Fragility / Vulnerability	It is important to assess the level of threat to archaeological monuments from erosion, natural degradation, agricultural activity, land clearance, neglect, careless treatment or development. The nature of the archaeological evidence cannot always be specified precisely but it may still be possible to document reasons to justify the significance of the feature. This category relates to the probability of monuments producing material of archaeological significance as a result of future investigative work.
Amenity Value	Regard should be taken of the existing and potential amenity value of a monument.

11.2.3 Description of the Existing Environment

From the above sources, a total of two areas of archaeological potential have been identified within the study area. These are listed in Table 11-2 below and shown on Figure 11.1.

Table 11-2: Archaeological or Cultural Baseline Conditions

Site Number	Site Name	Site Type	Designation	Importance
AR1	Garavogue River area of archaeological potential	River	None	Local
AR2	Copper River area of archaeological potential	River	None	Local

11.2.3.1 Baseline conditions

Whilst archaeological sites are known in the wider area, within the study area no known archaeological sites have been identified from the sources above. However, two areas of archaeological potential have been identified. These areas were identified during field survey undertaken as part of the 2011 Environmental Impact Statement for the N4-N15 Sligo Urban Road Improvement (Ryan Hanley WSP, 2011).

AR1 and AR2 comprise areas with the potential to contain archaeological remains due to the topography of the landscape and presence of water. The archaeological potential of AR1 and AR2 is considered to be threefold:

- Estuaries, rivers and wetlands are a recognised source of archaeological finds, from loss at crossing points or the deliberate deposition of artefacts for religious reasons;
- It is possible that typical prehistoric wetland sites such as fish traps or fulachta fiadh, could be present within undeveloped areas; and
- Although AR1 and AR2 have been subjected to extensive subsequent development in the post-medieval and modern periods, it is possible that the predominantly wet and muddy conditions could preserve organic materials and palaeoenvironmental remains from any period.

Review of borehole logs undertaken for the 2011 N4-N15 Sligo Urban Road Improvement indicates that the study area is located in an area of gravelly-clays over limestone (IGSL, 2009). No evidence for alluvium and / or peat immediately in river areas was identified. The evidence identified by the boreholes suggests a low potential for palaeoenvironmental remains to be present, due to the presence of heavier material such as gravel, rather than silts. Examination of historic Ordnance Survey maps indicates that the Copper River was subject to alteration prior to the publication of the 1st edition 6" map in 1837 with the straightening of the watercourse. In consideration of the modern development of these areas, and the evidence provided by borehole logs and historic mapping, the value of these sites has been assessed to be Low.

Since at least the medieval period the landscape has been subdivided into small administrative units known as townlands. The boundaries were described and recorded in the great surveys following the land confiscations of the mid-17th century and were further standardised in the mid-19th century with the work of the Ordnance Survey. Townland boundaries were often laid out along natural features including rivers, streams and high ground, or along manmade features such as roads and walls.

The study area extends across three townlands. The boundaries of townlands were originally defined by the watercourses of the Copper River and the River Garavogue, as shown on the 1st edition 6" Ordnance Survey map of 1837. No evidence of manmade townland boundaries has been identified within the study area. The townland boundaries shown on the 1st edition 6" Ordnance Survey map have since been rationalised and redrawn to follow slightly different alignments. Townland names in the study area are derived from a number of sources and provide valuable information about natural and man-made features, or important local personal names. Information on these townlands from Joyce (1870) is presented below in Table 11.3

Table 11-3: Townlands within the Study Area

Townland	Parish	Barony	Meaning
Cartron	Calry	Carbury	A 'quarter' of land (an Anglo-Norman measure of anything between 25 and 65 hectares)
Rathedmond	St John's	Carbury	Derived from 'rath' meaning a circular earthwork fort, followed by a personal name
Rathquarter	Unknown	Carbury	This name derives from rath, meaning a circular earthwork fort, and the Anglo-norman term for a 'quarter' of land

A zone of notification proposed for inclusion on the next edition of the Record of Monuments and Places extends slightly into the study area. This proposed zone includes a small part of the study area, covering the area to the east of Hughes Bridge. This area currently has no legal status but indicates an area of archaeological sensitivity.

11.2.4 Appraisal method used for assessment of impacts

11.2.4.1 Magnitude and significance of impact

The type of impact predicted to result from the proposed development is considered in terms of being direct or indirect, as described in Table 11-4 below.

Table 11-4: Types of Impact

Direct Impact	Impacts arising as a consequence of the development, including physical impacts upon a site or its setting.
Indirect Impact	Impacts which are caused by the interaction of effects or by associated off-site developments.

(source: NRA, 2005a)

Direct impacts occur where construction would cause direct physical damage to the archaeological or cultural heritage site or feature or where the archaeological or cultural heritage site could be affected by a range of factors, including: visual intrusion on its setting, noise, vibration, changes in groundwater levels or chemistry or air pollution.

Archaeological sites are considered to have a 'setting', which can contribute significantly to our understanding of them. Setting may be defined as 'the surroundings in which a place is experienced, while embracing an understanding of the perceptible evidence of the past in the present landscape' (Highways Agency, 2007). Impacts upon setting can therefore affect the overall archaeological and historic interest of a site.

The quality of impacts was assessed against the following criteria in Table 11-5, based on those set out in Appendix 4 of the NRA Guidelines (NRA, 2005a):

Table 11-5: Quality of Impact s

Negative Impact	A change that will detract from or permanently remove an archaeological monument or cultural heritage site from the landscape.
Neutral Impact	A change that does not affect an archaeological monument or cultural heritage site.
Positive Impact	A change that improves or enhances the setting of an archaeological monument or cultural heritage site.

The magnitude of impacts has been assessed on a scale of 'Very High', 'High', 'Medium', 'Low' and 'No change' as shown in Table 11-6 below.

Table 11-6: Magnitude of Impacts

Very High	Removal or complete severance of important parts of a site or feature such that its archaeological or cultural heritage importance would be lost or very substantially diminished.
High	Removal or loss of a majority of a site or feature or severance of important parts of a site or feature such that it's archaeological or cultural heritage importance would be lost or significantly diminished.
Medium	Partial removal or loss of a site or feature or major effects on its setting, or major severance, increases in noise, vibration disturbance or loss of amenity potential such that its archaeological or cultural heritage importance would be diminished to a moderate degree.
Low	Small-scale removal or negative effects on the setting of a site or feature, or minor severance, increases in noise, vibration, disturbance or loss of amenity potential such that its archaeological or cultural heritage importance would be diminished but to a minor or negligible degree.
No Change	No change.

The significance of impact has been assessed on a five-point scale of 'Profound', 'Significant', 'Moderate', 'Slight' and 'Imperceptible' as shown in Table 11-7 below.

Table 11-7: Terminology for the Significance of Impacts

Profound	Applies where mitigation would be unlikely to remove adverse effects. Reserved for adverse, negative effects only. These effects arise where an archaeological site is completely and irreversibly destroyed by a proposed development.
Significant	An impact which, by its magnitude, duration or intensity, alters an important aspect of the environment. An impact like this would be where part of a site would be permanently impacted upon, leading to a loss of character, integrity and data about the archaeological feature / site
Moderate	A moderate direct impact arises where a change to the site is proposed which though noticeable, is not such that the archaeological integrity of the site is compromised and which is reversible. This arises where an archaeological feature can be incorporated into a modern day development without damage and that all procedures used to facilitate this are reversible.
Slight	An impact which causes changes in the character of the environment which are not significant or profound and do not directly impact or affect an archaeological feature or monument.
Imperceptible	An impact capable of measurement but without noticeable consequences.

(source: Appendix 4 of the NRA Guidelines 2005a)

11.2.4.2 Assessment of significance of impacts

The significance of impacts was assessed using professional judgement guided by the matrix at Table 11-8 below.

Table 11-8: S Significance of Impacts

Importance of Site	**Magnitude of Impact**				
	No Change	**Low**	**Medium**	**High**	**Very High**
International	Neutral	Significant	Significant / Profound	Profound	Profound
National	Neutral	Moderate / Significant	Significant	Significant / Profound	Profound
Regional	Neutral	Imperceptible / Slight	Slight / moderate	Moderate / Significant	Significant / Profound
Local	Neutral	Imperceptible	Imperceptible / Slight	Slight / Moderate	Moderate / Significant

11.2.5 Predicted impacts of the proposed development

11.2.5.1 "Do Nothing Scenario"

The “Do Nothing” scenario is the outcome that would be achieved if the proposed development was not constructed. The baseline archaeology and cultural heritage sites would remain in their current form and condition.

11.2.5.2 Construction

Impacts resulting from the construction of the proposed development have been identified for two archaeological and cultural heritage sites. These are summarised in Table 11-9. Unless otherwise stated, all impacts are assessed to be negative and permanent.

Table 11-9: Predicted construction impacts on archaeological and cultural heritage sites

Site Number	Site Name	Importance	Magnitude of Construction Impact	Significance of Construction Impact
AR1	Garavogue River area of archaeological potential	Local	Low	Imperceptible
AR2	Copper River area of archaeological potential	Local	Medium	Imperceptible

Construction of the proposed development would result in direct impacts on the areas of archaeological potential associated with the Garavogue River (AR1) and the Copper River (AR2). The construction of a surface water drainage outfall to the south of the Markievicz Road junction within AR1 and the replacement of the existing culverts would result in the removal of any archaeological remains or palaeoenvironmental evidence that may be present within the footprint of these works. All other construction within Site AR1 would be located within the existing road or modern bridge. In consideration of the small area affected within AR1, the magnitude of this impact has been assessed to be Low. In consideration of the larger area affected within AR2, the magnitude of this impact has been assessed to be Medium. The significance of this impact has been assessed to be Imperceptible for both assets.

The outfall to the south west of Markievicz Road would be located within the proposed Zone of Notification proposed for inclusion in the next issue of the Record of Monuments and Places.

11.2.5.3 Operational

The removal of archaeological remains has been assessed to be a construction phase impact. As the importance of these sites is based on any physical remains that may be present, setting does not make a significant contribution to their value. No impacts are therefore predicted during the operation of the proposed development.

11.2.5.4 Proposed Mitigation and Avoidance Measures

Where preservation in situ is not feasible, preservation by record is recommended to mitigate identified impacts on archaeological sites. This methodology is in accordance with the principles and recommendations outlined in the 'Framework and Principles for the Protection of the Archaeological Heritage' (DAHG 1999). Preservation by record consists of fully recorded investigations in the field, followed by analyses, reporting and publication.

Archaeological monitoring would also be undertaken on the areas of archaeological potential at the Garavogue River and Copper River (AR1 and AR2), enabling the recording of any archaeological remains identified during construction works.

Proposed mitigation measures will also comply with the National Monuments Acts (1930-2004) and the Code of Practice (2000) agreed between the former National Roads Authority and the former Minister for Arts, Heritage, Gaeltacht and the Islands. Following approval of the proposed development, any mitigation measures will be carried out under Ministerial Direction, as defined in Section 14A(1) of the National Monuments (Amendment) Act 2004.

All archaeological works require a stage of post fieldwork assessment, analysis and reporting. All archaeological reporting shall have regard to the 'Guidelines for Authors of Reports on Archaeological Excavations' (NMS, 2006).

11.2.5.5 Residual Impacts

Residual impacts predicted as a result of construction of the proposed development are summarised in Table 11-10 below.

Table 11-10: Residual construction impacts on Archaeological and cultural sites

Site No.	Site Name	Importance	Unmitigated significance of construction impact	Mitigation Measure	Residual magnitude of construction impact	Residual significance of construction impact
AR1	Garavogue River area of archaeological potential	Local	Imperceptible	Watching brief	No Change	Neutral
AR2	Copper River area of archaeological potential	Local	Imperceptible	Watching brief	No Change	Neutral

11.2.5.6 Cumulative Impacts and Impact Interrelations

The NRA publication 'Environmental Impact Assessment of National Road Schemes – A Practical Guide' (2008) defines cumulative effects as impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions, together with the proposed development .

A review of the online planning systems for County Sligo has not identified any pending or granted planning applications for major developments which have the potential to increase the cumulative impact of the proposed development. The cumulative impact of the proposed development on archaeology and cultural heritage is therefore assessed to be Neutral.

11.2.6 Assessment Conclusions

A total of two archaeological and cultural heritage sites were identified within the study area. After mitigation, Neutral impacts are predicted on two Areas of Archaeological Potential (AR1 and AR2).

11.3 Architectural Heritage

11.3.1 Introduction

This section presents the results of the architectural heritage assessment for the proposed development.

The methodology used in the preparation of this assessment is based on guidance provided in the NRA 'Guidelines for the Assessment of Architectural Heritage Impacts on National Road Schemes' (NRA, 2005b).

11.3.1.1 Consultation

Consultation was carried out as detailed in Chapter 1. During the preparation of this assessment consultation via the DAU was undertaken with the National Monuments Service of the Department of Arts, Heritage and the Gaeltacht. The DAU advised that they had no comment to make at this time. Consultation was also carried out with the County Sligo Heritage Office, and the Transport Infrastructure Ireland Project Archaeologist. The methodology for this assessment was agreed with the TII Project Archaeologist in January and April 2016.

11.3.1.2 Baseline data gathering

The study area was defined as extending 50 m from the footprint of the proposed development. For the purposes of this assessment, the footprint of the proposed development was defined as the outline of the earthworks, carriageway and structures.

Baseline information for this area was gathered from the following sources of information:

- Technical reports prepared during the assessment of the N4-N15 Sligo Urban Road Improvement Environmental Impact Statement (Ryan Hanley WSP, 2011) and N4 Traffic Improvement Scheme Environmental Appraisal Report - Hughes Bridge Widening (ARUP, 2012);

- The National Inventory of Architectural Heritage (NIAH) for County Sligo, for historic building and gardens information;
- The Register of Historic Monuments for County Sligo;
- The List of National Monuments in State Care: Ownership and Guardianship (EHLG & NMS, 2009);
- Sligo and Environs Development Plan (2010-2016) (Sligo County Council (SCC), 2009);
- Sligo Town Environs Plan 2010-2016, including the Record of Protected Structures (SCC, 2010);
- Sligo County Development Plan 2011-2017 (SCC, 2011); and
- A site inspection undertaken on 2nd December 2015.

No potential for impacts on the setting of designated architectural heritage sites outside the study area was identified.

11.3.2 Assessment of Importance

In accordance with the requirements of the NRA Guidelines, an assessment of the importance of architectural heritage sites was undertaken on a four point scale of 'International', 'National', 'Regional', and 'Local' (NRA, 2005b). Assessment was informed by the criteria outlined in the Planning and Development Act 2000 for the designation of Protected Structures:

- Architectural;
- Historical;
- Archaeological;
- Artistic;
- Cultural;
- Scientific;
- Technical; and
- Social interest.

The NIAH Handbook (DAHG, 2011) provides further information on the definition of National, Regional and Local importance, as summarised in Table 11-11 below.

Table 11-11: Criteria for the assessment of importance for Architectural Heritage Sites

Importance	Criteria
International	Structures or sites of sufficient architectural heritage importance to be considered in an international context. These are exceptional structures that can be compared to and contrasted with the finest architectural heritage in other countries.
National	Structures or sites that make a significant contribution to the architectural heritage of Ireland. These are structures and sites that are considered to be of great architectural heritage significance in an Irish context.
Regional	Structures or sites that make a significant contribution to the architectural heritage within their region or area. They also stand in comparison with similar structures or sites in other regions or areas within Ireland. Increasingly, structures that need to be protected include structures or sites that make a significant contribution to the architectural heritage within their own locality. Examples of these would include modest terraces and timber shopfronts.
Local	Structures or sites of some vintage that make a contribution to the architectural heritage but may not merit being placed in the Record of Protected Structures separately. Such structures may have lost much of their original fabric.

(based on DAHG 2011a, 22)

11.3.3 Description of the existing environment

From the above sources, a total of six Architectural Heritage sites were identified within the study area. These sites are presented in Table 11-12 below and shown on Figure 11.2.

Table 11-12: Architectural Heritage baseline conditions

Site Number	Site Name	Site type	Designation	Importance
AH1	Yard behind Custom House	Walls	None	Local
AH2	Sligo Harbour Wall	Quay	Protected Structure	Regional
AH3	Markievicz House	House	Protected Structure	Regional
AH4	Ard-Na-Greine	House	None	Local
AH5	Copper River culvert	Bridge	None	Local
AH6	Sea wall	Sea wall	None	Local

11.3.3.1 Architectural Heritage sites of Regional value

Sligo Harbour Wall (AH2) was constructed in the 1830's and improved in the 1870's. On the south side of the river, this harbour wall extended the earlier C-shaped harbour located at the end of Quay Street (Protected structure number 150), and is labelled as the New Quay on the 1st edition 6" Ordnance Survey map of 1837, The harbour wall is constructed of coursed limestone blocks with large coping stones. Historic cobbled and paved surfaces and mushroom-shaped mooring posts are retained to the rear of the wall. The extent of the Protected Structure includes other stretches of the harbour wall along the Garavogue River, including a stretch on the north riverbank. The harbour wall provides evidence of Sligo's history as a port, and is particularly valuable following the loss of many associated port structures. It is also of group value with the adjacent Old Harbour. Designated as a Protected Structure, this site has been assessed to be of Regional importance.

Markievicz House (AH3) is a large house of mid-19th century date, prominently sited on a small hill overlooking the Garavogue River and the site of the proposed development. The house is designated as a Protected Structure. It is of three bays and two storeys over basement, with a projecting flat-roofed porch set in the centre of the elevation. It is rendered and brightly painted with simple quoins running to either side of the elevation, and moulded architraves to the windows. The building was employed as a school and then as a hospital throughout the 20th century, resulting in considerable extension of the original building and much internal alteration. Despite this development, the large garden associated with the building is largely retained, defined by a stone boundary wall to the south and west. This wall results from rebuilding following realignment of Victoria and Markievicz Road during the 20th century, and has been constructed in a style sympathetic to the historic building. Now surrounded by modern road and urban development, Markievicz House continues to enjoy long views across the River Garavogue and to dominate views north across the river. In consideration of its architectural interest and its designation as a Protected Structure, Markievicz House has been assessed to be of Regional importance.

11.3.3.2 Architectural Heritage site of Local value

Site AH1 comprises substantial stone walls defining a former yard to the south of Custom House Quay. Constructed of mortared rubble, the wall includes three pairs of substantial square gatepiers fronting onto Custom's House Quay. The yard is depicted on the 1st edition 6" Ordnance Survey map of 1837 and is likely to have formed part of the complex associated with the Custom's House. In consideration of its interest as a structure associated with Sligo's past as a port, the importance of this site has been assessed to be Local.

Site AH4 comprises Ard-Na-Greine, a large two-storey house dating from the 1920's, sited within Cartron townland. The principal elevation is oriented to the south and comprised by two gables flanking a central recessed bay. The house is set within a large garden, well screened by mature vegetation. In consideration of

its interest as an example of a substantial 1920's villa, the importance of this asset has been assessed to be Local.

A crossing carrying Carton Hill (now the R291) over the Copper River (AH5) is depicted on Nimmo's plan of Sligo Harbour dating from 1821 and the 1st edition 6" Ordnance Survey map of 1837. A stone-built culvert survives in this location today and continues to carry the modern road over the Copper River. The structure comprises a buttressed wall to the west, the only visible above-ground element of the structure. A CCTV survey undertaken for this proposed development has confirmed the presence of two stone culverts carrying the Copper River below the modern road. The culverts have been altered for the widening of the road with the removal of the eastern parapet and construction of concrete and steel culverts directly to the east of the structure. In consideration of its interest as evidence of historic roads infrastructure and its previous alteration, AH5 has been assessed to be of Local importance.

A sea wall (Site AH6) depicted on the 1st edition 6" Ordnance Survey map of 1837 continues to form the boundary with Cartron Bay to the west of the R291, and comprises a wall constructed of large rectangular stone blocks at ground level, with a battered slope of constructed of smaller blocks below. The sea wall has been assessed to be of Local importance, due to its interest as evidence of coastal management in the 19th century.

11.3.4 Appraisal Method used for Assessment of Impacts

11.3.4.1 Description of potential impacts

Potential impacts of the proposed development on architectural heritage were considered in terms of their quality, duration, and type.

The quality of impact was assessed based on the definitions provided in the EPA guidelines: (EPA, 2002), as listed in Table 11-13.

Table 11-13: Quality of Impacts

Negative Impact	A change which reduces the quality of the environment.
Neutral Impact	A change which does not affect the quality of the environment.
Positive Impact	A change which improves the quality of the environment.

(source: EPA, 2002)

The requirement to define the duration of an impact is defined in the published EPA Guidelines (2002, 25). These criteria are laid out in Table 11-14 (EPA 2002, 139) below.

Table 11-14: Duration of Impacts

Temporary	Impact lasting for one year or less
Short-Term	Impact lasting one to seven years
Medium-Term	Impact lasting seven to fifteen years
Long-Term	Impact lasting fifteen to sixty years
Permanent	Impact lasting over sixty years

(source: EPA, 2002)

The type of impact predicted to result from the proposed development is considered in terms of being direct or indirect, as described in Table 11-15 (NRA, 2005b).

Table 11-15: Type of Impacts

Direct Impacts	Where a feature or site of architectural heritage merit is physically located in whole or in part within the footprint of the road alignment
Indirect Impacts	Where a feature or site of architectural heritage merit or its setting is located in close proximity to the footprint of the proposed road.

(source: NRA, 2005b)

11.3.4.2 Magnitude and significance of impacts

The magnitude of impact was assessed on a five point scale of 'Very High', 'High', 'Medium', 'Low' and 'Neutral'. Assessment was based on consideration of the nature of the impact (for example demolition, visual intrusion or enhancement of amenity) as well as quality, duration and type of impact.

The significance of impact was then assessed using professional judgement, guided by the matrix presented inTable 11-16. Five levels of significance were defined which apply equally to positive and negative impacts (NRA, 2005b):

Table 11-16: Significance of Impact Matrix

Importance	**Magnitude**				
	Very High	**High**	**Medium**	**Low**	**Neutral**
International	Profound	Profound	Significant	Significant	No Impact
National	Profound	Significant	Significant	Moderate	No Impact
Regional	Significant	Significant	Moderate	Slight	No Impact
Local	Significant	Moderate	Slight	Imperceptible	No Impact

(source: NRA, 2005b)

Definitions of the levels of significance for architectural heritage impacts are described in Table 11-17(NRA, 2005b).

Table 11-17: Definition of levels of significance of impact Architectural Heritage sites

Impacts of Negative Quality	**Profound** An impact that obliterates the architectural heritage of a structure or feature of national or international importance. These effects arise where an architectural structure or feature is completely and irreversibly destroyed by the proposed development. Mitigation is unlikely to remove negative effects.
	Significant An impact that, by its, magnitude, duration or intensity alters the character and / or setting of the architectural heritage. These effects arise where an aspect or aspects of the architectural heritage is / are permanently impacted upon leading to a loss of character and integrity in the architectural structure or feature. Appropriate mitigation is likely to reduce the impact.
	Moderate An impact that results in a change to the architectural heritage which, although noticeable, is not such that alters the integrity of the heritage. The change is likely to be consistent with existing and emerging trends. Impacts are probably reversible and may be of relatively short duration. Appropriate mitigation is very likely to reduce the impact.
	Slight An impact that causes some minor change in the character of architectural heritage of local or regional importance without affecting its integrity or sensitivities. Although noticeable, the effects do not directly impact on the architectural structure or feature. Impacts are reversible and of relatively short duration. Appropriate mitigation will reduce the impact.
	Imperceptible An impact on architectural heritage of local importance that is capable of measurement but without noticeable consequences.
Impacts of Positive Quality	**Significant** A beneficial effect that permanently enhances or restores the character and / or setting of the architectural heritage in a clearly noticeable manner.
	Moderate A beneficial effect that results in partial or temporary enhancement of the character and / or setting of the architectural heritage and which is noticeable and consistent with existing and emerging trends.
	Slight A beneficial effect that causes some minor or temporary enhancement of the character of architectural heritage of local or regional importance which, although positive, is unlikely to be readily noticeable.
	Imperceptible A beneficial effect on architectural heritage of local importance that is capable of measurement but without noticeable consequences.

(source: NRA, 2005b)

11.3.5 Predicted impacts of the proposed development

11.3.5.1 "Do Nothing scenario"

The "do nothing" scenario is the outcome that would be achieved if the proposed development was not constructed. The baseline architectural heritage sites would remain in their current form and condition.

11.3.5.2 Construction

Markievicz House (AH3) is a Protected Structure and has been assessed to be of Regional importance. To allow widening of the carriageway, approximately 150 m of the rebuilt boundary wall associated with Markievicz House would be removed along its frontage with Victoria Road. This would comprise approximately 65 m of the full height boundary wall, and approximately 85m of the lower wall with railing, located to the north. Temporary intrusion on the building's setting would also result from construction activities. Whilst the boundary wall is of modern construction, it is of sympathetic construction and forms a clear boundary to the grounds of Markievicz House, positively contributing to the setting of the Protected Structure. The magnitude of this permanent impact has therefore been assessed to be Low and the significance of impact has been assessed to be Slight.

Construction of the proposed development would result in the replacement of the modern culvert directly to the east of the River Copper culvert (AH5), resulting in temporary intrusion on the setting of the structure and the potential for accidental damage during construction. The historic culverts and west elevation would be retained in their current form. The magnitude of this impact has been assessed to be Low and the significance of impact has been assessed to be Imperceptible.

No impact is predicted on the remaining four assets. Whilst construction works would be visible from the yard behind the Customs House (AH1), Sligo Harbour Wall (AH2) and the sea wall (Asset AH6), this would not affect our understanding of these sites. The garden setting of Ard-Na-Greine (AH4) would be maintained in its current condition and views of the construction of the proposed development would be screened by mature vegetation. No impact is therefore predicted on these four assets.

11.3.5.3 Operation

No impact on architectural heritage is predicted during operation of the proposed development.

The current road forms a prominent element in the setting of Markievicz House (AH). Whilst the proposed development would result in widening of the carriageway, alteration of Markievicz Road junction and change to signage, this would not materially alter the character of the building's setting, or increase intrusion from the road. The prominence of Markievicz House, views from the building towards the River Garavogue, and its relationship to the surrounding townscape would be maintained. The remaining five sites (Sites AH1, AH2, AH4, AH5 and AH6 would be maintained in their current form and setting.

11.3.5.4 Proposed mitigation and avoidance measures

Measures to avoid or reduce potential impacts on architectural heritage sites have been considered and incorporated into the detailed design of the proposed development. The following additional mitigation measures are proposed for architectural heritage:

- A boundary wall to Markievicz House (AH3) would be reinstated along the N4 (Victoria Road). This would be constructed as a concrete core retaining wall faced with stonework. The height, facing and capping would match the appearance of the existing wall.
- Protection of the River Copper culvert (AH5) during construction to prevent accidental damage to the historic structure.
- Historic Building recording of the River Copper culvert (AH5) comprising a metal detection and photographic survey in advance of construction and during construction works. This would document the form and construction of the culvert, including the twin culverts normally concealed below the road surface.

11.3.5.5 Residual impacts

Residual impacts predicted during the construction of the proposed development are summarised in Table 11-18. A residual impact of No change is predicted on two sites during construction. No impact is predicted on the remaining four sites.

No residual impacts on architectural heritage are predicted during operation of the proposed development.

Table 11-18: Predicted Residual construction impacts on Architectural Heritage Sites

Site Number	Site Name	Importance	Unmitigated significance of construction impact	Mitigation Measure	Residual magnitude of construction impact	Residual significance of construction impact
AH3	Markievicz House	Regional	Slight	Rebuilding of boundary wall	Neutral	No change
AH5	River Copper Culvert	Local	Imperceptible	Protection during construction. Historic Building recording in advance of and during removal.	Neutral	No change

11.3.5.6 Cumulative Impacts and Impact Interrelations

The NRA publication 'Environmental Impact Assessment of National Road Schemes – A Practical Guide' (2008, 52) defines cumulative effects as impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions, together with the proposed development .

A review of the online planning systems for County Sligo has not identified any pending or granted planning applications for major developments which have the potential to increase the cumulative impact of the proposed development. The cumulative impact of the proposed development on architectural heritage is therefore assessed to be Neutral.

11.3.6 Assessment Conclusions

A total of six architectural heritage sites were identified within the study area.

During construction, potential impacts on two sites were identified. After mitigation, No impact is predicted on these two sites (AH3 and AH6).

No residual impacts are predicted during operation.

11.5 References

Cartographic Sources

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12. Waste Management

12.1 Introduction

This chapter of the EAR considers and assesses the anticipated types of waste and the waste impacts associated with both the construction and operation of the proposed development.

12.2 Description of the Existing Environment

12.2.1 The Study Area

The proposed development is adjacent to the Garvogue River / Estuary and crosses over the Copper River, a tributary of the Garvogue. It borders the Cummeen Strand / Drumcliff Bay SAC / pNHA (Site Code 000627) and the Cummeen Strand SPA (Site Code 004035). The proximity to water courses and protected areas means that good waste management practices are particularly required in order to prevent pollution to those waters, particularly during the construction phase of the development.

12.2.2 Plans and Policies

The Connacht Ulster Waste Management Plan 2015-2021, compiled by Mayo County Council on behalf of all local authorities in the Connacht and Ulster Region, shows that the amount of Construction and Demolition (C&D) waste collected in the entire region increased in 2012 following a year on year decrease from 2007 (the peak) to 2011, during the economic downturn. While the plan does not contain any policies or objectives specific to C&D waste, it does contain several policies about generally improving waste management; for example Policy A3 sets out an objective to “Contribute to the improvement of management performance across all waste streams through the implementation of policy actions and monitor progress towards national targets.”

The Sligo County Development Plan 2011-2017 states as Policy P-WM-1 that Sligo County Council will “Promote reduction, recycling, reuse and proper management of all waste through practices which limit environmental pollution.” More specifically on construction and demolition waste Policy P-WM-4 states that Sligo County Council will “Promote measures to reduce the production of waste and encourage the recycling of construction and demolition waste and the reuse of aggregates and other materials in future construction projects.”

12.2.3 Baseline

Typical wastes associated with existing roads are primarily litter and waste generated from the maintenance of drainage systems. The waste generated by the existing section of N4-N15 within the study area would not be considered a significant quantity based on the relatively short length of road (670 m) and the existing drainage system within the study area.

12.3 Appraisal Method used for Assessment of Impacts

12.3.1 Approach and methods

The assessment of the potential impact of the proposed development on the waste management environment has been undertaken in accordance with the general requirements of the “Guidelines on the Information to be contained in Environmental Impact Statement”, (EPA, 2002) and the criteria contained in the “NRA Environmental Impact Assessment of National Road Schemes-A Practical Guide”, (NRA, 2008). The characteristics of an impact which will be defined relate to the quality, significance and duration of the impact. The definition of these impacts is provided in the below tables.

Table 12-1: Quality of Impacts

Type	Description
Positive Impact	A change which improves the quality of the environment (for example by increasing species diversity; or improving the reproductive capacity of an ecosystem; or improving amenities).
Neutral Impact	A change which does not affect the quality of the environment.
Negative Impact	A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem, or damaging health or property or by causing nuisance).

Table 12-2: Significance of Impacts

Type	Description
Imperceptible Impact	An impact capable of measurement but without noticeable consequences.
Slight Impact	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Impact	An impact that alters the character of the environment that is consistent with existing and emerging trends.
Significant Impact	An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Profound Impact	An impact which obliterates sensitive characteristics.

Table 12-3: Duration of Impacts

Type	Description
Temporary Impact	Impact lasting for one year or less
Short-term Impact	Impact lasting one to seven years
Medium-term Impact	Impact lasting seven to fifteen years
Long-term Impact	Impact lasting fifteen to sixty years
Permanent Impact	Impact lasting over sixty years

12.4 Predicted Impacts of the Proposed Development

12.4.1 Do Nothing Scenario

In the event that the proposed development is not progressed, it is assumed that the existing N4-N15 will continue to operate and function as it does at present. The predicted impact of the Do Nothing scenario is therefore assessed as Neutral with an Imperceptible significance and a Short to Medium-term duration, assuming that something will likely need to be done to upgrade the road at some point in the future.

12.4.2 Construction Phase Impacts

In the absence of mitigation, all potential construction phase impacts are considered Negative.

12.4.2.1 Excavated Materials / Demolished Structures

The proposed development will result in approximately 6,200 m^3 of material being excavated as part of the site clearance works. It is likely that this material will be unacceptable for reuse in the development, therefore it is anticipated that all of this material will be disposed of off-site. There will also be approximately 850 m^3 of waste material generated through the demolition of the existing road or structures, including structural material and surrounding backfill, etc. The impact significance of excavated material is therefore assessed as Moderate as some of the material, e.g. material from the existing road structure, will potentially be contaminated and if improperly stored and managed will have the potential to pollute the nearby water courses. The impact quality is assessed as Negative and the impact duration as Short-Term.

12.4.2.2 Pile Arisings

Pile bores may be required for the Copper River bridge structure. Soil arisings from the drilling will be generated from these pile bores should they be required. The majority of the excavated material is anticipated to be soils, but the pile arisings may also contain sands and gravels.

The pile arisings could potentially be contaminated with cement and without management of this waste stream on site, the impact significance of pile arisings is therefore assessed as Moderate due to the potential to cause pollution of the Copper River and surrounding environment. The impact quality is assessed as Negative and the impact duration as Short-Term.

12.4.2.3 Surplus Material

Surplus material and waste may occur where material supply exceeds material demand. While some surplus materials may have re-use potential, other materials may be considered as waste and fall under relevant regulatory controls. Surplus materials and wastes could arise from excavations of materials which cannot be reused in the proposed development. Materials brought to site but not fully utilised for their original purpose can result in waste such as damages, off cuts and surplus products.

For surplus materials and waste, the potential environmental effects would primarily be associated with the production, movement and transport, processing and disposal of the materials on and off site and, if required, the disposal of wastes at licenced / permitted facilities. On this basis, the impact significance of surplus material is assessed as Slight. The impact quality is assessed as Negative and the impact duration as Short-Term.

12.4.2.4 Waste Management

Poor practice when it comes to the storage, handling, transportation or disposal of waste materials during construction could have the potential to cause pollution of the air, soil, groundwater and / or surface waters. Such poor practices could include locating unmanaged stockpiles of wastes close to waters / drainage, improper storage of chemicals, or improper segregation of wastes on site.

On this basis, without implementation of waste management plans on site, the impact significance is assessed as Moderate due to the potential to cause pollution of the surrounding environment. The impact quality is assessed as Negative and the impact duration as Short-Term.

12.4.2.5 Made Ground / Land Contamination

Two potential land contamination sources have been identified within the study area, namely the made ground across the study area, and a nearby disused quarry (refer to Chapter 7). The nature of the proposed development, being a road upgrade scheme within an urban area, much of the material excavated will be made ground. The disturbance or storage of made ground during construction can lead to the release of chemical pollutants into the air, ground or water through remobilisation of contaminants.

Should previously unidentified contamination be found during the construction phase, the proposed management / mitigation measures in Section 12.5.1.5 will be applied.

Due to the potential of remobilised unidentified contaminants to pollute the environment, the impact significance of made ground is therefore assessed as Moderate. The impact quality is assessed as Negative and the impact duration as Short-Term.

12.4.3 Operational Phase Impacts

The main potential impacts from the operational phase of the proposed development will arise from attenuation / treatment pond maintenance, verge cleaning, green waste from landscape maintenance and wastes generated through littering.

The predicted characteristics of the impacts resulting from the operation of the road are Imperceptible due to the size of the proposed development, the low volume of maintenance wastes and the high proportion of such being green, biodegradable wastes.

12.5 Proposed Mitigation and Avoidance Measures

12.5.1 Construction Phase

During the construction phase of the proposed development, waste will be managed in accordance with the waste hierarchy in so far as is possible. As per the NRA waste management guidelines (NRA, 2008), the management of raw materials and wastes must prioritise management options in the following order:

- Waste prevention (including waste minimisation);
- Waste re-use;
- Waste recycling; and
- Secure ultimate disposal for materials that cannot be subject to the other options.

In the case of all of the following predicted waste sources, disposal off-site will be utilised only where all other options are unsuitable.

12.5.1.1 Excavated Materials / Demolished Structures

It is anticipated that none of the excavated material will be acceptable for reuse in road embankments and landscaping. During construction any excavated materials will be segregated where possible and stored in designated storage area(s) outside of any exclusion zones around water courses. Any stockpiling which is carried out will be managed to ensure that material is stable and not piled too high. Where the waste generated is not reusable, samples will be taken and waste acceptance criteria laboratory testing will be undertaken on the excavated material. The results of the laboratory testing will be used to classify the waste as Inert, Non-Hazardous or Hazardous. Licenced waste facilities will be contacted for their acceptance criteria requirements, and the excavated waste from the proposed development compared with these, and sent to the appropriately licenced waste facilities without undue delay.

Where practicable, the closest suitable facilities to the proposed development will be selected to reduce impacts associated with vehicle movements such as air emissions. There are a number of Permitted Waste Facilities which accept C&D wastes in County Sligo, three of which are located within approximately 12 km south of Sligo Town, near Ballysadare. There is a fourth approximately 40 km to the south near Tubbercurry. There are no facilities in County Sligo which accept hazardous C&D wastes. The nearest is in Moneenbradagh, outside Castlebar in County Mayo. This is approximately 40 km to the southwest.

12.5.1.2 Pile Arisings

The Contractor will be contractually bound temporarily store, handle, and transport any pile arisings in accordance with best practice guidelines. This will include, but is not limited to the following:

- Environmental Good Practice on Site, (Construction Industry Research and Information Association) CIRIA, C715, 2015 guidelines;
- Construction code of practice for the sustainable use of soils on construction sites (DEFRA) 2009; and

- BS 6031:2009 Code of Practice for Earthworks (incorporating corrigendum No. 1).

Arisings will only be stored in designated storage area(s) outside of any exclusion zones around water courses. Due to the likelihood of cement contamination of the arisings, they will be sampled, tested and disposed of without undue delay, to a licensed waste management facility, as discussed in 12.5.1.1 above.

12.5.1.3 Surplus Materials

Any surplus material generated by excavation, which cannot be re-used elsewhere for landscaping or as fill for road embankments, will be sampled, tested and disposed of to a licensed waste management facility, as per 12.5.1.1 above.

12.5.1.4 Waste Management

The contractor responsible for constructing the works will ensure that any facility to which waste is brought is licensed / permitted in compliance with Waste Management Legislation and will obtain the appropriate certification of disposal / destruction of waste.

An Environmental Operating Plan (EOP), in accordance with the Guidelines for the Creation and Maintenance of an Environmental Operating Plan (National Roads Authority, 2007) will be produced, implemented and maintained by the contractor as a system of documenting compliance with environmental commitments and requirements during the construction of the proposed development. The key elements of such a plan will include:

- Appointment of an Environmental Manager by the contractor;
- Incorporation of environmental commitments and requirements;
- Outlining methods by which construction work will be managed to meet these environmental commitments and requirements;
- Identification of roles and responsibilities of the contractor's staff having regard to the contractor's organisational structure;
- Incorporation of procedures for communicating with the public and communicating within the contractor's organisation;
- Incorporation of procedures for environmental awareness training;
- Incorporation of monitoring procedures and responses to the results of monitoring, where contractually required; and
- Provision of a system of audit and review with regards to the effectiveness of the plan.

As part of the EOP, the contractor will prepare a Project Construction and Demolition Plan for the provision of waste management during the construction phase of the proposed development. The plan will take into account the following guidance document on the minimisation and management of construction and demolition waste:

- Guidelines for the Management of Waste from National Road Construction Projects, NRA 2008;
- Best Practice Guidelines on the preparation of Waste Management Plans of Construction and Demolition Projects, Department of the Environment, Heritage and Local Government, July 2006; and
- CIRIA document 133 Waste Minimisation in Construction.

12.5.1.5 Made Ground / Land Contamination

There is a possibility of encountering potential contamination at the site during construction due to the fact that existing made ground will be disturbed as part of the proposed works. This made ground may contain chemical contaminants. If contaminated soils are encountered during the construction works, further investigation, testing and risk assessment will be undertaken to determine whether the soils are suitable for reuse or need to be disposed of to a licensed facility off-site.

Materials identified as not being suitable for reuse or disposal at an Inert or Non-Hazardous facility based on contamination levels will require to be suitably disposed of in a licensed Hazardous material disposal facility. Any such material will be managed in accordance with waste management legislation and the following requirements:

- Soil excavation will be targeted and stockpiling will be managed in order to prevent any potential contaminants from being released into the surrounding environment;
- All hazardous waste will be covered at all times by appropriate material such as high density polyethylene (HDPE) to minimise possible washout or wind blow of contamination. All stockpiles will be clearly labelled to enable proper and safe handling, transportation and storage of waste;
- No asbestos-containing materials have been found in any of the historical site ground investigations. However, if asbestos or suspected asbestos-containing material is encountered during construction, specialist asbestos contractors will be engaged to arrange appropriate testing, removal and disposal to a licensed facility;
- Waste records will be maintained in relation to all hazardous waste materials generated on site including stockpile locations; volumes; origins; and additional testing undertaken; and
- A Waste Transfer Form (WTF) will be used to record the transportation of hazardous waste within the State and will be required of any movements of hazardous wastes arising during construction of the proposed development. Should the need arise for the Transfrontier Shipment (TFS) of waste, the movement of waste between countries is subject to control procedures under the EU and national legislation and guidance, such as the Waste Management (Transfrontier Shipment of Waste) Regulations, 2007.

The contractor, as the waste producer, will be responsible for ensuring the compliant disposal of all wastes disposed of as part of the proposed development, and as such will be required to retain records of all hazardous wastes. Sligo County Council will monitor that all waste arising as part of the construction is handled and disposed of compliantly by the contractor as per these requirements.

12.5.2 Operational Phase

Management of wastes arising during the operational phase of the proposed development will be the responsibility of Sligo County Council or contractors appointed by the council to provide waste management and landscaping services.

Waste silts and hydrocarbons / oily waters collected in the on-site drainage interceptors and arising from attenuation / treatment pond maintenance will be disposed of through specialist contractors as and when required. The specialist contractors will clean out the interceptors and maintain the attenuation / treatment pond and the associated waste material will be sent to a suitable licensed facility for treatment and / or disposal.

12.5.3 Residual Impacts

The residual impacts associated with the proposed development after adherence to the implementation of mitigation measures are summarised in Table 12-4:

Table 12-4: Residual Impact after Mitigation Measures

Impact	Significance Pre Mitigation	Significance Post Mitigation
Construction		
Excavated Material	Moderate	Imperceptible
Pile Arisings	Moderate	Imperceptible

Impact	Significance Pre Mitigation	Significance Post Mitigation
Surplus Material	Slight	Imperceptible
Waste Management	Moderate	Imperceptible
Made Ground / Land Contamination	Moderate	Slight
Operation	Imperceptible	Imperceptible

12.6 Difficulties Encountered in Compiling Information

There is some uncertainty with regards to the ground conditions under the existing road, and therefore the material which will need to be excavated. There may be unknown contaminated material encountered once excavations commence. If this should arise the material will need to be appropriately managed and compliantly disposed of.

12.7 Cumulative Impacts and Impact Interrelations

It is not considered that any significant impacts will arise from interaction of environment aspects with waste management and no significant cumulative impacts ate expected to arise.

13. Material Assets

13.1 Introduction

This chapter of the EAR considers and assesses the effects of the proposed development on the material assets of the surrounding area during construction and operation. The material assets considered as part of the assessment comprise:

- Major Utilities; and
- Imported Material.

Cultural Heritage Assets are covered in Chapter 11. This chapter provides a description of the existing major utilities and required imported material in the area, and a statement of the likely impacts associated with both the construction and operational phases of the proposed development on these aspects. Measures to mitigate the likely impacts of the proposed development are proposed, and residual impacts described.

13.2 Description of the Existing Environment

A number of utility providers have installations within the extents of the proposed development and these are summarised below in Table 13-1 below.

Table 13-1: Summary of Existing Utilities in the Existing Environment

Ref No	Utility Provider	Service Type	Approximate Chainage*	Location	Description
ESB1	ESB	Electricity Provider	70-460	Verge of northbound carriageway	Medium voltage underground
ESB2	ESB	Electricity Provider	330	Crossing N4 mainline	Medium voltage underground
ESB3	ESB	Electricity Provider	460-510	Crossing N15 mainline	Medium voltage underground
ESB4	ESB	Electricity Provider	R291 0-80	Footway of left turn slip road and R291 Rosses Point Road northbound	Low voltage underground
ESB5	ESB	Electricity Provider	N16 10-65	Crossing N16 Duck St	Medium voltage underground
ESB6	ESB	Electricity Provider	N16 65	Crossing N16 Duck St	Medium voltage underground
EIR1	EIR	Telecommunications	70-140	Verge of southbound carriageway and R870 Markievicz Road northbound carriageway footway	4 x 100 mm PP ducts 2 chambers
EIR2	EIR	Telecommunications	115	N4 mainline and R870 Markievicz Road junction left turn slip road	9 x 100 mm PP ducts
EIR3	EIR	Telecommunications	130-135	Crossing N4 mainline and continuing along R870 Markievicz Road	4 x 100 mm PP ducts

Ref No	Utility Provider	Service Type	Approximate Chainage*	Location	Description
EIR4	EIR	Telecommunications	135-460	Verge of northbound carriageway	9 x 100 mm PP ducts Bespoke manhole 2 chambers 2 standard manholes
EIR5	EIR	Telecommunications	410	Crossing N4 mainline	6 x 100 mm PP duct
EIR6	EIR	Telecommunications	R291 0-80	Footway of left turn slip road and continuing along R291 Rosses Point Road northbound	3 x 100 mm PP ducts 2 x100 mm CD ducts 1 x 50 mm ST ducts 3 chambers
EIR7	EIR	Telecommunications	N16 15	Crossing mouth of N16 Duck St	1 x 100 mm PP duct
EIR8	EIR	Telecommunications	N16 15-65	N16 Duck St southbound carriageway	4 x 100 mm PP ducts 1 chamber Fibre cabinet adjacent to boundary wall in verge
EIR9	EIR	Telecommunications	410-445	Crossing N15 left turn slip road to N16 Duck Street and associated traffic island	2 x 100 mm PP ducts Copper Cabinet 1 manhole
EIR10	EIR	Telecommunications	410-445	Crossing N15 left turn slip road to N16 Duck Street and associated traffic island	4 x 100 mm PP ducts 1 chamber
EIR11	EIR	Telecommunications	445-650	Footway of southbound carriageway	2 x 100 mm PP ducts 1 x 100 mm CD ducts 3 chambers Copper Cabinet Fibre cabinet
EIR12	EIR	Telecommunications	640-650	Footway of southbound carriageway	4 x 100 mm PP ducts 1 chambers
EIR13	EIR	Telecommunications	R291 0	Crossing R291 Rosses Point Road	1 x 50 mm PP duct
ENET 1	E-net	Telecommunications	70 – 95	Verge of southbound carriageway	4 x 110 mm ducts
ENET 2	E-net	Telecommunications	95-170	Crossing slip roads and mouth of R870 Markievicz Road junction	4 x 110 mm ducts
ENET 3	E-net	Telecommunications	170-375	Footway of southbound carriageway	4 x 110 mm ducts
ENET	E-net	Telecommunications	N16	Crossing mouth of Barrack Street junction	4 x 110 mm ducts

Ref No	Utility Provider	Service Type	Approximate Chainage*	Location	Description
4			0-65	into N16 westbound carriageway footway	
VIR1	Virgin Media	Telecommunications	70-480	Footway of southbound carriageway and footway of left turn slip road	1 x 110 mm duct
VIR2	Virgin Media	Telecommunications	195	Crossing N4 mainline	1 x 110 mm duct
SEW1	Irish Water	Foul & Combined Sewers	R870 0-65	R870 Markievicz Road carriageway to junction with N4 and then crossing the N4 mainline	375 mm dia combined sewer
SEW2	Irish Water	Foul & Combined Sewers	140-480	Verge / embankment of northbound carriageway and footway of left turn slip road	375 mm / 450 mm dia combined sewer
SEW3	Irish Water	Foul & Combined Sewers	N16 0-15	Barrack Street and crossing N16 Duck St	225 mm dia combined sewer
SEW4	Irish Water	Foul & Combined Sewers	N16 0-65	N16 Duck St through junction and crossing N4 mainline	225 mm / 400 mm dia combined sewer
SEW5	Irish Water	Foul & Combined Sewers	395-440	N4 northbound carriageway	Overflow from SEW4
SEW6	Irish Water	Foul & Combined Sewers	480-510	Crossing N15 mainline	225 mm dia combined sewer
SEW7	Irish Water	Foul & Combined Sewers	485-515	Crossing N15 mainline	300 mm dia combined sewer
SEW8	Irish Water	Foul & Combined Sewers	R291 0-60	Footway of R291 Rosses Point Road northbound	225 mm dia combined sewer
SEW9	Irish Water	Foul & Combined Sewers	510	Off-road path from R291 Rosses Point Road slip road along estuary	450 mm dia combined sewer
SEW10	Irish Water	Foul & Combined Sewers	515	Off-road path from R291 Rosses Point Road slip road along estuary	300 mm dia combined sewer
WAT1	Irish Water	Watermains	70-150	Verge of southbound carriageway crossing R870 Markievicz Road into HSE property	180 mm HPPE main
WAT2	Irish Water	Watermains	150-385	Within grounds of HSE property	180 mm HPPE main
WAT3	Irish Water	Watermains	N16 0-65	N16 Duck St eastbound carriageway	Unknown
WAT5	Irish Water	Watermains	N16 20-65	N16 Duck St westbound carriageway	Unknown

Ref No	Utility Provider	Service Type	Approximate Chainage*	Location	Description
WAT4	Irish Water	Watermains	N16 20	Barrack St carriageway	Unknown
WAT6	Irish Water	Watermains	395-485	Mainline to left turn slip road to R291 Rosses Point Road	Unknown
WAT7	Irish Water	Watermains	R291 0-90	R291 Rosses Point Road southbound carriageway	Unknown

* N4-N15 Mainline Chainage unless stated otherwise

13.3 Appraisal Method used for Assessment of Impacts

13.3.1 Introduction

The assessment of the impact on major utilities was undertaken through a review of existing available information including service record drawings from the utility providers, detailed topographical information and proposed development drawings. A number of slit trenches and trial holes were also undertaken in May 2016 to investigate and / or confirm the location of underground utilities. Consultation was undertaken with each of the utility providers to assess the potential impact of the proposed development on their respective services and identify appropriate mitigation where required.

13.3.2 Standards and Guidelines

The material assets assessment has been undertaken with reference to the following main standards and guidelines:

- Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2002);
- Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) (EPA, 2003); and
- Environmental Impact Assessment of National Road Schemes - A Practical Guide (NRA, 2008).

13.3.3 Significance Assessment Criteria

The significance criteria as set out in the EPA guidelines have been used for the purpose of this assessment, and are presented in Table 13-2 below:

Table 13-2: Material Assets Assessment Criteria

Significance Level	Criteria
Profound	An impact which obliterates sensitive characteristics
Significant	An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Moderate	An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends.
Slight	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities.
Imperceptible	An impact capable of measurement but without noticeable consequences.

As per the EPA Guidelines, impacts can be considered to be negative, neutral or positive in effect.

Impact duration is considered as being Temporary (for up to one year), Short term (from 1 to 7 years), Medium term (7 to 15 years), Long term (from 15 to 60 years) or Permanent (in excess of 60 years).

13.4 Predicted Impacts of the Proposed Development

13.4.1 Utilities

It is envisaged that the proposed development will impact those utility providers' services listed in Table 13-3 below. Impact to the services shall be permanent in nature, and occur during the construction phase. The impact on services in the absence of mitigation would be profound as many of the services would no longer be functioning.

There will be no additional impact during the operational phase.

13.4.2 Imported Material

It is anticipated that approximately 6,500 m^3 of imported fill material will be required for the proposed development.

Impacts associated with the transport of the primary raw materials and manufactured products associated with the above imported material will occur off site, but are considered as an impact of the proposed development. In addition, HGV movements to and within the proposed development will increase. Based on the volume of material required, approximately 500 HGV movements will require access to the proposed development over an approximate period of 8-12 months during the construction of the main embankments. The impact significance of imported material is assessed as moderate due to these increased HGV movements.

There will be no additional impact during the operational phase.

13.5 Proposed Mitigation and Avoidance Measures

The following mitigation measures will be implemented for the proposed development during the construction and operational phases.

13.5.1 Utilities

A summary of the mitigation measures for the Utility Providers' services are listed below in Table 13-3. When the mitigation is implemented, the magnitude of impact is reduced to Imperceptible as the services will have been satisfactorily protected, extended or diverted, and will therefore continue to operate in their current form.

As there are no operational phase impacts on utilities associated with the proposed development, no specific mitigation measures are required for the operational phase.

13.5.2 Imported Material

The source(s) of the imported fill materials will be selected from local and regional approved and licenced suppliers where practicable, thereby reducing the length of vehicle trips required. A number of key issues will be considered as part of the selection process for these suppliers, including but not limited to the following:

- Source;
- Material specification;
- Production and transport costs; and
- The availability of materials.

Where granular fill is required for the proposed development, local or regional virgin sources, or recycled materials held at waste management / transfer facilities that meet the required specification will be sourced. An appropriate traffic management plan will be developed at construction stage to manage the flow of delivery

vehicles to the site and minimise the impact on the local road network. The impact associated with imported materials will reduce to Slight.

As there are no operational phase impacts on imported material associated with the proposed development, no specific mitigation measures are required for the operational phase.

13.6 Residual Impacts

There will be no residual impact on utilities or imported material.

13.7 Difficulties Encountered in Compiling Information

There were no difficulties encountered in compiling information.

13.8 Cumulative Impacts and Impact Interrelations

No cumulative material assets impacts will occur as a result of the proposed development.

Table 13-3: Utility Mitigation Measures

Ref No	Utility Provider	Service Type	Mitigation
ESB1	ESB	Electricity Provider	Divert 2 No. 125 mm diameter ducts into northbound carriageway verge.
ESB2	ESB	Electricity Provider	Adjust termination of ducting as required to connect to diverted ESB service ESB1. Protect remainder of the route in place.
ESB3	ESB	Electricity Provider	Protect in place for the duration of the Works.
ESB4	ESB	Electricity Provider	Protect in place for the duration of the Works.
ESB5	ESB	Electricity Provider	Protect in place for the duration of the Works.
ESB6	ESB	Electricity Provider	Protect in place for the duration of the Works.
EIR1	EIR	Telecommunications	Protect remainder of the route in place for the duration of the works.
EIR2	EIR	Telecommunications	Extend existing ducting to connect to EIR4 diversion.
EIR3	EIR	Telecommunications	Extend existing ducting to connect to EIR4 diversion.
EIR4	EIR	Telecommunications	Divert service into northbound verge between Ch 135-310. Protect remainder of the route in place for the duration of the works.
EIR5	EIR	Telecommunications	Locally divert and extend existing ducting to connect to EIR8 diversion.
EIR6	EIR	Telecommunications	Divert service into R291 northbound carriageway footway from approximate Ch 20-55. Protect in place the remainder of the length. Adjust covers for new footpath levels.
EIR7	EIR	Telecommunications	Locally divert and extend existing ducting to connect to EIR8 diversion.
EIR8	EIR	Telecommunications	Reconstruct chamber in relocated traffic island. Locally divert and extend existing ducting to new chamber.
EIR9	EIR	Telecommunications	Divert service from new chamber in EIR11 diversion to new chamber in EIR8 chamber. Construct new manhole in relocated traffic island and relocate cabinet to new island.
EIR10	EIR	Telecommunications	Divert service from new chamber in EIR11 diversion to new chamber in EIR8 chamber. Construct new chamber in footway of left turn slip road.
EIR11	EIR	Telecommunications	Divert service into N15 southbound carriageway verge. Construction of three new chambers. Protect existing cabinets in place but reconnect ducts to connect to diverted service.

Ref No	Utility Provider	Service Type	Mitigation
EIR11	EIR	Telecommunications	Protect in place for the duration of the Works.
EIR12	EIR	Telecommunications	Protect in place for the duration of the Works.
ENET1	E-net	Telecommunications	Protect in place for the duration of the Works.
ENET2	E-net	Telecommunications	Protect in place for the duration of the Works.
ENET3	E-net	Telecommunications	Protect in place for the duration of the Works from Ch 170-230. Divert service into southbound carriageway verge from approximate Ch 230-375.
ENET4	E-net	Telecommunications	Protect in place for the duration of the Works.
VIR1	Virgin Media	Telecommunications	Divert service into northbound carriageway verge and footway along route of redundant R291 left turn slip road.
VIR2	Virgin Media	Telecommunications	Extend existing ducting to connect to VIR1 diversion.
SEW1	Irish Water	Foul & Combined Sewers	Protect in place for the duration of the Works. Adjust cover levels as required.
SEW2	Irish Water	Foul & Combined Sewers	Divert service into northbound carriageway verge and footway along route of redundant R291 left turn slip road.
SEW3	Irish Water	Foul & Combined Sewers	Protect in place for the duration of the Works. Adjust cover levels as required.
SEW4	Irish Water	Foul & Combined Sewers	Protect in place for the duration of the Works. Adjust cover levels as required.
SEW5	Irish Water	Foul & Combined Sewers	Extend existing pipe to connect to SEW2 diversion.
SEW6	Irish Water	Foul & Combined Sewers	Protect in place for the duration of the Works. Adjust cover levels as required.
SEW7	Irish Water	Foul & Combined Sewers	Protect in place for the duration of the Works. Adjust cover levels as required.
SEW8	Irish Water	Foul & Combined Sewers	Protect in place for the duration of the Works. Adjust cover levels as required.

Ref No	Utility Provider	Service Type	Mitigation
SEW9	Irish Water	Foul & Combined Sewers	Protect in place for the duration of the Works.
SEW10	Irish Water	Foul & Combined Sewers	Protect in place for the duration of the Works.
WAT1	Irish Water	Watermains	Protect in place for the duration of the Works.
WAT2	Irish Water	Watermains	Protect in place for the duration of the Works (adjacent to proposed boundary wall).
WAT3	Irish Water	Watermains	Protect in place for the duration of the Works.
WAT4	Irish Water	Watermains	Protect in place for the duration of the Works.
WAT5	Irish Water	Watermains	Protect in place for the duration of the Works.
WAT6	Irish Water	Watermains	Protect in place for the duration of the Works.
WAT7	Irish Water	Watermains	Protect in place for the duration of the Works.

14. Inter-relationships between Environmental Factors

14.1 Introduction

The interaction of environmental aspects was clearly identified at an early stage in the assessment to be an important factor to be considered in the full evaluation of the environmental impacts associated with the proposed development. While all environmental factors are inter-related to some extent, the significant interactions and inter-dependencies were taken into consideration by the specialist environmental consultants when preparing their assessments. These interactions were integrated into the individual sub-sections from Chapters 4 to 14 of this EAR. In addition, a summary of the general interactions is presented in Table 14-1 and the detail of the interactions in Table 14-2.

Table 14-1: Relationships between the Environmental Aspects

Inter-Relationship Matrix – Environmental Elements	Socio-Economic	Flora & Fauna	Surface Water	Geology, Soils & Hydrogeology	Air Quality & Climate	Noise & Vibration	Landscape & Visual	Archaeology, Cultural & Architectural Heritage	Waste	Material Assets
Socio-Economic										
Flora & Fauna			✓	✓	✓	✓	✓			
Surface Water	✓	✓		✓						
Geology, Soils & Hydrogeology		✓	✓						✓	
Air Quality & Climate	✓	✓							✓	
Noise & Vibration	✓	✓					✓	✓		
Landscape & Visual	✓	✓							✓	
Archaeology, Cultural & Architectural Heritage	✓					✓	✓			
Waste	✓		✓	✓	✓		✓			
Material Assets	✓				✓					

Table 14-2: Explanatory Notes on the Relationships between the Environmental Aspects

Typical Inter-Relationship Matrix – Environmental Elements	Socio-Economic	Flora & Fauna	Surface water	Geology, Soils & Hydrogeology	Air Quality & Climate	Noise & Vibration	Landscape & Visual	Archaeology, Cultural & Architectural Heritage	Waste	Material Assets
Socio-Economic										
Flora & Fauna			Surface water quality effect on estuarine species and habitats	Groundwater quality effect on flora and fauna	Air Pollution effect to flora and fauna	Vibration/ noise disturbance to flora and fauna	Flora and fauna contribute to visual amenity of landscape			
Surface water	Surface water quality e.g. Copper River / Garavogue River	Surface water quality on estuarine species/ habitats e.g. Copper River, Garavogue River and /or Estuary		Pollutant pathway between surface soil/ water and groundwater (limestone bedrock in regions)						
Geology, Soils & Hydrogeology		Local change to soil/ groundwater quality and composition will impact on flora and fauna	Pollutant pathway between surface soil/ water and groundwater (limestone bedrock in regions)					Changes in hydrogeology can affect waterlogged buried archaeological remains	Waste arising from construction work	
Air Quality & Climate	Changes to air quality can impact communities	Air quality effect on sensitive flora and fauna (e.g. Lough Gill pNHA and Cummeen Strand SAC / SPA)							Stockpiling of waste materials and nuisance dust emissions	
Noise & Vibration	Elevated noise / vibration levels impact communities (e.g. HSE Sligo Care Centre)	Noise / vibration disturbance effect on local fauna					Visual impact on nearby heritage assets	Vibration effects on structural integrity of local heritage assets		
Landscape & Visual	Visual impact effect to social amenity areas e.g. Salmon Point.	Landscaping can effect commuting route for mammals						Visual effects on the setting of heritage assets	Stockpile / storage impact on visual amenity	
Archaeology, Cultural & Architectural Heritage	Amenity value of heritage sites to local community and tourism (e.g. Markievicz House)					Vibration effects on structural integrity of local heritage assets	Visual impact on nearby heritage assets			
Waste	Storage / stockpiling material effect on local community		Pathways for contaminants between waste stores and surface /groundwater	Waste generated from construction work, most notably excavated materials (e.g. soils and / gravel)	Excavation / stockpiling dust effects on air quality		Stockpiling effect on visual amenity			
Material Assets	Impacts on utilities / services will have an effect on human beings				Transport of imported materials for construction impact air quality / climate change					

15. Schedule of Environmental Commitments

15.1 Introduction

This chapter summarises the mitigation measures (environmental commitments) in the Environmental Impact Statement for the proposed development. The purpose of these environmental commitments is to mitigate or ameliorate potentially significant adverse impacts that have been identified in the EAR.

15.2 Socio-Economic

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
Socio-Economic			
N/A	No mitigation is required.	N/A	N/A

15.3 Flora and Fauna

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
Flora and Fauna			
5.7.2.1.1	An Ecological Clerk of Works (ECoW) will be appointed during the construction phase to: • Review the contractor's method statements relating to environmental protection (e.g. relating to pollution control measures, movement of machinery across the SAC); • Site visit at the start of construction phase (and once every two months thereafter) to ensure all elements of environmental protection outlined in method statements are adhered to; and • Supervision of pilling works / movement of machinery across SAC (at the start of these works) to ensure timber bog mats are in place and the movement of machinery is kept as close as possible to the shore.	Impact to designated sites	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
5.7.2.1.2	A preliminary Erosion and Sedimentation Control Plan (pESCP) has been developed in conjunction with the EAR, see Appendix 6.5. This details specific pollution prevention measures to be employed during construction and will be binding on the appointed contractor and actively monitored by SCC and the appointed ECoW. No additional measures are required to mitigate the significance of potential pollution effects.		Construction
5.7.2.1.3	Timber bog mats will be deployed in intertidal habitats to enable construction machinery to safely move across the cSAC / SPA while limiting impacts on these intertidal habitats. These provide an effective method of ensuring heavy plant and equipment can traverse soft terrain without being impeded or causing excessive damage to the habitats underfoot. The contractor will develop a method statement approved by the ECoW for this work.	Impact to designated sites	Construction
5.7.2.2.2	Species-rich native grass seed mixes, of a composition similar to the 'Traditional Wildflower Meadow Mixture' (Code WF02; available online from wildflowers.ie) will be used to landscape all roadside verges, and the above-ground containment tank facing the estuary to mitigate loss of wet grassland and dry meadow habitat. Small losses of scrub, woodland, and hedge will be partially mitigated by planting of a species-rich native scrub hedgerow mix inside the fence-line of the proposed development. Hedges will be native, and species-rich, to include willow Salix cinerea which is locally abundant, in addition to at least three other native woody species. Although existing, ash will not be replanted due to concerns associated with ash	Habitat loss	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	dieback. Ash will be replaced by alder Alnus glutinosa. The site compound will be located within an area of existing hardstanding (the Valet Depot) on Ballast Quay.		
5.7.2.2.3	No construction will take place within any area affected by Japanese knotweed until it has been successfully treated or removed. SCC commenced treatment of Japanese knotweed by stem injection in October 2016. This multi-annual treatment is being managed by SCC and undertaken as part of TII's wider invasive species treatment programme across the national road network. It is estimated that successful treatment will take up to four years. In the event that construction is required to commence within four years, or in the event that any invasive species material remains after treatment, the material will be removed under an advance works contract (which shall be subject to a separate invasive species management plan). In any event, specialist with relevant expertise in the area of invasive species will verify the removal of all knotweed-related material prior to any construction commencing.	Spread of invasive species	Construction
5.7.2.3.2	Vegetation including scrub and grassland will not be removed, where practicable, between March and August inclusive. The Wildlife Acts provide an exemption from this seasonal restriction for road construction but there is no exemption for nest destruction. Where the construction programme does not allow this seasonal restriction to be observed, vegetated areas will be inspected by a suitably qualified ecologist for the presence of breeding birds prior to clearance. Where nests are found within the area to be cleared, or within the potential ZoI of indirect disturbance (i.e. at least 50 m for most common passerines) the appointed ecologist will advise the Contractor if a licence is	Impacts on breeding birds	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	required from the NPWS to permit disturbance and / or removal of the nest. Areas found not to contain nests must be cleared within 3 days of the survey, or further surveys will be required. Grey wagtail may nest in stonewall habitats rather than vegetation. If works to the Copper River Bridge overlap the breeding bird season, a geotextile membrane will be installed on the rock gabion within 50 m of the Copper River works to prevent grey wagtail nesting in the area of disturbance.		
5.7.2.3.4	Implementation of breeding bird mitigation will restrict vegetation removal during the shrew breeding season (March-August inclusive).	Effects on pygmy shrews	Construction
5.7.2.3.3	The installation of temporary lighting during the construction works for the Copper River Bridge works will be monitored by a suitably qualified ecologist prior to continuous use to ensure that any light spill into dark areas especially near the river are minimised. Adjustment to light orientation and height may be required to minimise the net change in illumination to previously dark areas.	Effects of lighting on bats	Construction
5.7.2.3.5	• Although fish were scoped out from the assessment, IFI have requested best-practice design in accordance with *Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters* (IFI, 2016). Accordingly, a method statement for instream works will be submitted to IFI. As per IFI's requirements, and the NRA Guidelines for crossing of watercourses during construction, the bridge structure will be designed: • Without trash screens or with types of screen which permit fish passage; • With the level of the culvert bottom (invert) about 500 mm below the level of the natural stream bed;	Effects on fish	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	• With a constant slope throughout its length which does not exceed 1%; and • With a grade allowing the upstream invert to remain drowned (by back-watering) under low-flow conditions, to a depth suitable for the easy passage of the largest species frequenting the stream.		
5.7.3.3	Pre-construction survey and potential licencing requirements have been proposed for breeding birds, in the event where vegetation clearance cannot avoid the breeding season.	Impacts on breeding birds	Construction

15.4 Hydrology, Geomorphology and Hydromorphology

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
Hydrology, Geomorphology and Hydromorphology			
6.9.1	All construction works will be completed in line with the recommendations of the following guidelines: • 'Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes' (NRA, 2005); • CIRIA C649 Control of Water Pollution from Linear Construction Projects: Site Guide (Murnane *et al*., 2006); • 'Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors' (CIRIA, 2001); • Inland Fisheries Board Guidance Document (formerly developed by Eastern Fisheries Board) "Requirements for the protection of fisheries habitat during Construction and development works at river Sites"; and	Pollution of watercourses	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	• UK Environment Agency: • PPG5 Pollution Prevention Guidelines Works and Maintenance in / or near Water; • PPG21 Incident Response Planning; • PPG22 Dealing with Spills; and • PPG26 Drums and Intermediate Bulk Containers.		
6.9.1	To avoid the pollution of watercourses during the construction phase a preliminary Erosion and Sediment Control Plan (pESCP) is contained in Appendix 8.5. This pESCP is intended to be a working document and will be updated by the contractor to form the detailed Erosion and Sediment Control Plan (dESCP) which will form part of the contractors Environmental Operating Plan (EOP) for the construction of the proposed road development. The construction contractor will prepare the dESCP prior to commencing the construction works. To prevent or reduce the amount of sediment released into watercourses, the sediment / silt control plan will include the following measures to be implemented by the contractor; full details are provided Appendix 8.5:	Pollution of watercourses due to sediment / silt release	Construction
6.9.1	Construction of structures during periods of low flow (typically during summer months) to reduce the risk of scour and erosion around a structure or to the disturbed river bed.	Pollution of watercourses due to sediment / silt release	Construction
6.9.1	Provision of measures to prevent the release of sediment concentrations over baseline conditions to WF1-WF3 during the construction works will include but not be limited to silt fences, silt curtains, settlement lagoons and filter materials.	Pollution of watercourses due to sediment / silt release	Construction
6.9.1	Provision of measures to prevent the displacement and subsequent erosion and release of large volumes of soft sediment, particularly from bridge works over WF3. These measures will include but not be limited to an over pump regime on the copper river during construction, settlement tanks, silt curtains and / or sediment fences.	Pollution of watercourses due to sediment / silt release	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
6.9.1	Temporary construction surface drainage and sediment control measures will be in place before earthworks commence.	Pollution of watercourses due to sediment / silt release	Construction
6.9.1	Provision of exclusion zones and barriers (sediment fences) between earthworks, stockpiles and temporary surfaces and watercourses to prevent sediment washing into the watercourses.	Pollution of watercourses due to sediment / silt release	Construction
6.9.1	Measures will be provided to ensure that all works associated with the Copper River Bridge construction are protected against the 1:100 year return period fluvial flood event and the 1:200 year return period coastal flood to ensure that there is no hydraulic connectivity between the temporary works and the Copper River during construction.	Pollution of watercourses due to sediment / silt release	Construction
6.9.1	Limiting the extent of vegetation clearance and thereby minimising the potential release of sediment from bare ground following clearance.	Pollution of watercourses due to sediment / silt release	Construction
6.9.1	Precast concrete will be used in preference to pouring concrete where possible.	Pollution of watercourses due to sediment / silt release	Construction
6.9.1	Pouring of concrete for the works will be carried out in the dry and allowed to cure for 48 hours before re-flooding. Pumped concrete will be monitored to ensure no accidental discharge. Mixer washings and excess concrete will not be discharged to surface water.	Pollution of watercourses due to sediment / silt release	Construction
6.9.1	No storage of hydrocarbons or any toxic chemicals will occur within 50 m of any watercourse. Fuel storage tanks will be bunded to a capacity at least 110% of the volume of the storage tank. Re-fuelling of plant will not occur within 50 m of any watercourse and only in bunded refuelling areas. Emergency procedures and spillage kits will be available and construction staff will be familiar with emergency procedures.	Pollution of watercourses due to sediment / silt release	Construction
6.9.1	The contractor shall liaise with SCC, the NPWS and IFI in relation to the dESCP and shall include their recommendations as appropriate in this regard. • The contractor shall ensure that the construction methodologies used will ensure no wastes will be discharged to the watercourses.	Pollution of watercourses due to sediment / silt release	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	Consultation will be undertaken with the above stakeholders prior to works including any advanced works.		
6.9.1.1	Pre-construction water quality monitoring will be undertaken by the contractor once every two weeks for a four month period, prior to the commencement of the construction works. Samples will be taken for total suspended solids (TSS), turbidity, pH, temperature, dissolved oxygen (DO) and hydrocarbons up and downstream of the Copper River Bridge to build upon the baseline monitoring carried out at the Environmental Assessment stage and in order to further establish the baseline water quality conditions prior to the construction phase. Samples for turbidity, pH, DO and temperature will be taken in situ; samples for TSS and hydrocarbons will be sent to an accredited laboratory for analysis.	Pollution of watercourses due to sediment / silt release	Pre-Construction
6.9.1.2	The contractor will monitor the levels of TSS, turbidity, pH, temperature, DO and hydrocarbons at the same locations up and down stream once a week for the duration of the following works: • Site clearance works, earthworks movements and stockpiling; • Excavations including those associated with the provision of drainage works; • Construction of the Copper River Bridge; and • Construction works within watercourses. • The construction monitoring results will be compared with those results established in pre-construction monitoring. In the event of an elevation above pre-construction levels an investigation will be undertaken by the contractor and remediation measure will be put in place in agreement with SCC. • In addition, daily visual inspections of the surface drainage and sediment control measures and the watercourses will be undertaken by the contractor. Indicators that water pollution may have occurred include the following:	Pollution of watercourses	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	• Change in water colour; • Change in water transparency; • Increases in the level of silt in the water; Oily sheen to water surface; Floating detritus; or Scums and foams. These inspections shall be recorded. In the event that such indicators are observed, works will cease, sampling will be immediately undertaken as described for the weekly monitoring and an investigation of the potential cause will be undertaken by the contractor in consultation with SCC. • Where the works are identified as the source causing the exceedance the following will apply: • Contact will be made with the SCC; • SCC will liaise with the NPWS and IFI on the issue; • Works capable of generating sediment and all discharges shall be stopped immediately; and • The contractor will be required to take immediate action to implement measures to ensure that such discharges do not re-occur. The above monitoring will alert the contractor to any detrimental effects that particular construction activities may have on water quality in order that appropriate remedial action can be taken as quickly as possible and allow the contractor to demonstrate the success of the mitigation		

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	measures employed in maintaining any sediment release within the trigger value established.		
6.9.2.1	A penstock, handstop, or an orifice that can be readily blocked in the event of accidental spillage will be provided on the attenuation / treatment pond. If lowered in time prior to discharge of significant quantities, penstocks can potentially retain 100% of spilled material	Pollution of watercourses by carriageway run-off	Operation
6.9.2.1	In line with IFI requirement the treatment system used shall ensure a standard of 10-15 mg/l for suspended solids to inform retention time needed. All other requirements of the IFI as set out in their response in Appendix 6.2 will be implemented in the final drainage design.	Pollution of watercourses by carriageway run-off	Operation
6.9.2.1	In order to ensure the drainage system operates to the required standard, SCC will monitor on a twice yearly basis the water quality at the inlet and outlet to the attenuation / treatment pond as undertaken for the EAR and compare these to the standards in the European Communities Environmental Objective (Surface Water) Regulations, S.I. 272 of 2009. If exceedances are found remediation measures will be undertaken.	Pollution of watercourses by carriageway run-off	Operation
6.9.2.1	In order to avoid adverse watercourse impacts due to spills or accident leakages a contaminant spill emergency plan will be put in place to contain, remove or remediate any catastrophic spill before it reaches any surface water receptor. Emergency equipment / spill kits to facilitate the implementation of such plan will be made available in secured locations within the area.	Pollution of watercourses	Operation
6.9.2.2.1	• The following specific mitigation measures and good practice guidance for the operation of culverts will be employed: • Allowing for the passage of water and sediment for a range of flows (including low flow conditions); • Avoiding reduction of the river length through shortening the channel planform and maintaining the existing channel gradient, thus reducing potential erosion at the upstream and downstream	Pollution of watercourses	Operation

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	extent of the culvert; • Keeping the length of a culvert to a minimum and aligning a culvert with the existing watercourse, retaining natural bed and banks where possible; and • Depressing the invert of culverts to allow for formation of a more natural bed.		
6.9.2.2.2	• The following specific mitigation measures and good practice guidance for the operation of culverts will be employed: • Allowing for the passage of water and sediment for a range of flows (including low flow conditions); • Avoiding reduction of the river length through shortening the channel planform and maintaining the existing channel gradient, thus reducing potential erosion at the upstream and downstream extent of the culvert; • Keeping the length of a culvert to a minimum and aligning a culvert with the existing watercourse, retaining natural bed and banks where possible; and • Depressing the invert of culverts to allow for formation of a more natural bed.	Alteration of watercourses by structures	Operation

15.5 Geology, Soils and Hydrogeology

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
Geology, Soils and Hydrogeology			
7.6.2	• Where made ground is expected to be intercepted by the proposed development, the contractor will undertake a risk assessment, and mitigation, if required, should be confirmed and specified on a site specific basis. Mitigation measures to include as applicable based on the risk assessment: • Storage of excavated made ground material using bunded facilities and development of re-use criteria; • Removal of contaminated soils from site; • Consolidation for treatment ex-situ; and / or • Treatment in situ (of soil and / or water).	Ground and surface water contamination	Construction
7.6.2	During construction, safe methods of work will be implemented to protect workers from direct interaction with any potentially contaminated soil, contaminated groundwater or asbestos, using appropriate PPE as a last resort.	Risk to human health – construction workers	Construction
7.6.2	Waste management procedures including a Waste Management Plan to form part of the Contractors EOP and to be approved by Sligo County Council, will be put in place by the contractor during construction.	Ground and surface water contamination	Construction

15.6 Air Quality & Climate

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
Air Quality and Climate			

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
8.5.1	• A dust minimisation plan has been formulated for the construction phase of the development, as construction activities are likely to generate some dust emissions and is contained in Appendix 8.4. An outline of the dust mitigation measures to be included in the dust minimisation plan are below. • Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic. • Furthermore, any road that has the potential to give rise to fugitive dust must be regularly watered, as appropriate, during dry and / or windy conditions. • Vehicles using site roads will have their speed restricted, and this speed restriction must be enforced rigidly. On any un-surfaced site road, this will be 20 kph, and on hard surfaced roads as site management dictates. • Vehicles delivering material with dust potential (soil, aggregates) will be enclosed or covered with tarpaulin at all times to restrict the escape of dust. • Public roads outside the site will be regularly inspected for cleanliness, and cleaned as necessary. • Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods. • During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions.	Nuisance dust	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	Full details of the mitigation measures to be implemented by the contractor are contained in Appendix 8.4.		

15.7 Noise & Vibration

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
Noise and Vibration			
9.5.1	• The contract documents will clearly specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of *BS5228-1:2009+A1:2014* and the *European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001.* These measures will include that: • • No plant used on site will be permitted to cause an ongoing public nuisance due to noise. • The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations. • All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract. • Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.	Construction noise	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	• Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use. • Any plant, such as generators or pumps that is required to operate before 07:00 hrs or after 19:00 hrs will be surrounded by an acoustic enclosure or portable screen.		
9.5.1.1	Normal working times will be 07:00 hrs to 19:00 hrs Monday to Friday and 08:00 hrs to 16:30 hrs on Saturdays. Works other than the pumping out of excavations, security and emergency works will not be undertaken outside these working hours without the written permission of Sligo County Council. Such permission will only be granted in circumstances where other alternatives have been assessed and deemed to be impractical. Granted permission can be withdrawn at any time should the working regulations be breached. Works other than the pumping out of excavations, security and emergency works will not be undertaken at night and on Sundays without the written permission of Sligo County Council. Night is defined as 19:00 hrs to 07:00 hrs.	Construction noise	Construction
9.5.1.3	Measures will be taken by the contractor to minimise vibration due to plant and machinery on the site and no machine which uses the dropping of heavy weights for the purpose of demolition shall be permitted.	Construction vibration	Construction
9.5.2	The results of the noise modelling assessment show that noise mitigation will be required for two receptors along the proposed development. In this instance, these receptors relate to the western façade of the HSE Sligo Primary Care Centre which contains clinical services areas and can therefore be regarded as a sensitive receptor in accordance with the NRA Guidelines.	Road traffic noise	Operation

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	It is proposed that the mitigation in this case would consist of increasing the height and length of the existing boundary wall when it is reinstated. The wall will be required to extend approximately 70 m along the western boundary adjacent to the HSE Sligo Primary Care Centre. The wall will be required to be constructed to a height of 2.5 m from its existing 0.8 m and 1.5 m. The location of the proposed extension to the wall has been outlined in Appendix 9.3 for reference.		

15.8 Landscape & Visual

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
Landscape and Visual			
10.5.1	See Figure 10.1. The construction stage will be implemented on the basis of an Environmental Operating Plan (EOP) which will be drawn up by the main contractor using the NRA's 'Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan' (EOP).	Visual intrusion	Construction
10.5.1	Solid temporary site hoarding shall be provided where construction works adjoin particular areas, e.g. HSE Care Centre and Kilronan residential property.	Visual intrusion	Construction
10.5.1	In specific areas protective fencing shall be erected at the boundary of proposed works to protect retained landscape, planting, features etc. This includes at Salmon Point Amenity Area; at the HSE care Centre; and at the Kilronan property.	Loss / damage to retained landscape / features	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
10.5.1	Existing features at Salmon Point Amenity Area shall be removed in advance of the works and retained for reinstatement. This includes the plaques, railings, entrance arch, lighting standards and tree planters.	Damage to amenity features	Construction
10.5.1	Areas and features where no or minimal works are proposed shall be protected during the construction stage. These include: the amenity area at Hughes Bridge (other than provision of an outfall); the wall fronting Markievicz House; the boundary walls of the properties at Barrack Street / N16 Duck Street, and the boundaries of properties west of the R291 Rosses Point Road and opposite Suncroft Villas.	Loss / damage to features	Construction
10.5.1	The existing bronze sculpture in the wall fronting Markievicz House shall be protected during the works.	Loss / damage to features	Construction
10.5.1	The existing stone wall and entrance at Kilronan shall be salvaged for re-instatement to match existing in character and style.	Loss / damage to features	Construction
10.5.1	The limestone wall fronting Suncroft Villas and the R291 Rosses Point Road shall be salvaged and re-used in the new wall located at the setback location.	Loss / damage to features	Construction
10.5.1	Where possible existing trees shall be retained at the HSE Property, the R291 junction and at the Kilronan Property.	Loss / damage to features	Construction
10.5.1	Site machinery shall operate within the proposed road development construction area.	Visual intrusion	Construction
10.5.1	Storage areas shall be located so as to avoid impacting further on existing residential and other property, woodlands, trees, hedgerows, drainage patterns, or other landscape features.	Visual intrusion	Construction
10.5.2	See Figure 10.2. The reinstatement works at Salmon Point shall include footpath connections and re-use of an appropriate number of the existing tree	Loss / damage to features	Operation

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	planters and trees.		
10.5.2	The new wall at the HSE Centre shall match the existing retaining wall and shall incorporate the existing Special Olympics plaque in the new construction.	Loss / damage to features	Operation
10.5.2	A selection of new semi-mature trees of appropriate local species (*e.g.* oak) shall be planted on the retained grass area immediately north of the location of the existing mature trees which will be lost during construction. The planting shall be discussed and agreed with the property owners / managers in advance of the works.	Visual intrusion	Operation
10.5.2	A new planting of hedgerow and shrubs shall be established along the inside of the new boundary wall in agreement with the Kilronan property owner.	Visual intrusion	Operation
10.5.2	A line of new evergreen screening shall be established along the new N15 boundary in agreement with the Kilronan property owner.	Visual intrusion	Operation
10.5.2	The existing low limestone wall between the existing R291 Rosses Point Road and adjoining coastal amenity area shall be extended north along the full length of the grassland amenity. The wall shall provide for the re-aligned access to the property west of the R291 Rosses Point Road and for pedestrian / cycle access.	Visual intrusion	Operation
10.5.2	A selection of new trees of appropriate local species (*e.g.* oak) shall *be* replanted at the reconfigured R291 junction to replace those lost by construction works.	Visual intrusion	Operation
10.5.2	Proposals will be developed by the contractor to allow for the attenuation pond to develop as an attractive feature of biodiversity, which could at some future stage be incorporated into land uses in the wider area, these proposal shall be agreed with SCC.	Visual intrusion	Operation

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
10.5.2	Locally appropriate planting and seed mixes shall be used in making-good and in reinstatement works.	Visual intrusion	Operation
10.5.2	All areas disturbed by construction shall be reinstated insofar as possible to their pre-construction condition at the end of the construction contract.	Visual intrusion	Operation

15.9 Archaeology, Cultural Heritage and Architectural Heritage

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
Archaeology, Cultural Heritage and Architectural Heritage			
11.2.5.4	Where preservation in situ is not feasible, preservation by record is recommended to mitigate identified impacts on archaeological sites. This methodology is in accordance with the principles and recommendations outlined in the 'Framework and Principles for the Protection of the Archaeological Heritage' (DAHG 1999). Preservation by record consists of fully recorded investigations in the field, followed by analyses, reporting and publication. Archaeological monitoring would also be undertaken on the areas of archaeological potential at the Garavogue River and Copper River (AR1 and AR2), enabling the recording of any archaeological remains identified during construction works. Proposed mitigation measures will also comply with the National Monuments Acts (1930-2004) and the Code of Practice (2000) agreed between the former National Roads Authority and the former Minister for Arts, Heritage, Gaeltacht and the Islands. Following approval of the proposed development, any mitigation measures will be carried out	Loss of archaeological / cultural heritage	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	under Ministerial Direction, as defined in Section 14A(1) of the National Monuments (Amendment) Act 2004. All archaeological works require a stage of post fieldwork assessment, analysis and reporting. All archaeological reporting shall have regard to the 'Guidelines for Authors of Reports on Archaeological Excavations' (NMS, 2006).		
11.3.5.4	• Measures to avoid or reduce potential impacts on architectural heritage sites have been considered and incorporated into the detailed design of the proposed development. The following additional mitigation measures are proposed for architectural heritage: • A boundary wall to Markievicz House (AH3) would be reinstated along the N4 (Victoria Road). This would be constructed as a concrete core retaining wall faced with stonework. The height, facing and capping would match the appearance of the existing wall. • Protection of the River Copper culvert (AH5) during construction to prevent accidental damage to the historic structure. • Historic Building recording of the River Copper culvert (AH5) comprising a metal detection and photographic survey in advance of construction and during construction works. This would document the form and construction of the culvert, including the twin culverts normally concealed below the road surface.	Impact to architectural heritage	Construction

15.10 Waste

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
Waste			
12.5.1.1	It is anticipated that none of the excavated material will be acceptable for reuse in road embankments and landscaping. During construction any excavated materials will be segregated where possible and stored in designated storage area(s) outside of any exclusion zones around water courses. Any stockpiling which is carried out will be managed to ensure that material is stable and not piled too high. Where the waste generated is not reusable, samples will be taken and waste acceptance criteria laboratory testing will be undertaken on the excavated material. The results of the laboratory testing will be used to classify the waste as Inert, Non-Hazardous or Hazardous. Licenced waste facilities will be contacted for their acceptance criteria requirements, and the excavated waste from the proposed development compared with these, and sent to the appropriately licenced waste facilities without undue delay. Where practicable, the closest suitable facilities to the proposed development will be selected to reduce impacts associated with vehicle movements such as air emissions. There are a number of Permitted Waste Facilities which accept C&D wastes in County Sligo, three of which are located within approximately 12 km south of Sligo Town, near Ballysadare. There is a fourth approximately 40 km to the south near Tubbercurry. There are no facilities in County Sligo which accept hazardous C&D wastes. The nearest is in Moneenbradagh, outside Castlebar in County Mayo. This is approximately 40 km to the southwest.	Pollution of the environment with waste materials	Construction
12.5.1.2	• The Contractor will be contractually bound temporarily store, handle, and transport any pile arisings in accordance with best practice guidelines. This will include, but is not limited to the	Contamination of surface water, groundwater and soils with concrete / cementitious materials	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	following: • Environmental Good Practice on Site, (Construction Industry Research and Information Association) CIRIA, C715, 2015 guidelines; • Construction code of practice for the sustainable use of soils on construction sites (DEFRA) 2009; and • BS 6031:2009 Code of Practice for Earthworks (incorporating corrigendum No. 1). • Arisings will only be stored in designated storage area(s) outside of any exclusion zones around water courses. Due to the likelihood of cement contamination of the arisings, they will be sampled, tested and disposed of without undue delay, to a licensed waste management facility.	from bored piles	
12.5.1.3	Any surplus material generated by excavation, which cannot be re-used elsewhere for landscaping or as fill for road embankments, will be sampled, tested and disposed of to a licensed waste management facility.	Disposal of surplus materials at an inappropriate facility / pollution of the environment with waste material	Construction
12.5.1.4	The contractor responsible for constructing the works will ensure that any facility to which waste is brought is licensed / permitted in compliance with Waste Management Legislation and will obtain the appropriate certification of disposal / destruction of waste.	Disposal of surplus materials at an inappropriate facility / pollution of the environment with waste material	Construction
12.5.1.4	An Environmental Operating Plan (EOP), in accordance with the Guidelines for the Creation and Maintenance of an Environmental Operating Plan (National Roads Authority, 2007) will be produced, implemented and maintained by the contractor as a system of documenting compliance with environmental commitments and requirements during the construction of the proposed development. The key elements of such a plan will include:	Disposal of surplus materials at an inappropriate facility / pollution of the environment with waste material	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	• Appointment of an Environmental Manager by the contractor; • Incorporation of environmental commitments and requirements; • Outlining methods by which construction work will be managed to meet these environmental commitments and requirements; • Identification of roles and responsibilities of the contractor's staff having regard to the contractor's organisational structure; • Incorporation of procedures for communicating with the public and communicating within the contractor's organisation; • Incorporation of procedures for environmental awareness training; • Incorporation of monitoring procedures and responses to the results of monitoring, where contractually required; and • Provision of a system of audit and review with regards to the effectiveness of the plan.		
12.5.1.4	• As part of the EOP, the contractor will prepare a Project Construction and Demolition Plan for the provision of waste management during the construction phase of the proposed development. The plan will take into account the following guidance document on the minimisation and management of construction and demolition waste: • Guidelines for the Management of Waste from National Road Construction Projects, NRA 2008; • Best Practice Guidelines on the preparation of Waste Management Plans of Construction and Demolition Projects, Department of the Environment, Heritage and Local Government, July 2006; and • CIRIA document 133 Waste Minimisation in Construction.	Disposal of surplus materials at an inappropriate facility / pollution of the environment with waste material	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
12.5.1.5	If contaminated soils are encountered during the construction works, further investigation, testing and risk assessment will be undertaken to determine whether the soils are suitable for reuse or need to be disposed of to a licensed facility off-site.	Further contamination of soils / groundwater / surface water Cross contamination of stockpiled materials	Construction
12.5.1.5	• Materials identified as not being suitable for reuse or disposal at an Inert or Non-Hazardous facility based on contamination levels will require to be suitably disposed of in a licensed Hazardous material disposal facility. Any such material will be managed in accordance with waste management legislation and the following requirements: • Soil excavation will be targeted and stockpiling will be managed in order to prevent any potential contaminants from being released into the surrounding environment; • All hazardous waste will be covered at all times by appropriate material such as high density polyethylene (HDPE) to minimise possible washout or wind blow of contamination. All stockpiles will be clearly labelled to enable proper and safe handling, transportation and storage of waste; • No asbestos-containing materials have been found in any of the historical site ground investigations. However, if asbestos or suspected asbestos-containing material is encountered during construction, specialist asbestos contractors will be engaged to arrange appropriate testing, removal and disposal to a licensed facility; • Waste records will be maintained in relation to all hazardous waste materials generated on site including stockpile locations; volumes; origins; and additional testing undertaken; and • A Waste Transfer Form (WTF) will be used to record the transportation of hazardous waste within the State and will be	Further contamination of soils / groundwater / surface water Cross contamination of stockpiled materials	Construction

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
	required of any movements of hazardous wastes arising during construction of the proposed development. Should the need arise for the Transfrontier Shipment (TFS) of waste, the movement of waste between countries is subject to control procedures under the EU and national legislation and guidance, such as the Waste Management (Transfrontier Shipment of Waste) Regulations, 2007. • The contractor, as the waste producer, will be responsible for ensuring the compliant disposal of all wastes disposed of as part of the proposed development, and as such will be required to retain records of all hazardous wastes. Sligo County Council will monitor that all waste arising as part of the construction is handled and disposed of compliantly by the contractor as per these requirements.		
12.5.2	Management of wastes arising during the operational phase of the proposed development will be the responsibility of Sligo County Council or contractors appointed by the council to provide waste management and landscaping services. Waste silts and hydrocarbons / oily waters collected in the on-site drainage interceptors and arising from attenuation / treatment pond maintenance will be disposed of through specialist contractors as and when required. The specialist contractors will clean out the interceptors and maintain the attenuation / treatment pond and the associated waste material will be sent to a suitable licensed facility for treatment and / or disposal.	Incorrect management of wastes causing contamination of environment	Operation

15.11 Material Assets

EAR Section Reference	Description of Mitigation Measure / Environmental Constraint	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
Material Assets			
13.5.1	A summary of the mitigation measures for the Utility Providers' services are listed below in Table 13-3.	Severance of utility providers' services	Construction
13.5.2	The source(s) of the imported fill materials will be selected from local and regional approved and licenced suppliers where practicable, thereby reducing the length of vehicle trips required. A number of key issues will be considered as part of the selection process for these suppliers, including but not limited to the following: • Source; • Material specification; • Production and transport costs; and • The availability of materials. Where granular fill is required for the proposed development, local or regional virgin sources, or recycled materials held at waste management / transfer facilities that meet the required specification will be sourced.	Transportation of imported fill material to site	Construction